

HEALTH SERVICES & OUTCOMES RESEARCH

HSOR

The evidence behind your decisions
2006 to 2008



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Foreword

It is indeed a privilege to write this foreword for a new born department within the National Healthcare Group (NHG). Four years ago there was nothing; today the toddler has made itself truly felt and needed.

Aligned with the vision of NHG of adding years of healthy life to the people of Singapore, the Health Services and Outcomes Research (HSOR) Department was set up in September 2005 to build capacity and advance knowledge in Health Services Research (HSR) particularly in the local context. Its mission? To provide the best available evidence for decision making and knowledge translation. Through the extensive engagement of the stakeholders in all its research projects, the department was able to provide the best evidence for clinicians and policy makers to make informed decisions. Many of us (including those in the Ministry of Health) who have tapped on their expertise can attest to this.

Within its first three years, the HSOR department grew from a team of five to the current strength of 17 researchers. They come from backgrounds as diverse as medicine, epidemiology, public health, nursing, physiotherapy, operations research, medical informatics, biostatistics, economics, and social sciences. It is therefore no surprise to learn that the team has made presentations and won numerous awards in both local and overseas conferences. It is in receipt of numerous grants doing research in collaboration with other clinicians within and across the clusters. In 2008, a MOU was signed with the Joanna Briggs Institute, making the department the first international Collaborating Centre for Evidence-based Health Services Management. This reaffirmed its commitment to provide best evidence for health policy makers.

Besides conducting research, the HSOR department provides extensive training in this relatively new field of HSR. Through various seminars, workshops and symposia, HSOR has created a significant amount of interest in HSR within the healthcare community. It has helped equip many who are interested with the basic skills in conducting HSR. The department has more than delivered on its own outcomes.

It gives me great pleasure to introduce the first HSOR report which provides a summary of projects completed from 2006 to 2008. The projects encompass many areas in HSR, namely: health services planning, decision science, evaluation research, and health technology assessment. As one who has benefitted from the work of the department's staff or as one yet to know them, I believe you will find the report informative and insightful.

I congratulate the staff of HSOR for their sterling achievements. I am sure they will continue to provide in coming years, the best evidence for healthcare decisions to be made.



A handwritten signature in black ink, appearing to read 'Chee Yam Cheng'.

Prof Chee Yam Cheng
Assistant CEO (Clinical),
National Healthcare Group

The Team

Dr Heng Bee Hoon

MBBS, MSc (Public Health), FAMS



Dr Heng has been the Director of HSOR since its establishment in 2005.

Dr Matthias Toh

MBBS, MMed (Public Health), FAMS



Dr Matthias Toh, Associate Consultant, is one of the key drivers behind the development of the NHG Chronic

Disease Management System (CDMS). His current research interest involves primary care and chronic disease management.

Anusha Govinda Raj

BSc (Psychology),
MSc (Epidemiology)



Anusha, Analyst, is currently involved in systematic reviews and evaluation of disease management

programmes. Prior to joining NHG, she was a research coordinator with the Institute for Work and Health and the Mobility Programme Clinical Research Unit in St. Michael's Hospital, Canada. During this time, in addition to study coordination, she was also involved in predictive modeling and systematic reviews.

Charis Ng Wei Ling

BA (Psychology & Communications)



Charis, Analyst, was involved in a research project which evaluated the effectiveness and efficiency of a short stay ward in a local hospital. Having had previous experiences with patient-related surveys, she is interested in survey research, and is currently working on a few survey projects to determine the healthcare needs of Singaporeans, as well as evaluation of programmes in the polyclinics.

Cheryl Lobo

BA (History)



Cheryl, Research Assistant, assists the team with data management for various projects. She is also actively involved in organizing training activities conducted by the team, and is a systematic reviewer certified by the Joanna Briggs Institute (JBI).

Chong Wai Fung

BN, MBA



Wai Fung worked as a Critical Care nurse before joining NHG as a programme coordinator for respiratory disease management programmes. Now a Senior Analyst with HSOR, she works with clinicians to design and plan health services research projects, and manages them from data collection to analysis, interpretation and presentation of findings.

Dr Joseph Antonio D Molina

MD, MSc (Public Health)



Dr Molina, Senior Analyst, has been involved in training activities, health technology assessments and patient satisfaction surveys. Prior to joining NHG, he was Assistant Professor of Preventive Medicine in a university in the Philippines, and was involved in clinical quality monitoring and hospital accreditation for Joint Commission International.

Ng Kok Ping

BSc (Hons) Physiotherapy



Kok Ping, Senior Analyst, is currently involved with the development of the NHG Chronic Disease Management System (CDMS) and the production of health technology assessments (HTA). Prior to joining NHG, she worked as a physiotherapist in the National University Hospital in the areas of stroke and geriatric rehabilitation.

Palvannan Kannapiran

BEng (Mechanical Engineering),
MEng (Industrial & Systems
Engineering)



Palvannan, Operations Research Specialist, focuses on applying Operations Research techniques such as simulation, optimization and decision analysis to support management decision making. Before joining NHG, he managed and developed decision support solutions in the Defence Science & Technology Agency (DSTA).

Pradeep Paul George Gunapal
BSMS, MSc (Epidemiology)



Pradeep, Analyst, has many years of experience in epidemiologic research. Prior to joining NHG, he worked with the Clinical Trials & Epidemiology Research Unit, (CTERU). He was a faculty member of the Singapore branch of the Australasian Cochrane Center and was actively involved in the teaching and research activities of the Cochrane branch. His research interests include ophthalmic and chronic disease epidemiology, systematic reviews and meta-analysis, health outcomes research, pharmacoepidemiology, and public health informatics.

Rebekah Lim
BMath (Hons) (Combinatorics & Optimisation)



Rebekah, Analyst, is responsible for Clinical Utilisation, Chronic Disease analysis and reporting. She is also involved in the development of NHG Chronic Disease Management System (CDMS), and the NHG Diabetes Bulletin. Prior to joining NHG, she was a Business Research Manager in Merck Sharp & Dohme.

Robyn de Verteuil
MA (Hons) (Economic Science & Management Studies), MSc (Health Services & Public Health Research)



Robyn, Analyst, focuses on systematic reviews as well as contextualizing economic evidence from systematic reviews and health technology assessments to the Singaporean setting. Prior to her appointment at NHG, Robyn trained as a health economist at the University of Aberdeen in the UK, specializing in the development and application of economic evaluation methods to trials and systematic reviews.

Dr Sun Yan
MSc (Data Mining), PhD (Medical Informatics)



Sun Yan, Medical Informatics and Biostatistics Specialist, specializes in medical informatics and statistical modeling. Prior to joining NHG, she worked in A*STAR's Bioinformatics Institute. Her research interests include the development of clinical decision support systems, predictive modeling and outcomes evaluation using large observational databases.

Tan Woan Shin
BSocSc (Hons) (Economics), MSocSc (Economics)



Woan Shin, Senior Analyst, has been a principal investigator on several projects. She has conducted technical analyses for studies evaluating quality improvement interventions, chronic disease interventions, health resource utilization and costs. Her current research interests include evaluating the impact of risk adjustment methods on outcomes and the application of economic evaluations in healthcare. She was one of three recipients of the ISPOR Contributed Research Award for Best New Investigator Podium Presentation in 2007. Prior to joining NHG, Woan Shin worked as a Research Economist with the Ministry of National Development.

Teow Kiok Liang
BEng (Electrical Engineering), MSc (Industrial & Systems Engineering)



Kiok Liang, Operations Research Specialist, deals with projects on optimization of hospital work processes for both out- and inpatient settings, and projections of national healthcare demands. Prior to joining NHG, he was with the Defence Science & Technology Agency (DSTA). His key research interests include Operations Research, Data Mining, and Health Services Planning.

Wong Lai Yin
BA (Economics & Statistics)



Lai Yin, Analyst, specializes in spatial-analysis using Geographical Information System (GIS) tools to support national health resource planning and decision making. She also specializes in survey methods, and has managed several surveys, including the population-based survey of knowledge, attitudes, beliefs and practice (KABP) of chronic diseases, and survey of KABP of clinicians on complementary and alternative medicine. She is also a registered Traditional Chinese Medicine physician.

Dr Zhu Zhecheng
MSc (Information Engineering), PhD (Industrial & System Engineering)



Zhecheng, Operations Research Specialist, has completed his PhD thesis on the optimal scheduling algorithms for multiple-order processing system. His research interests include optimization, schedule algorithms and data mining techniques applied to the healthcare system.

