CENTRE FOR HEALTH SYSTEMS AND SAFETY RESEARCH

ANNUAL REPORT 2010

Better Health Care Through Communication

UNSW THE UNIVERSITY OF NEW SOUTH WALES

AIHI | AUSTRALIAN INSTITUTE OF HEALTH INNOVATION

CHSSR | CENTRE FOR HEALTH SYSTEMS AND SAFETY RESEARCH

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MISSION STATEMENT

Vision

To lead in the design and execution of innovative health systems research.

Mission

To produce a world-class evidence base which informs policy and practice, focusing on patient safety and the evaluation of information and communication technologies in the health sector.

Aims

The Centre's research is underpinned by a systems perspective, exploiting highly innovative and wide-ranging research methods. Its research team is characterised by its talent and enthusiasm for working within and across discipline areas and sectors. The Centre has a focus on translational research, aimed at turning research evidence into policy and practice, while also making fundamental contributions to international knowledge.

The Centre's research program has four central aims:

- Produce research evidence of the impact of information and communication technologies (ICT) on health care delivery (efficiency and effectiveness), health professionals' work and patient outcomes
- Develop and test rigorous and innovative tools and approaches for health informatics evaluation
- Design and apply innovative approaches to understand the complex nature of health care delivery systems and make assessments of health care safety
- Disseminate evidence to inform policy, system design, practice change and the integration and safe and effective use of ICT in health care.

Functions and goals

The functions of the Centre are to:

- Build capacity and research capability in health systems research, patient safety and health informatics
- Deliver research output in the form of grants, publications and presentations
- Participate in the development and sharing of infrastructure and research expertise for research across the Centres of the Australian Institute of Health Innovation (AIHI)
- Encourage and support collaboration across the Centres
- Forge relationships between the AIHI Centres and other entities within and external to UNSW
- Continue to build and consolidate an international reputation in health systems and safety research.

This will be achieved through:

- Strong collaborative research programs supported by continued peer-reviewed grants and commissioned research
- Extensive linkages with industry, practitioners and policy makers at local, state and national levels to improve the relevance and impact of research
- Increased numbers of skilled researchers undertaking research and evaluation activities in the area of health systems and safety research
- Increased numbers of postgraduate research students
- Exercising influence via dissemination and transfer of research findings through publications, presentations and forums with a focus on academic, industry, practitioner and policy maker audiences.

DIRECTOR'S REPORT

Our move in 2010 to the University of New South Wales (UNSW) heralds the start of an exciting new era for the Centre for Health Systems and Safety Research (CHSSR).

Formerly configured as the Health Informatics Research and Evaluation Unit at The University of Sydney, we are delighted to have joined UNSW's Australian Institute of Health Innovation - one of Australia's largest research groupings conducting multidisciplinary research into health sector practices, organisation and management.

The Institute presents a dynamic and innovative environment where researchers from the four Centres - the Centre for Clinical Governance Research; the Centre for Health Informatics; the Simpson Centre for Health Services Research and now the CHSSR - are able to combine their diverse disciplinary skills and expertise to lead in health system innovation research and to translate that knowledge to improve health systems.

While our new name reflects our increased focus on safety research, we continue to build on our very strong foundation in health informatics evaluation. The CHSSR is Australia's largest health informatics evaluation research team and we are recognised as one of the world's leading research centres in this area.

Our core work is to research the impact that information and communications technology (ICT) has on the health care system, the quality and safety of care, health professionals' work and communication patterns, and the efficiency and effectiveness of the care they provide.

Never has our research been more relevant. Health reform, safety and eHealth feature prominently on the agenda of state and federal governments, particularly with the advent of the National Broadband Network, the imminent introduction of personal electronic health records, and telemedicine.

Yet despite the money and expertise being invested into developing new technology in the health sector, little is known about its effectiveness, efficiency and safety.

Our aim is to evaluate how new technology can be applied in the real world: how people, the health system and ICT intersect, and to what extent they improve the quality and safety of health care.

The Centre has made particular contributions in assessing the impact of electronic prescribing systems and pathology order entry systems, demonstrating how these systems can work to reduce errors and improve the speed with which clinicians receive test results. These findings are informing health care organisations as they seek evidence to underpin decisions about large investments in clinical information technologies.

Our fundamental research on patient safety, particularly on rates of medication errors in hospitals, and the safe and effective management of test results, has been highlighted in important research publications during the year.

Internationally, health systems are being challenged by a declining health workforce in the face of increased demand for services. Technology provides a vital tool to deliver safe and effective health services into the future.

The CHSSR is leading vital research on developing and applying innovative techniques for measuring health professionals' work and communication patterns to understand where and how clinical systems might be applied to support safe and efficient work practices. This research has included the development of the Work Observation Method by Activity Timing (WOMBAT) technique, most recently validated by a Canadian research team. Results are illustrating both the expected and unexpected ways in which work patterns are influenced when technology is introduced into complex clinical environments.

Innovation in work practices and the ways in which we can use information technologies to support new models of care delivery is a major theme of our work. Working with our health care organisational partners, the CHSSR has current studies examining technology use across multiple sites in Emergency and Intensive Care.

The potential benefits of ICT to aged care have been considerably under-explored. The CHSSR has a new research stream examining the fundamental challenges of ensuring effective and safe information flow across the aged and community care sector.

The dire need for research into effective models of aged care provision and the role of ICT in enabling innovations in safe care delivery have been recently highlighted by the Productivity Commission. The CHSSR aims to deliver new evidence to support reform in this sector.

