and Prevention guidelines) compared to handrubbing using the 7-step technique as recommended by the World Health Organisation remained unknown.

We embarked on a 6-week randomised controlled trial on medical and nursing staff in all subsidised general wards during routine inpatient care on weekday mornings which were the busiest times of the week when most patient-care activities were performed. Our comparative effectiveness study on the two alcohol handrubbing protocols and chlorhexidine handwashing found that all three protocols were effective in reducing healthcare staff's hand bacterial load ($P < .01$).

During routine patient care, alcohol handrubbing covering all hand surfaces required less time (median, 26.0 seconds) than alcohol handrubbing using the 7-step technique (median 38.5 seconds; $P = .04$) and chlorhexidine handwashing (median, 75.5 seconds; $P < .001$). Hence, our current alcohol handrubbing protocol was the most time-effective hand hygiene protocol for routine patient-care activities in busy general wards. Our findings provided the scientific evidence and confidence for the continued active promotion of our alcohol handrubbing protocol for day-to-day patient-care activities in our hospital, as well as in other healthcare settings locally and globally. To date, our study remains the only internationally published randomised controlled clinical trial comparing hand hygiene techniques.

From our experience, timely and coordinated clinical epidemiological and comparative effectiveness research can play an important role in improving the scientific understanding of the transmission of emerging infections and guide infection prevention efforts toward both old and new infections.

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USING DECISION MODELS TO SUPPORT PATIENT-CENTERED CARE AND HEALTH SERVICES: A COOPERATIVE EFFORT

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The decision-making process in many aspects of the healthcare delivery system is often complicated and intricate, requiring several considerations before arriving at a course of action in patient care. Clinical Decision Models (CDMs) have increasingly been used to assist in the decision-making process aimed at achieving specific clinical outcomes, as well as guide the allocation of healthcare resources and reduce costs.

CDMs integrate evidence from various sources to standardise the care process, reduce variation in decision-making, and achieve faster, cheaper and presumably, better decisions. Methods used to develop CDMs include expert opinions, statistical multivariate models, decision trees and Bayesian networks, etc.

A cooperative effort among researchers, Information Technology (IT) specialists, clinicians and decision-makers, is vital for the success of decision models, particularly as more information on patients' outcomes and their contributing factors continue to expand, resulting in more parameters than the human decision-maker can process effectively.

Our recently completed study on predicting patients' waiting time at the Emergency Department (ED) of Tan Tock Seng Hospital (TTSH) is a good example of a collaborative effort among a multidisciplinary team.

Decision-makers and clinicians in the ED found that long waiting times can affect patient satisfaction and quality of care. However, this problem could not be easily resolved due to the complexity of causes, limited resources and unpredicted surges in demand. Literature reviews suggested that informing patients on their expected waiting time in ED could help make the long waiting more bearable, and deter patients from abandoning the ED before treatment. Our researchers collected retrospective data, and identified factors which affected patients' waiting times at ED with inputs from clinicians and existing literature. A statistical decision model was then developed and validated with a rigorous study design.

The model was assessed by the whole team, and was found to be valid (made accurate predictions of risk), relevant (shown to improve patient-oriented outcomes), easy to use at the point-of-care, and acceptable (with good face validity and transparency of recommendations).

The model was then integrated with the existing electronic health information system, where calculations were performed automatically based on individual patient data to streamline decision-making.

The model was an inexpensive way to improve patients' satisfaction with constrained resources. It could also help clinicians to monitor waiting times, prioritise patients, and minimise the time spent away from frontline patient care.

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I would also like to thank Dr Tay Seow Yian, Head of Emergency Medicine Department in TTSH, and his excellent team for their passion and open-minds on using new technology in patient care and health services.

I am also deeply appreciative towards the IT specialists from IBM and IHIS for their great contribution in implementing the model. The project's success could only be possible because of everyone's collaborative effort.

About the contributor
Dr Sun received her PhD from the Nanyang Technological University (NTU) in 2002. She joined HSOR in 2005 and has been a health services researcher since.

She was awarded the Healthcare Manpower Development Programme (HMDP) grant to study at The Harvard School of Public Health in 2009. Her current research interests are in clinical decision modelling, microsimulation, statistical modelling, and outcome evaluation using large observational databases.

She is also a Principal Investigator and co-PI of several grants supported by the Ministry of Health and NHG.

REAL WORLD RESEARCH

THE FINAL LEG OF THE JOURNEY TOWARD IMPROVED HEALTH CARE

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Health research can be classified according to the various stages in the translation continuum, spanning the full spectrum of scientific discovery from basic science (bench) to clinical (bedside) to health services & systems research.

In my work at the Health Services and Outcomes Research (HSOR) department of NHG, I have seen the importance of investing in real-world research. While certain treatments or interventions may lead to favourable outcomes under ideal situations, the same cannot be said of the effects in real world situations. One begins to see that in the real world, a multitude of factors, other than the intended treatment, can determine what happens to the patient.

One such study involved an investigation into the effects of initially admitting critically ill medical patients from the Emergency Department (ED) to the general wards before transferring them to the medical intensive care unit (MICU).

Given that each MICU bed is a precious hospital resource, priority is often given to patients with serious but potentially reversible conditions who may benefit from more intensive observation and treatment than is provided in the general ward. Emergency and critical care physicians understand that each inappropriate admission to the ICU may translate to one less bed for a patient who would otherwise have benefitted from intensive care. In a similar manner, inappropriate admissions of a medical patient to the general wards instead of the MICU may have disastrous consequences.

This was the motivation for a group of ED and MICU consultants from Tan Tock Seng Hospital to embark on the project with the ultimate goal of improving triage decisions. In the study, the magnitude of these indirect admissions, vis-à-vis direct admissions to the MICU from the ED was investigated. Patient outcomes included in-patient and 60-day mortality, MICU and total hospital length of stay (LOS). The study utilised a retrospective cohort design involving patients who were admitted to the MICU within 24 hours of presentation at the ED.

The evidence-based medicine movement has radically changed the way health professionals acquire and assimilate information relevant to patient care. Although observational designs are ranked lower than experimental studies in the hierarchy of evidence, they are nevertheless a rich source of evidence for health services research (HSR).

In the case of the ED-MICU study, indirect admissions hypothesised to be harmful precluded the use of a randomised trial. Additionally, triage decisions and their consequences were best observed under real world situations rather than a stringently controlled environment. After all, the research question posed was a practical one placed in the context of the daily operations in a hospital setting and not with any underlying assumptions and pre-conditions.

HSR or what may be viewed as real-world research draws upon the field of Epidemiology for methods and techniques. Unlike clinical specialties, Epidemiology and HSR do not involve the delivery of care directly to the patient, but rather in the processes in the delivery of care which would have an impact on patient outcomes.

By identifying which treatments, investigations and interventions work best for whom, HSR is ultimately a useful tool for improving outcomes which matter to patients.