Projects

HSOR is privileged to work in partnership with some of the institutions within NHG, and to be a part in finding solutions through rigorous analysis and successful implementation. We are thankful to the many clinical and administrative departments, individuals and healthcare leaders for their belief and confidence in the team, as well as for their continuing support. Some of our collaborative efforts are as follows:

- **A Disease Management Programme successfully controls cholesterol in Coronary Artery Disease patients – Results of the LIVE Programme**

This study served to introduce the results of a disease management programme for patients with Coronary Artery Disease (CAD) in Singapore. Specifically, it presented the changes observed in CAD patients' LDL-C after participating in the Control of Coronary Risk Factors Initiative (LIVE) Programme, which aimed to achieve LDL-C of <100mg/dL and blood pressure levels <140/90mmHg (non-diabetes patients) and <130/80mmHg (diabetes patients) among patients with CAD-related diseases through a disease management process.

All CAD patients admitted to the Cardiology Departments in three large public hospitals in Singapore, namely Tan Tock Seng Hospital, the National University Hospital and Alexandra Hospital were enrolled in the programme and underwent patient education, dose titration of medications by case managers, and telephonic management in order to achieve these stringent levels of control. 5,001 consecutive patients were enrolled in the programme. 35% had diabetes, 60% had hypertension, and 73% had elevated LDL-C. Results suggested that the use of generic statins and a multi-dimensional programme supported by case managers and pharmacists facilitated the translation of knowledge from guidelines into actual practice.

- **Cost of boarding inpatients at an Emergency Department**

With hospital occupancy rates rising, patients requiring admission are increasingly being held at the Emergency Department (ED). This practice adversely affects care quality and channels resources away from emergency care. In partnership with the Tan Tock Seng Hospital ED, a study was conducted to determine the amount and value of resources lost due to boarding in an acute care general hospital. Boarding is defined to have occurred when the time interval between the decision to admit and physical departure of the patient from the ED exceeds 2 hours.

Using administrative data and data derived from a time and motion study, it was found that boarding patients in the ED reduced the functional bed capacity of the ED by 57,710 hours and consumed 2,977 hours of staff time. Although the volume of procedures, radiology, and laboratory tests carried out for boarded patients were not significantly different, the cost of admission delays to the ED was estimated to be \$450,822, which could have been used to provide emergency care for new patients.

■ **Development of decision tree for admitting patients with Dengue Hemorrhagic Fever**

Differentiating Dengue Fever (DF) from more severe forms of Dengue Hemorrhagic Fever (DHF) and Dengue Shock Syndrome (DSS) in the early phases of illness is clinically challenging. Studies have been performed to compare DF and DHF patients to derive predictors of DHF, but none has resulted in a clinically useful tool to assist clinicians in recommending hospitalization for patients with dengue in the early febrile phase of their illness. Consequently about 80% of notified adult dengue cases in Singapore were hospitalized from 2000 to 2005 despite low rates of DHF (1.8%-2.8%).

This study aimed to develop a simple decision tree for clinicians to decide between hospitalization and outpatient monitoring of dengue patients. Demographic, clinical, laboratory and radiological data of all laboratory-diagnosed dengue patients who were admitted to Tan Tock Seng Hospital in 2004 were collected, and classified into DF or DHF cases. The best decision tree prediction had three branches, comprising a history of clinical bleeding, serum urea level, and serum total protein level. This tree had a sensitivity of 100%, specificity of 46%, and an overall accuracy of 48.1%. The results compared favorably with other predictive probability equations and sophisticated laboratory tests, and would prevent 43.9% of mild DF cases from hospitalization.

■ **Evaluation of a Congestive Heart Failure Disease Management Programme**

This study assessed the impact of a multidisciplinary disease management programme implemented in three different hospitals on the functional status, quality of life, and utilization of hospital resources for patients with congestive heart failure. The study also examined the financial outcomes of the programme.

Hospital readmission rates were found to be significantly lower for programme patients as compared with the control group at 3- and 12-months. The mean hospital days and emergency room visits per patient was also significantly reduced. Although the mean 6-minute walk distance did not increase significantly from baseline, there was a 10% decline in the New York Heart Association Functional Classification score and a markedly improvement in quality of life was registered. The return on investment was calculated to be 0.82. This evaluation demonstrated that a multidisciplinary heart failure programme led to improved functional status and better quality of life, and at the same time reduced utilization of acute hospital resources.

■ **Factors influencing the rehabilitation Length of Stay of stroke patients**

In view of the rising stroke burden and increase in demand for stroke rehabilitation services, this two-part study aimed to optimize the management of bed resources. The underlying reasons pertaining to delays in discharges were examined, and the findings suggested that social issues such as families' request for extension of stay and caregiver-related issues accounted for 78% of the delays. System-level constraints in nursing home beds and home care services were also key contributors. Hence, to reduce delayed discharges, problems with formal and informal post-discharge caregiving must be addressed.

Healthcare professionals generally rely on clinical experience and analytical reasoning to estimate patients' Length of Stay (LOS). This involves significant amounts of either intuitive pattern recognition or intuitive regression of clinical, functional and socioeconomic factors. To improve the accuracy of LOS prediction, prognostic variables were translated into a statistical model in the second study. Patients' socioeconomic status and family structure were found to influence LOS, and should be considered in allocating resources and determining treatment needed. The extent of motor function of patients at admission is an important factor influencing rehabilitation LOS and is a useful tool for facilitating rehabilitation resource planning for stroke patients.

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- **Forecasting daily attendances at an Emergency Department to aid resource planning**

There are wide variations in disease severity and acuity among patients presenting at the Emergency Department (ED). Clinical services and resources required, likewise, vary considerably. The ability to predict daily attendances at the ED is valuable at a micro-level for the planning of staff rosters, and at a macro-level for financial and strategic planning.

This study aimed to identify the local factors associated with the daily attendances at ED, and to make predictions based on these factors. Patients were stratified into three acuity categories (PACs), with PAC1 being the most acute and PAC3 being the least acute. Through time series analyses, PAC1 attendances did not show any weekly or yearly periodicity and was only predicted by ambient air quality of PSI >50. PAC2 showed weekly periodicities, and were also significantly predicted by public holidays. PAC3 attendances were significantly correlated with day of the week, month of the year, public holidays, and ambient air quality of PSI >50. The developed models showed good prediction accuracy and were able to account for most of the significant autocorrelations present in the data.

- **Improving efficiency of an Inpatient Rehabilitation Centre**

This study was done in partnership with the Tan Tock Seng Rehabilitation Centre to identify areas for improvement. At the centre, the delivery of patient care takes place in an inter-disciplinary team setting, involving psychiatrists, physiotherapists, occupational therapists, speech therapists, nurse clinicians, medical social workers, and psychologists. Therefore, optimizing work coordination between staff groups is crucial in ensuring operational efficiency and provision of high-quality patient care.

A time and motion study was conducted to examine work processes. In consultation with the centre's staff, a set of recommendations were generated to improve the scheduling of patient care activities, communication between different staff groups, and to reduce non-value-added work.

- **Knowledge, attitudes, beliefs and referral patterns of healthcare professionals towards Complementary and Alternative Medicine in Singapore**

There has been an increasing use of complementary and alternative medicines (CAM) in Singapore, yet little is known about the attitudes and perceptions regarding CAM therapies amongst healthcare professionals. This study aimed to examine the knowledge, attitudes and beliefs of CAM and referral patterns among healthcare professionals within the hospitals.

A survey was conducted among doctors, nurses, physiotherapists (PT) and occupational therapists (OT) within the Tan Tock Seng Hospital. Results showed that the doctors, PTs and OTs had a good knowledge of CAM. However, the majority of healthcare professionals perceived their knowledge of CAM to be low. Limited personal knowledge and experiences were associated with lower referrals for CAM therapies. Nonetheless, there were favorable attitudes towards CAM and hence, indicating a demand for more CAM educational programmes.

■ NHG Polyclinics Care Management Programme evaluation

- Previous management of chronic disease patients involved didactic education and authority in helping them adopt changes necessary for better health. A new process, patient centered counseling (PCC) was introduced in February 2007, which incorporated interviewing skills such as basic principles of motivational interviewing. Multiple evaluation tools were used to assess compliance, processes and outcomes:

(1) Process compliance

A retrospective audit of care management notes was carried out to evaluate care managers' (CM) process compliance with the revised nursing care management practices. The results highlighted that the new practices were employed to varying degrees by different clinics and compliance rates also differed across different process components, suggesting a need to explore the barriers that have impeded the adoption of these changes by CMs.

(2) Barriers for implementation

The study aimed to understand how CMs applied PCC in their practice and the barriers for implementation, through the conduct of focus groups. CMs expressed a unanimous feeling of fulfillment in PCC, as they felt it facilitated rapport building with the patients, and made patients assume ownership for their own health and well-being. A need for a structured and standardized training session was also expressed, as some inconsistencies were noted between the training and implementation materials which may have created some confusion among the CMs in the understanding of PCC. Barriers mentioned included spoken language and time taken to counsel effectively.

PCC, although well accepted by the CMs, may not be as applicable in some subgroups such as the elderly and uneducated, and other methods need to be explored. Formalized sessions such as focus groups allow for useful feedback to determine the acceptance of new processes and for ways in which they may be improved.

(3) Patient survey

Patient-centered activities such as listening to patients, considering their priorities, developing collaborative goals and eliciting coping suggestions are essential components of the programme. Adapted from the Patient Assessment of Chronic Illness Care survey, it was found that patients assessed CMs to have performed well in four domains of care: patient activation, delivery system design, goal setting and problem solving. However, the results revealed that patients were least likely to be asked to contribute when making an action plan or when setting goals. It was also noted that CMs do not always encourage patients to attend health education workshops to improve self-management of their chronic condition.

(4) Intermediate outcomes evaluation

The study also assessed the impact of a team-based approach to manage diabetic patients with poor cardiovascular risk control. In addition to routine care provided by the doctors and dieticians, diabetes patients with poor cardiovascular risk control were referred to CMs to strengthen their ability to self-manage. While LDL-C and blood pressure of hyperlipid and hypertensive patients improved significantly over two years, their BMI remained unchanged. Although the study lacked a control group, it has shown that a team-based approach was associated with a persistent reduction in HbA1c, blood pressure and LDL-C for high-risk diabetic patients who returned for regular appointments.

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■ **Patient satisfaction survey at Yishun Polyclinic**

- This was a pilot study which aimed to assess the quality of care provided at Yishun Polyclinic as reported by the patient. Experiences gained from the use of the survey instrument as well as the methodological and logistical aspects of survey implementation can be used to facilitate future implementation of similar studies in other polyclinics.

Critical to the study was the survey tool which was based on the Consumer Assessment of Healthcare Providers & Systems (CAHPS) Clinician & Group survey instrument. A total of 220 respondents completed the survey. The results demonstrated that most health professionals showed respect for what patients had to say, spent enough time with them, listened carefully, and explained things clearly. While most patients felt that 10 minutes was enough time for a consultation, 25% reported that they were not informed of their diagnosis, half were not encouraged to discuss their health concerns, 33% were unable to talk about their medicines and only 25% of those who were concerned about medication costs were able to talk about it. Half of those with chronic conditions made appointments, but most preferred to visit the clinic on weekday mornings. Half were willing to pay more than SGD 10 for a guaranteed appointment. Half were also willing to come for a non-urgent illness even if waiting time will be long.

■ **Predicting positive blood cultures in patients presenting with Community-Acquired Pneumonia at an Emergency Department in Singapore**

- Routine blood cultures have been recommended for all patients in treatment guidelines for Community-Acquired Pneumonia (CAP). This practice has become a major area of resource utilization, despite the lack of evidence in the clinical utility of this practice. Calls for abandoning the practice is balanced by the occasions of uncovering an unexpected pathogen or an unusual antimicrobial resistance pattern. The aim of this study was to identify factors that predicted positive blood cultures among patients hospitalized for CAP upon presentation at the Emergency Department (ED).

A case control study was carried out on patients treated for CAP in the ED who had routine blood cultures performed as part of their management. The pneumonia severity index (PSI) was used to categorize patients into low- and high-risk for 30-day mortality. Routine blood cultures yielded negative results in 94% of patients presented with CAP. The development of the clinical scoring system was a first step towards selecting patients for whom blood cultures would be performed and improve cost-effectiveness.

■ **Review of factors associated with successful integration of care**

- To support a policy review within the NHG on the integration of care, this study examined the factors behind the successful integration of care in Kaiser Permanente, Intermountain Health System and Veteran Health administration in the United States. The key enablers are: (1) Common objectives and shared purpose; (2) Explicit implementation plans with clear measurable deliverables; (3) Team-based approach with clear organizational roles and responsibilities; (4) Clear link between integration results with performance appraisal and reward system; (5) Results-, learning-, and change-oriented culture and infrastructure; (6) Strong commitment towards quality and process improvement programmes (7) Investment in health services research (8) Evidence-based clinical practice guidelines deployed across care continuum (9) Use of information technology as a decision support tool and for reliable outcomes evaluation; and (10) Financing structure to align with goal of integrating care.



- **User satisfaction with an Electronic Prescription System in a primary care group**

Electronic prescribing has been proposed as an important strategy to reduce medication errors and improve the quality of patient care and create savings in health care costs. Despite these potential advantages, user satisfaction plays a significant role in the success of its implementation. In partnership with the NHG Polyclinics, an anonymous survey was conducted in each of the nine polyclinics to examine users' satisfaction with an Electronic Prescription System (EPS).

The survey found that the implementation of the EPS had gone reasonably well. However, there was some degree of workflow interference for the pharmacy staff. As user satisfaction could affect the acceptability of a new technology and the speed of diffusion within an organization, the results served as feedback for further system and workflow enhancement.

- **Venous Thromboembolism at the NHG, Singapore**

The objective of the study was to describe in-hospital and projected population-based incidence rates of Venous Thromboembolism (VTE) and Pulmonary Embolism (PE) in Singapore. While there has been a wealth of literature from Western countries, the disease has not attracted as much attention in Asia. There is growing evidence that suggests Asians have a lower risk of VTE compared to Westerners, thus possibly affecting the relevance of Western prophylactic guidelines in the Asian setting.

Using 2006 data obtained from the Operations Data Store, NHG Annual-Statistics Bulletin and Singapore Statistics, in-hospital and population-based overall, age, gender and ethnic group-specific incidence of VTE were computed. Results suggested a lower overall risk of VTE for the Singapore population when compared alongside results of studies from the West. There was also a possible association between ethnicity and VTE, as rates of the condition appeared to be lower for Asians than Westerners. Given the descriptive nature of the study, there was a need to implement analytic studies in order to confirm the relationship between ethnicity and VTE.

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Information Infrastructure Development

The NHG Chronic Disease Management System (CDMS)

Traditionally, the delivery of care for chronic diseases has been relatively fragmented in both inter- and intra-institutions. Often, there were no disease-specific registers to monitor patient clinical outcome over time. Longitudinal tracking of patients enrolled in our disease management programmes were handled manually, and were often tedious.

In October 2005, HSOR partnered the Information Technology Division (ITD) to develop the Diabetes module of the CDMS for population identification, outcome measurement and routine reporting. The scope of CDMS was to cover hypertension and dyslipidaemia in 2008. Key features included clinical decision alert prompts and cluster-wide access to patients' medical problem list and laboratory results for comprehensive and efficient delivery of diabetes care.

The CDMS is especially pertinent for chronic diseases such as diabetes mellitus since the monitoring of multiple clinical and process outcomes over time provides quality assurance. The identification of abnormalities with early intervention can potentially prevent long-term complications. Patients hence benefit through better care coordination, reduction in duplicate services and tests since healthcare providers can better deliver care through the readily available information of their patients.

Operations Research

Operations Research (OR) is the use of mathematical models to describe systems to support effective management decision making. Good models provide much insight that reduces uncertainty and complements management. As one of the key focus areas of HSOR, OR is becoming increasingly important in the analysis of healthcare service delivery.

Our team of OR specialists work closely with other HSOR members to support decision makers in NHG and beyond. Quantitative models are used for projects that range from policy impact analysis, process evaluation and improvement, and resource optimization. Some of the completed projects are described below.

■ **Feasibility of automation in an Outpatient Pharmacy**

■ In collaboration with the National University Hospital pharmacy, the study examined the impact of a prototype automated dispensing system on operational efficiency and service standards in an outpatient pharmacy. Using discrete event simulation, it was found that automating the prescription-filling function using a prototype that picked and packed at 20 seconds per item would not assist the pharmacy in achieving the waiting time target of 30 minutes. Instead, to meet the waiting time target, two additional pharmacists were needed to overcome the process bottleneck at the point of medication dispense. However, if automation was inevitable, the speed of the system needed to be twice as fast as the current configuration to facilitate the reduction of the maximum patient waiting time to below 30 minutes. The faster processing speed would concomitantly allow the pharmacy to reduce the number of pharmacy technicians from eleven to eight.

■ **Functional Bed Occupancy Rate**

■ Bed Occupancy Rate (BOR) was previously computed by dividing the number of in-flight patients by the number of beds in service. Patients admitted to all normal, high dependency, intensive care and isolation beds were considered. However, this assumed homogeneity of supply and that all available beds contributed towards the hospital's capacity. In practice, certain beds were configured and reserved for specific uses. BOR rates currently computed based on the midnight census would not accurately reflect bed crunch situations that occurred during the day.

To improve the management and oversight of bed occupancy, an accurate working definition of capacity utilization was required. Led by Tan Tock Seng Hospital, in partnership with Alexandra Hospital, Changi General Hospital, National University Hospital, and Singapore General Hospital, the BOR indicator was reviewed to more accurately reflect the functional capacity and utilization rate of deployable beds observed in practice.

From the results of the simulation and mathematical modelling, a suitable number of beds required for the preferred level of utilization was then derived

■ Hospital bed utilization projects

- Inpatient beds are a tight resource and much work has been done in this area. Inpatient bed utilization often fluctuates throughout the week, and there is a great need to optimize the utilization of this limited resource. Working with the operations team from National University Hospital to “smooth” elective admissions, mathematical models such as linear programming, were built to perform complex computations to allow more admissions with the same resources (number of beds).

Another area of work also involved the evaluation of the operational impact of bed partitions, in terms of trade-off between clinical outcomes and access to care (bed wait time). A discrete event simulation was built to mimic the patient flow - one with partitioning and one without. As predicted by the Queueing Theory, the simulation results showed that partitioning would lead to a higher bed wait time. From the results of the simulation and mathematical modelling, a suitable number of beds required for the preferred level of utilization was then derived.

■ Planning for Jurong General Hospital

- Working closely with Ministry of Health to first decide on the location of Jurong General Hospital (JGH), an estimate of the workload for the various service points, such as inpatient beds, Specialist Outpatient Clinics, Day Surgery/ Operating Theatres was drawn together with the JGH Planning Committee.

A few techniques were employed, such as a “facility location” model to decide on the location of where the hospital would cover the supply gap in Singapore. The analysis was further complemented with the Geographical Information System (GIS). Illustrative maps produced clearly showed the patient distribution in Singapore. The various methods provided a greater understanding of the current profile of patients in Singapore, and enabled future projection.

Past growths, regional demands, age-specific healthcare/acute care utilization rates, and projected population growth, were studied to estimate future demand for the various services for JGH. These projections allowed the planning team to plan for the infrastructure design and manpower for the upcoming hospital.

■ Specialist outpatient appointment scheduling projects

- In the Specialist Outpatient Clinic (SOC) setting, an optimization of appointment scheduling was required to reduce patient waiting time with the current workload and constraints in resources. Variability in consult duration, patients’ arrivals, no-show and many other factors made this a complex problem.

Literature was searched to gather ideas. Queueing Theory and Discrete Event Simulation were two key techniques that were eventually used. Working with the Operations Department from the various institutions to collect clinic data, Discrete Event Simulation models were then built to emulate the current situation. Once the computer model was calibrated to be relatively accurate, the new schedules were ready for testing. Many new schedules, based on ideas from literature, were then crafted and simulated. Some of the best scheduling rules were then selected, and tested at the institutions.

Health Technology Assessment and Systematic Reviews

Health Technology Assessment (HTA) is a type of policy research applied in healthcare which examines the consequences of the application of a technology, specifically in terms of its effectiveness, appropriateness and cost. In raising awareness and capability building in HTA, HSOR has successfully implemented several HTA projects in partnership with proponents from institutions within the NHG.

Additionally, in 2008, HSOR joined the international network of the Joanna Briggs Institute (JBI) Collaboration as the first international Collaborating Centre for Evidence-based Health Services Management (EBHSM), to promote evidence-based health care globally, educate and train as well as to conduct systematic reviews. Through the new EBHSM track, the team aims to develop practical resources from global research to promote the wider use of evidence by policymakers, health services executives and managers.

■ **A review of studies and guidelines on fasting and procedural sedation at the Emergency Department**

Commissioned by the Emergency Department (ED) of Tan Tock Seng Hospital, in compliance with Joint Commission accreditation requirements, the review synthesized evidence on the need for pre-procedure fasting to minimize aspiration among adults undergoing procedural sedation with analgesia (PSA) or without, for emergency procedures. Fasting, which is required prior to deeper levels of sedation, is difficult to impose in emergencies.

Overviews, guidelines with graded recommendations and primary studies on aspiration and pre-procedure fasting in PSA were retrieved, of which one primary study and one guideline were included. The American College of Emergency Physicians guideline stated that "recent food intake is not a contraindication for administering procedural sedation and analgesia..." The primary study compared patients who ate or drank more than 6 and 2 hours from induction, with those who ate or drank within 6 and 2 hours respectively. There were no cases of aspiration in both groups. As there were no reports of aspiration among patients undergoing PSA in medical literature, guidelines relied on expert consensus due to the lack of primary studies. The contextualization of existing guidelines were quick and efficient strategies for developing locally relevant tools.

- **An evaluation of diagnostic tests for Acute Appendicitis in adults**

- This HTA was conducted to determine the diagnostic test to improve the accuracy for diagnosing Acute Appendicitis (AA) in adults. A literature review was performed to determine the accuracy of various diagnostic tests for AA. All prospective or review articles on diagnostic accuracy of AA were selected. A cost analysis of the diagnostic tests was also done for hospitals within NHG in Singapore.

The Computed Tomography (CT) scan with contrast was the test of choice to improve diagnostic accuracy of suspected AA. Although likely to result in a reduction in the negative appendectomy rate, its effect on appendiceal perforation rate was unclear. Routine use of CT was associated with high cost, but could be reduced with a more selective approach.

- **An evaluation of non-invasive temperature measurement for inpatients:**
 - **A review of the literature**

A HTA was conducted to determine the temperature measurement method best suited for inpatient use. A literature review was performed to evaluate the relative merits of four non-invasive temperature measurement methods. Published articles that included a comparison of oral, axillary, tympanic and temporal artery temperature measurements against a core temperature were selected for review. Cost of various thermometers were synthesized and analyzed for the hospitals within the NHG.

The literature review and cost analysis showed that there was not one temperature measurement method most suitable for inpatient hospital use. If accuracy, equipment and maintenance cost were more important factors, oral temperature measurement using digital thermometers should be chosen. If speed, manpower utilization, and patient's comfort were more important factors, infrared tympanic thermometers should be chosen.

- **Community-Acquired Pneumonia preliminary studies:**
 - **A review of the literature**

A literature review was done to determine whether blood cultures should be performed in the Emergency Department for Community-Acquired Pneumonia (CAP). Studies were included if CAP and blood cultures were mentioned, costs associated with treating pneumonia in hospital settings were described, and articles were published within the last ten years.

There was considerable doubt over the impact of physician behaviour on treatment and patient outcomes following blood cultures. Research consistently stated that more discrimination on blood culture use was needed. Studies were all small-scaled, so it was difficult to extrapolate these research situations into the clinical practice here in Singapore. Further primary analysis was necessary before a final recommendation could be made to physicians.

If accuracy, equipment and maintenance cost are more important factors, oral temperature measurement using digital thermometers should be chosen



■ **Cross-infection and hospital clothing**

■ This HTA reported on hospital attire and the associated risk of cross-infection. A systematic review of seven medical journal databases demonstrated the interest and state of research into the clothing of hospital workers as vectors of cross-infection.

There was little information available about the impact of clothing on infection control in a hospital setting. Of particular note was that there were no studies focusing on a non-European or non-north American context. Literature suggested that changing policy about clothing alone would not have a significant impact on nosocomial or cross-infection rates, if not combined with glove use, hand washing and disinfectant and other environmental strategies.

■ **The effectiveness of Portable Bladder Ultrasound protocols**

■ This HTA was conducted to determine whether Portable Bladder Ultrasound (PBU) protocols could be implemented locally to guide decision for catheterization in hospitalized patients. A systematic review was done to evaluate the clinical effectiveness of such protocols.

The systematic search revealed a paucity of high quality research. Only three studies of reasonable quality were selected for this review. All three studies showed that using a PBU protocol to guide decision for catheterization was effective in reducing the rate of catheterization. Hence, there was some evidence to support implementation of PBU protocols. However, due to the lack of high quality studies and limited generalizability of findings, an outcome evaluation was highly recommended.

■ **Measuring physician performance: A review of the literature**

■ A systematic review was performed to determine key factors in measuring physician performance. Journal articles and reviews were included if they had been published within the last ten years, were in English and included information on health systems in urban settings. Articles were critically appraised, and thematically summarized with a view to the Singapore context.

Despite the experiential nature of many of the articles, many themes emerged from the literature. Developing performance measures for physicians was a complex and costly process, requiring accurate data systems, buy-in from physicians and multiple sources of information (including other healthcare professionals and patient satisfaction surveys). Measures should be representative of the activities of the specialty, attributable to an individual rather than the whole care team and be adjusted for confounders but should also be feasible to collect. Process issues which cannot be changed should not be included in performance measures. Development of trusted performance measures would be critical in the consideration of pay-for-performance schemes.

Clinical bedside assessment is important in diagnostic pathways directing the treatment and potentially in the speed at which more complex investigations can be ordered

- **Patients presenting with Altered Mental State to the Emergency Department: A mini systematic review of the literature**

A systematic review was performed to appraise the evidence concerning the diagnosis of Altered Mental State (AMS) in the Emergency Department (ED) and evaluate the extent to which Computed Tomography (CT) scans were effective in the early identification of stroke when AMS was the presenting symptom. Original articles and guidelines were included if they discussed AMS or cognitive impairment as a presenting symptom, included a discussion of early management of stroke in the ED, or contained information about diagnosing stroke.

CT scans were essential for clinical management decisions of stroke patients. However, CTs and Magnetic Resonance Imagings (MRIs) did not always conclusively showed stroke.

Clinical bedside assessment was important in diagnostic pathways directing the treatment and potentially in the speed at which more complex investigations could be ordered. There was a need for ED physicians with experience in neurological conditions to assist in the clinical assessment of stroke. Clinical assessment of stroke when presented as AMS should receive further health services research attention as should further investigation into when it is clinically and cost-effective to use CT scans.

- **Effectiveness of bedrails in preventing falls**

A HTA was conducted to determine if the policy on routine use of restrictive bedrails for patients at risk of falls ought to be reviewed. A literature review was performed to evaluate the role of bedrails in preventing falls in the acute hospital setting. Bedrails can be classified as restrictive or non-restrictive. Most studies reviewed showed that use of restrictive bedrails had no effects on rate of falls. Other less desirable effects of restrictive bedrails reported were risk of entrapment and injuries from climbing over bedrails.

An analysis of local data showed no significant difference in the injury rate between fallers with restrictive bedrail use and the fallers without, though serious injury only occurred in the former group. Hence, without evidence to justify their continued use, a review of the policy on routine use of restrictive bedrails for patients at risk of falls was recommended.

- **The effects of general practice size on quality of care**

This HTA was conducted to determine the effects of general practice size on quality of care. Much has been debated on the capacity of single-handed general practices to provide comprehensive management of chronic diseases and to support policy ambitions for out-of-hospital care. Some countries such as the United Kingdom and Australia, have recommended the consolidation of general practices into large multi-partner practices, so as to promote inter-disciplinary teamwork to deliver better and more affordable services to patients.

The results showed that single-handed general practices performed as well as larger practices in certain domains of care. However, due to the limited number of rigorous evaluations, no firm conclusions could be drawn from the review, and further research would be required.



Publications

- 1. Allocation of hospital beds in an existing hospital.** Journal of Operations and Logistics 2008; 2: 11-19. *Teow KL, Tan WS.*
- 2. Bridging the gap between primary and specialist care – An integrative model for stroke.** Annals Academy of Medicine Singapore 2008; 37: 118-127. *Venketasubramanian N, Ang YH, Chan BPL, Chan P, Heng BH, Kong KH, Kumari N, Lim LLH, Phang JSK, Toh MPHS, Widjaja S, Wong LM, Yin A, Cheah JTS.*
- 3. Predictive value of simple clinical and laboratory variables for dengue hemorrhagic fever in adults.** Journal of Clinical Virology 2008; 42 (1): 34-39. *Lee VJ, Lye DCB, Sun Y, Fernandez G, Ong A, Leo YS.*
- 4. The effectiveness of bedrails in preventing falls.** Singapore Nursing Journal 2008; 35 (4): 10-17. *Ng KP, McMaster FR, Heng BH.*
- 5. Measuring the quality of care of diabetic patients at the Specialist Outpatient Clinics in public hospitals in Singapore.** Annals Academy of Medicine Singapore 2007; 36: 980-986. *Toh MPHS, Heng BH, Sum CF, Jong M, Chionh SB, Cheah JTS.*
- 6. Perception of the public towards the mentally ill in a developed Asian country.** Social Psychiatry and Psychiatric Epidemiology 2007; 42: 734-739. *Chong SA, Verma S, Vaingankar JA, Chan YH, Wong LY, Heng BH.*
- 7. A 24-year review on the epidemiology and control of measles in Singapore, 1981-2004.** Southeast Asian Journal of Tropical Medicine and Public Health 2006; 37: 96-101. *Ong G, Heng BH, Ong A, Chua LT, Chew SK, Goh KT.*
- 8. Epidemiology and control of SARS in Singapore: SARS revisited.** Annals Academy of Medicine Singapore 2006; 35: 301-311. *Goh KT, Cutter J, Heng BH, Ma S, Koh KWB, Kwok C, Toh CM, Chew SK.*

Conference Presentations

Nov 2008 NHG Annual Scientific Congress, Singapore

- 1. Cost impact of boarding admitted patients in the Emergency Department.**
Tan WS, Teow KL, Tay SY, Seow E, Heng BH.
- 2. Effects of survey mode on results of a patient satisfaction survey at an acute care hospital in Singapore.**
Molina JAD, Heng BH, Lim GH, Seow E.
- 3. Knowledge, attitudes, beliefs and referral patterns of Western medicine trained healthcare professionals towards Complementary and Alternative Medicine in Singapore.**
Wong LY, Toh MPHS, Kong KH, Heng BH.
- 4. Measuring patient satisfaction with the CAHPS® Hospital Survey in an observation unit.**
Ng CWL, Lim GH, McMaster FR, Molina JA, Seow E, Heng BH.
- 5. Modelling and forecasting daily attendances at the Emergency Department using time series analysis.**
Sun Y, Heng BH, Tay SY, Seow E.
- 6. Planning outpatient appointment schedules using multiple methods.**
Teow KL.

Sep 2008 International Society for Pharmacoeconomics and Outcomes Research 3rd Asia Pacific Conference, Seoul

- 7. Initial improvement in glycaemic control amongst new Type 2 diabetic patients.**
Govinda Raj A, Toh MPHS, Heng BH.

Jul 2008 Health Technology Assessment International Conference, Montreal

- 8. An evaluation of diagnostic tests for Acute Appendicitis in adults.**
Ng KP, Molina JAD, Heng BH.
- 9. An evaluation of non-invasive temperature measurement for inpatients.**
Ng KP, McMaster FR, Heng BH.
- 10. Diagnosing Altered Mental State in the Emergency Department: A review of the evidence.**
McMaster FR.

11. Impacts of an ageing population: Elderly patients in the Emergency Department.

McMaster FR, Foo CL, Ng C, Seow E, Heng BH.

12. Measuring physician performance: A review of the evidence.

McMaster FR, Heng BH.

13. The effectiveness of bedrails in preventing falls.

Ng KP, McMaster FR, Heng BH.

14. Use of blood cultures in treating Community Acquired Pneumonia: The evidence.

McMaster FR.

May 2008 **International Society for Pharmacoeconomics and Outcomes Research
13th Annual International Meeting, Toronto**

15. Trends in mortality, length of stay and readmissions among patients with acute stroke at the National Healthcare Group.

Sun Y, Toh MPHS, Heng BH, Venketasubramanian N, Cheah JTS.

Disease Management Conference, Singapore

16. A team-based approach to diabetes management in a primary care setting: Outcomes of patients with regular follow-up.

Tan WS, Yeo LS, Liew D, Heng BH, Cheah JTS.

17. An audit of process compliance in Nursing Care Management.

Yeo LS, Liew D, Tan WS, Chong WF.

18. NHG Stroke Programme Planning: Estimating patient volume.

Govinda Raj A, Heng BH, Venketasubramanian N, Phang JSK.

19. Outcomes of patients with first stroke at the National Healthcare Group, Singapore.

Toh MPHS, Jiang GZ, Yin A, Venketasubramanian N.

20. Performance assessment of a nurse-led diabetes care management service: Does risk-adjustment matter?

Tan WS, Yeo LS, Liew D, Heng BH.

21. Predictors of cardiovascular health screening among healthy Singapore residents.

Toh MPHS, Wong LY, Heng BH.

22. Survey of private primary care doctors on Chronic Disease Management.

Govinda Raj A, Toh MPHS, Lee YC.

23. Use of quality indicators to assess diabetes care at the Specialist Outpatient Clinics in Singapore.

Toh MPHS, Jiang GZ, Heng BH, Cheah JTS.

24. Use of the modified Consumer Assessment of Healthcare Providers and Systems (CAHPS®) Clinician and Group Survey as a tool for improving quality of care.

Molina JAD, Heng BH.

1st International Conference on Healthcare Transformation: Primary Care Focus, Singapore

25. Determinants of polyclinic demand in aid of planning.

Teow KL, Wong LY, Heng BH, Cheah JTS, Tan CB.

26. Evaluating user satisfaction with an Electronic Prescription System in a primary care group.

Tan WS, Phang JSK, Lobo C, Santos DR, Tan LK, Heng BH, Cheah JTS

27. Knowledge, attitudes and practices of primary care physicians towards depression.

Tang WE, Toh MPHS, Tan YHC

28. Patients' willingness to pay at a subsidized National Healthcare Group (NHG) Polyclinic.

Molina JAD, Heng BH, Hwang CH, Cheah JTS.

29. Risk factor control and secondary prevention among post-stroke patients at the National Healthcare Group Polyclinics, Singapore.

Toh MPHS, Yin A, Phang JSK, Leong SSH, Cheah JTS.

30. Willingness to travel for polyclinic services.

Wong LY, Teow KL, Heng BH, Cheah JTS, Tan CB.

Jan 2008

2nd International Conference of the Asia Pacific Society for Healthcare Quality, Singapore

31. Optimized parameters of Pharmacy Robotic System (PRS) for hospital and polyclinic pharmacies.

Chua SL.

Nov 2007

NHG Annual Scientific Congress, Singapore

32. A validation study on the usefulness of selected ultrasonographic features for the diagnosis of breast tumors among Filipino adult females consulting at a private tertiary hospital.

Molina JAD, Molina MDC.

33. Complications and mortality among patients with acute stroke at the National Healthcare Group, Singapore.

Toh MPHS, Heng BH, Yin A, Venketasubramanian N, Cheah JTS.

34. Evaluation of the pharmacy payment process.

Chua SL, Wang HH, Gnanamani SUD.

35. Factors affecting delays in discharge of post-stroke patients in a rehabilitation centre.

Tan WS, Chong WF, Chua KSG, Chan KF.

36. Factors influencing inpatient rehabilitation length of stay.

Tan WS, Chong WF, Chua KSG, Chan KF.

37. Measuring quality of diabetes care in NHG Polyclinic, Singapore.

Leong DKC, Heng BH, Cheah JTS.

38. Predictors for readmission within 30 days of discharge among patients admitted with acute stroke in the National Healthcare Group, Singapore.

Jiang GZ, Heng BH, Venketasubramanian N.

39. Predictors of 30-day post-diagnosis mortality among stroke patients at the National Healthcare Group, Singapore.

Molina JAD, Heng BH, Venketasubramanian N.

40. Trends of patients with acute stroke in the National Healthcare Group, 2000-2004.

Sun Y, Toh MPHS, Heng BH.

41. Use of time by nurses in a rehabilitation centre.

Tan WS, Chong WF, Patmawali K, Zee IC.

42. Using mathematical programming to optimize bed occupancy by smoothing elective against emergency admissions.

Teow KL, Heng BH, Chong Y, Sim J.

43. Yearly DFS and education by trained nurse and podiatry assistants in NHG Hospitals.

Ng A, Toh MPHS, Tay JC.

Sep 2007 2nd Asian Stroke Forum, Kyoto

44. Complications and mortality among patients with acute stroke at the National Healthcare Group, Singapore.

Toh MPHS, Heng BH, Yin A, Venketasubramanian N, Cheah JTS.

Jun 2007 AcademyHealth Annual Research Meeting, Orlando

45. Quality of inpatient care for ischaemic stroke and transient ischaemic attack at the National Healthcare Group, Singapore.

Toh MPHS, Heng BH, Yin A, Venketasubramanian N, Cheah JTS.

May 2007 International Society for Pharmacoeconomics and Outcomes Research 12th Annual International Meeting, Arlington

46. Evaluation of a multicentre and multidisciplinary congestive heart failure management program.

Tan WS, Heng BH.

47. Outcomes of patients hospitalized for exacerbations of Chronic Obstructive Pulmonary Disease (COPD) in Singapore, 2000-2005.

Sun Y, Heng BH, Lim TK.

International Conference on Industrial Engineering and Systems Management, Beijing

48. Hospital beds reallocation using mathematical programming.

Teow KL, Tan WS.

Mar 2007 Asia Pacific Academy of Ophthalmology (APAO) Conference, Singapore

49. The influence of patient characteristics on the rate of posterior capsule during routine cataract surgery.

Atif MM, Sun Y, Heng BH, Au Eong KG.

Sep 2006 NHG Annual Scientific Congress, Singapore

50. Cardiovascular risk factors and sickness absenteeism in the workplace – the Alexandra Hospital’s experience.

Wee WK, Chong PK, Toh MPHS, Heng BH, Cheah JTS.

51. Variation in care of diabetes at specialist clinics of NHG, Singapore.

Toh MPHS, Heng BH, Chan PS, Sum CF, Cheah JTS.

Aug 2006 Regional Conference on Professionalism in Medicine, Singapore

52. Aging in a multicultural context: Clinician perceptions of elderly in the Emergency Department.

McMaster FR, Seow E, Foo CL, Tay SY, Chong WF, Tan WS, Heng BH, Cheah JTS.

53. Outcomes of elderly patients admitted for Community Acquired Pneumonia in Singapore.

Chong WF, Sun Y, Heng BH, Lim TK, Abisheganaden J, Sin FL, Cheah JTS.

Jul 2006 2nd Singapore Public Health & Occupational Medicine Conference, Singapore

54. Cardiovascular risk factors and sickness absenteeism – experience of a healthcare organization.

Toh MPHS, Wee WK, Chong PK, Cheah JTS.

55. Care of diabetes at Specialist Clinics of the National Healthcare Group.

Toh MPHS, Heng BH, Chan PS, Sum CF, Cheah JTS.

56. Comparative analysis of three modeling techniques on predicting rehospitalization risk for heart failure patients in Singapore.

Sun Y, Heng BH.

57. Feasibility study of Pharmacy Robotic System (PRS) at hospital outpatient pharmacy.

Chua SL, Heng BH, Cheah JTS.

58. Knowledge, attitude and belief associated with diabetes mellitus and health practices of Singaporeans with diabetes.

Wong LY, Heng BH, Toh MPHS, Cheah JTS.

59. Use of discrete event simulation to forecast waiting time of an experimental ‘Fast Track’ process in Emergency Department.

Teow KL, Heng BH.

60. Use of the Geographical Information System to determine the potential impact of AH @ Yishun on Tan Tock Seng Hospital.

Heng BH, Wong LY, Cheah JTS.



Jun 2006 **AcademyHealth Annual Research Meeting, Seattle**

- 61. Asthma treatment and perception of symptom control among adult residents in Singapore.**
Toh MPHS, Heng BH, Wong LY, Abisheganaden JA, Lim TK, Cheah TSJ.
- 62. Measuring quality of diabetes care in acute hospitals of the National Healthcare Group, Singapore.**
Toh MPHS, Heng BH, Chan PS, Sum CF, Chionh SB, Jong M, Soon PC, Cheah JTS.
- 63. Seeking improvements in inpatient stroke care at the National Healthcare Group, Singapore.**
Toh MPHS, Heng BH, Yin A, Venketasubramanian N, Cheah JTS.
- 64. The knowledge, attitude and practices associated with smoking and its impact on health promotion efforts in Singapore.**
Toh MPHS, Heng BH, Wong LY, Tan ASL, Cheah JTS.
- 65. The use of discrete simulation to evaluate waiting time of an experimental 'fast track' process in an Emergency Department in Singapore.**
Teow KL, Heng BH, Phe A, Cheah J.
- 66. Use of the Geographical Information System to determine the potential impact of a new hospital on an existing hospital in Singapore.**
Heng BH, Wong LY, Cheah JTS.

May 2006 **3rd National Disease Management Conference, Singapore**

- 67. Evaluating diabetes care in Specialist Clinics of NHG, Singapore.**
Toh MPHS, Heng BH, Chan PS, Sum CF, Chionh SB, Jong M, Soon PC, Cheah JTS.
- 68. Health screening and health promotion for an organization – The experience of a Singapore hospital.**
Wee WK, Chong PK, Toh MPHS, Cheah JTS.
- 69. How optimal is asthma treatment and control among adult Singapore residents?**
Toh MPHS, Heng BH, Wong LY, Abisheganaden JA, Lim TK, Cheah TSJ.

Awards

■ Best New Investigator for Contributed Podium Presentation Award

TAN WOAN SHIN

Evaluation of a multicentre and multidisciplinary congestive heart failure management program
12th International Society for Pharmacoeconomics and Outcomes Research Annual International Meeting, Virginia:
19-23 May 2007

■ Young Investigator Award

TAN WOAN SHIN

(Merit – Quality & Health Services Research)
Cost impact of boarding admitted patients in the Emergency Department
NHG Annual Scientific Congress, Singapore:
7-8 Nov 2008

TEOW KIOK LIANG

(Silver)
Using mathematical programming to optimize bed occupancy by smoothing elective against emergency admissions
NHG Annual Scientific Congress, Singapore:
10-11 Nov 2007

TAN WOAN SHIN

(Bronze)
Factors affecting delays in discharge of post-stroke patients in a rehabilitation centre
NHG Annual Scientific Congress, Singapore:
10-11 Nov 2007

■ Best Oral Competition

TEOW KIOK LIANG

(Merit – Quality & Health Services Research)
Planning outpatient appointment schedules using multiple methods
NHG Annual Scientific Congress, Singapore:
7-8 Nov 2008

DR JOSEPH MOLINA

(Merit – Quality & Health Services Research)
Predictors of 30-day post-diagnosis mortality among stroke patients at the National Healthcare Group
NHG Annual Scientific Congress, Singapore:
10-11 Nov 2007

■ Best Poster Award

CHARIS NG WEI LING

(Merit – Quality & Health Services Research)
Measuring patient satisfaction with the CAHPS® Hospital Survey in an observation unit.
NHG Annual Scientific Congress, Singapore:
7-8 Nov 2008

DR SUN YAN

(Merit – Quality & Health Services Research)
Modelling and forecasting daily attendances at emergency department using time series analysis
NHG Annual Scientific Congress, Singapore:
7-8 Nov 2008

TAN WOAN SHIN

(Merit – Nursing)
Use of time by nurses in a rehabilitation centre
NHG Annual Scientific Congress, Singapore:
10-11 Nov 2007

DR MATTHIAS TOH

(Quality and Health Services Research)
Complications and mortality among patients with acute stroke at the National Healthcare Group, Singapore.
NHG Annual Scientific Congress, Singapore:
10-11 Nov 2007

DR HENG BEE HOON

(2nd Prize)
Use of the Geographical Information System to determine the potential impact of AH @ Yishun on Tan Tock Seng Hospital.
2nd Singapore Public Health and Occupational Medicine Conference, Singapore:
13-14 Jul 2006

■ 1st NUH Way Partner Award (2007)

DR HENG BEE HOON

TEOW KIOK LIANG
in recognition of contributions to Hospital Resource Planning

Grants

Research Grants

- NHG Small Innovative Grant Phase I (2008)
 - TAN WOAN SHIN (Principle Investigator)
 - DR HENG BEE HOON (Collaborator)
 - DR SUN YAN (Collaborator)
 - A/Prof Ding Yew Yoong, TTSH/Geriatric Medicine (Co-Investigator)
 - Dr Tay Jam Chin, TTSH/Geriatric Medicine (Collaborator)
 - Dr Tan Yu-Ling, Jackie, TTSH/Geriatric Medicine (Collaborator)
 - *Using functional status, social support and socioeconomic indicators to improve risk adjustment for health outcomes in older hospitalized patients* [\$49,464]

- MOH Nursing Research Committee Grant (2008)
 - CHONG WAI FUNG (Co-Investigator)
 - TAN WOAN SHIN (Co-Investigator)
 - Yeo Loo See, NHGP/Nursing Service (Principal Investigator)
 - *Patient assessment of a nurse-led care chronic care management programme incorporating motivational interviewing techniques* [\$12,349]

- National Medical Research Council Grant (2007)
 - DR HENG BEE HOON (Collaborator)
 - CHONG WAI FUNG (Collaborator)
 - A/Prof Ding Yew Yoong, TTSH/Geriatric Medicine (Principal Investigator)
 - Prof Lim Tow Keang, NUH/Respiratory and Critical Care (Site Principal Investigator)
 - Dr John Abisheganaden, TTSH/Respiratory Medicine (Site Principal Investigator)
 - Dr Sin Fai Lam, AH/Medicine (Site Principal Investigator)
 - Prof Dan Berlowitz, Bolton University/Health Policy and Management (Collaborator)
 - A/Prof Cindy Christiansen, Bolton University/Health Policy and Management (Collaborator)
 - *Older patients hospitalized for pneumonia: description of clinical subgroups, modification of risk adjustment models, and demonstration of process-outcome linkages in the Singapore population.* [\$150,811]

- NHG Small Innovative Grant (2005-2007)
 - DR HENG BEE HOON (Co-Investigator)
 - FIONA MCMASTER (Collaborator)
 - Dr Lim Ghee Hian, TTSH/Emergency Department (Principal Investigator)
 - A/Prof Eillyne Seow, TTSH/ Emergency Department (Collaborator)
 - Dr Eugene Fidelis Soh, NHG/Research and Development Office (Collaborator)
 - *Emergency Diagnostic and Therapeutic Centre – measurement of its impact and effectiveness in Tan Tock Seng Hospital.* [\$87,860]

- NHG Cluster Research Fund (2004-2006)
 - DR HENG BEE HOON (Principal Investigator)
 - Dr Lim Fong Seng, NHGP/Medical Affairs (Collaborator)
 - Dr John Abisheganaden, TTSH/Respiratory Medicine (Collaborator)
 - *A population-based survey of knowledge attitudes, beliefs and practice of chronic diseases and vascular risk factors* [\$118,350]

Training Grant

- NHG Healthcare Manpower Development Programme 2008/09
 - TAN WOAN SHIN

Other Grant

- Re-Investment Fund, Ministry of Finance
 - DR HENG BEE HOON (Project Director)
 - *Development of Chronic Disease Management System (Stroke). FY 2008.* [\$2.6 million]
 - *Development of Chronic Disease Management System (Hypertension and Lipid Disorders). FY 2006.* [\$4 million]
 - *Development of Chronic Disease Management System (Diabetes). FY 2006.* [\$1.65 million]

Training and Education

Role of economic evaluation in Health Technology Assessment **4 December 2008**

PROFESSOR LUKE VALE

Chair in Health Technology Assessment, Health Services Research Unit, University of Aberdeen, Scotland

Professor, Health Services Research Unit, University of Aberdeen, Scotland

Professor, Health Economics Research Unit, University of Aberdeen, Scotland

Economic Editor to Cochrane Collaboration's Effective Practice and Organisation (EPOC) Review Group.

Convenor of the Economics Methods Group of the Cochrane and Campbell Collaborations.

Member of the Consensus Economic Evaluation Guidelines Development Group.

Member of the Advisory group Centre for Healthcare Randomized Trials (CHaRT), University of Aberdeen.

The half day workshop explored the role of economic evaluation in health technology assessment. Economic evaluation, as part of health technology assessments, were fast becoming a pinnacle component to healthcare decision making and an appreciation of its growing importance, worldwide, was essential. Attention was given to two pragmatic developments of economic evaluation, which were used by decision-makers in a variety of countries, to aid decision-making.

Economic evaluation – Design, methods and conduct **1 – 4 December 2008**

PROFESSOR LUKE VALE

Chair in Health Technology Assessment, Health Services Research Unit, University of Aberdeen, Scotland

Professor, Health Services Research Unit, University of Aberdeen, Scotland

Professor, Health Economics Research Unit, University of Aberdeen, Scotland

Economic Editor to Cochrane Collaboration's Effective Practice and Organization (EPOC) Review Group.

Convenor of the Economics Methods Group of the Cochrane and Campbell Collaborations.

Member of the Consensus Economic Evaluation Guidelines Development Group.

Member of the Advisory group Centre for Healthcare Randomized Trials (CHaRT), University of Aberdeen.

The three and a half day workshop sought to provide an introduction to the aims, methods and views of economic evaluation in healthcare. This was facilitated by using a mix of presentations of key issues and theories, real life examples and group work. The course was designed to familiarize participants with the design, conduct and appropriate methods for specific types of economic evaluation projects.



Introduction to the linkage of clinical databases to evaluate health care

17 September 2008

PROFESSOR D'ARCY HOLMAN

*Professor, School of Population Health, University of Western Australia
Adjunct Professor, Australian Centre for Economic Research on Health,
University of Western Australia
Foundation Director, University of Western Australia node of Australian Centre for
Economic Research on Health
Inaugural Director, Centre for Health Services Research, University of Western
Australia Foundation Chair in Public Health, University of Western Australia*

The half-day workshop familiarized participants with the latest international trends in the linkage of clinical and administrative databases as a powerful tool to evaluate the utilization and outcomes of health care. Participants learned about the creation of linkage keys that enabled disparate data sets to answer important questions about the health system and became familiar with examples of how these new resources and technologies could be used to evaluate patterns and outcomes of surgical care, chronic disease management, mental health services and medication safety.

Introduction to Health Services Research

31 July & 1 August 2008

HSOR TRAINERS: DR HENG BEE HOON, WONG LAI YIN, CHONG WAI FUNG, TEOW KIOK LIANG, ROBYN DE VERTEUIL, PALVANNAN KANNAPIRAN, ANUSHA GOVINDA RAJ, DR SUN YAN, DR JOSEPH ANTONIO MOLINA

A/PROF DING YEW YOONG

*Senior Consultant, Geriatric Medicine, Tan Tock Seng Hospital
Visiting Consultant, HSOR*

The two-day course provided an overview of the basic concepts, rationale, general and discipline-specific methods used in carrying out Health Services Research (HSR). With practical exercises, case studies and examples of real-world HSR projects, the course was designed to cover a broad range of topics at an introductory level. The main objective was to familiarize students with a repertoire of methods that were often encountered in the conduct of HSR. It was hoped that students would use the lessons and material gleaned from the course as a springboard to explore other methods in depth for their own efforts in applied research.



Patient Reported Outcomes / Quality of Life

28 April 2008

DR LUO NAN

*Assistant Professor, Department of Community, Occupational and Family Medicine, National University of Singapore.
Research Fellow, Centre for Health Services Research, National University of Singapore.*

This was an introductory lecture on patient reported outcomes / quality of life assessment. Both conceptual and methodological issues in patient reported outcomes / quality of life assessment were covered. Topics included definitions of patient reported outcomes, measurement theories, instrument development and validation, and cross cultural assessment of quality of life. At the end of the course, participants gained some knowledge on how to assess patient reported outcomes / quality of life in the local setting.

Introduction to Health Outcomes Research

28 March 2008

DR MABEL DEURENBERG-YAP

*Director, Health Services Research and Evaluation Division, Ministry of Health, Singapore.
Associate Professor, Health Services Research Centre, National University of Singapore.
Associate Professor, Department of Epidemiology and Public Health, National University of Singapore.*

DR LIM ENG KOK

*Deputy Director, Clinical Benchmarking, Clinical Quality Improvement Division, Ministry of Health, Singapore.
Deputy Director, Service Management, Healthcare Finance Division, Ministry of Health, Singapore.*

DR MATTHEW NITI

*Medical Epidemiologist, Health Services Research and Evaluation Division, Ministry of Health, Singapore.
Research Fellow, National University of Singapore.*

The half-day introductory course sought to enable participants to understand the concepts of health outcomes research and its use in monitoring and improving quality of care.

Challenges in Health Services Research

18 January 2008

HSOR TRAINERS: TAN WOAN SHIN, CHONG WAI FUNG, WONG LAI YIN

A/PROF DING YEW YOONG

Senior Consultant, Geriatric Medicine, Tan Tock Seng Hospital

Visiting Consultant, HSOR

The half-day introductory course prepared participants for complex challenges often involved in conducting Health Services Research (HSR). Topics covered included formulating appropriate research questions, deciding on the appropriate research design, issues related to data collection, and data analyses. Specific projects were presented and discussed with participants to demonstrate the issues in real world data collection and analysis. Participants gained a practical understanding of and insights into the issues involved in formulating and executing health research studies.

Multiple Health Service Research methods

5 October 2007

HSOR TRAINERS: DR HENG BEE HOON, DR JOSEPH ANTONIO MOLINA, TAN WOAN SHIN, WONG LAI YIN, TEOW KIOK LIANG

The half-day introductory course sought to familiarize participants with the applications of Health Services Research (HSR) and the various tools and methodologies used in its implementation. Specific projects were presented and discussed with participants in order to demonstrate the varied tools and methods applied in real world scenarios. At the end of the course, participants were aware of and familiar with the appropriate methodologies for specific types of HSR.

Health economics and policy

21 September 2007

HSOR TRAINER: TAN WOAN SHIN

Countries world-wide are confronted with the challenge of meeting seemingly unlimited patient needs with limited resources. Cost containment and the efficient use of resources in publicly funded healthcare sector have also become prominent issues. An understanding of the basic principles of health economics is of fundamental importance to health service personnel working to improve the efficiency and equity of the systems within which they work. The short course was designed to equip non-economists with the basic knowledge required to understand the relevance of economics in informing decision-making at various levels, and in different settings. Another purpose was also to provide an overview of principal questions that have been addressed in health economics literature.

Qualitative research methods

11 July 2007

HSOR TRAINER: FIONA MCMASTER

The one-day introduction to qualitative research aimed to give physicians, health professionals and researchers an overview of qualitative research methods and theories. The first half of the course was devoted to an overview of theories with practical Singapore-related examples. In the second half, a more practical approach was taken, with opportunities for exploration of designing and conducting focus groups and performing some primary analysis.



Operations Research Appreciation Course (ORAC)

29, 31 May & 2 June 2006; 21, 23 – 24 August 2007

HSOR TRAINERS: TEOW KIOK LIANG, CHUA SIANG LI, TAN WOAN SHIN

Operations Research (OR) techniques are useful to determine the best course of action of a decision problem under limited resources. The three-day course introduced OR concepts in healthcare applications, and also focused on building intuition around theory through illustrative examples and insights from results that supported and informed decision making. Case studies were used to show real applications of OR techniques as well as the process of problem solving during the engagement with the decision maker.

Methods and applications in Health Services Research

6 – 9 June 2006 (1st); 23 – 24, 26 – 27 April 2007 (2nd)

PROFESSOR ARNOLD M. EPSTEIN

*Professor of Health Policy and Management, Department of Health Policy and Management, Harvard School of Public Health
Chair, Department of Health Policy and Management
Professor of Medicine and Health Care Policy, Harvard Medical School
Chief, Section on Health Services and Policy Research, Division of General Medicine, Brigham & Women's Hospital*

PROFESSOR JOEL S. WEISSMAN

*Associate Professor, Department of Medicine, Massachusetts General Hospital, Harvard Medical School
Lecturer, Department of Health Care Policy, Harvard Medical School*

Designed to provide a broad overview and general training in methods commonly used in carrying out Health Services Research (HSR), the objective of the course was to familiarize participants with a repertoire of methods that were often encountered in the conduct of HSR or in the academic literature. Sessions focused on study design, analysis of large databases, assessment of quality of care, risk adjustment, cost effectiveness, assessment of appropriateness, use of focus groups, use of surveys, and practical issues in HSR.



HSOR

The evidence behind your decisions

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