We have achieved an outstanding level of success in extending our contribution to international research via high quality publications and facilitating the transfer of this knowledge to inform policy and practice locally, nationally and internationally. Engaging actively with our partners in the health system is fundamental to ensuring the translation of our findings into tangible improvements in health care delivery and outcomes.

Professor Johanna Westbrook

Director
Centre for Health Systems and Safety Research

MANAGEMENT BOARD

Role of the management board

The management board's role is to monitor the Centre's financial performance, assist with development of strategy and ensure that the objectives of the Centre are pursued in accordance with its terms of reference.

Management Board Members

Professor Denis Wakefield (Chair)

Associate Dean Research
Director of Office of Medical Research
Medicine
University of New South Wales

Professor Ann Williamson

Professor of Aviation Safety
Department of Aviation
Faculty of Science
University of New South Wales

Professor Ken Hillman

Director
Simpson Centre for Health Services Research
Australian Institute of Health Innovation
Professor of Intensive Care
University of New South Wales

Professor Ric Day

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St Vincent's Clinical School
University of New South Wales

Dr George Margelis

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Care Innovations - an Intel GE Company

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Royal Prince Alfred Hospital, NSW

Liverpool Hospital, NSW

Campbelltown Hospital, NSW

Bankstown Hospital, NSW

St Vincent's Hospital, NSW

Mater Hospital, QLD

Baptist Community Services NSW & ACT

The Elly-Kay Centre, VIC

Adventist Retirement Villages, NSW

Blue Cross, VIC

Sir Moses Montefiore, NSW

Finley Regional Care, NSW

Southern Cross Care, NSW & ACT

UnitingCare Ageing, NSW & ACT

YEAR AT A GLANCE

- The Centre became the Centre for Health Systems and Safety Research at the University of New South Wales' (UNSW) Australian Institute of Health Innovation in August, 2010. The CHSSR was formally established in January, 2011.

- The CHSSR researchers are chief investigators on research grants to the value of $14.9 million and in 2010 attracted new Australian Research Council grants totalling more than $2.9 million.

- Produced 48 peer-reviewed publications.

- Awarded the Branko Cesnik Award for the best paper at the 18th National Health Informatics Conference, for our work showing that electronic prescribing systems introduced into hospitals reduced prescribing errors by 50%.

- Contributed to debate around the role of ICT in reshaping the health system, including an editorial *Will information and communication technology disrupt the health system and deliver on its promise?* published in *Medical Journal of Australia*.

- Published breakthrough research in the *Archives of Internal Medicine*, demonstrating for the first time that the number of interruptions occurring to nurses during the administration of medications is significantly associated with the frequency and severity of medication errors. This work attracted considerable media attention.

- Presented several papers at the World Congress on Medical Informatics (MedInfo) in Cape Town, South Africa. Professor Westbrook played a lead role as co-chair of the Scientific Program Committee.

- Developed a new research stream on aged care informatics, researching how ICT can support decision making and improve quality of care.

- Staff actively engaged in professional activities: Associate Professor Joanne Callen was appointed editor in chief of the *Health Information Management Journal* and Dr Andrew Georgiou was elected as chair of the Health Informatics Society of Australia NSW branch. Professor Westbrook was awarded an Alumni Award for professional achievements from the University of Sydney.

RESEARCH PROGRAMS

MEDICATION SAFETY AND eHEALTH SYSTEMS

Medication errors are one of the most important safety issues for health care systems internationally. Electronic medication management systems (e-MMS) have been heralded as one of the most significant interventions to reduce these errors and improve patient safety. Evidence of the effectiveness of these systems largely rests on the experiences of a few leading hospitals in the United States which have designed and implemented home-grown systems. In 2010 the CHSSR continued its significant program of research on medication safety designed to answer fundamental questions regarding the effectiveness of eHealth interventions to reduce medication errors and to improve clinical work efficiency. Most importantly, we aim to provide evidence of the effectiveness of such interventions in Australian health care settings.

This research program tackles major methodological challenges of designing innovative measurement approaches and applying these in real-world clinical settings. New evidence of the incidence and severity of prescribing and medication administration errors in hospitals has been an important outcome of this research and provides the necessary baseline data against which to assess the effectiveness of new eHealth interventions designed to reduce medication error rates.

Effectiveness of e-MMS to reduce prescribing errors

Prescribing errors in hospital fell by more than 50% following the introduction of a commercial e-MMS to reduce prescribing errors (with limited decision-support activated), according to early results from our long-term study into this system.

Results from the larger study involving comparison of the effectiveness of two commercial e-MMS to reduce errors at two major teaching hospitals will be available in 2011. This will include results of the quantification and classification of new medication errors associated with e-MMS use.

Use of e-MMS was associated with a 50% reduction in prescribing errors.

References

Westbrook JI, Lo C, Reckmann M, Runciman W, Braithwaite J, Day RO (2010) **The effectiveness of an electronic medication management system to reduce prescribing errors in hospitals.** Proceedings of 18th National Health Informatics Conference. Hansen DP, Schaper L, Rowlands D. (Editors) Melbourne: 96-100. Awarded Branko Cesnik Award for best scientific paper.

Reckmann M, Westbrook JI, Koh Y, Lo C, Day RO (2009) **Does computerized order entry reduce prescribing errors for hospital inpatients? A systematic review.** Journal of American Medical Informatics Association. 16 (5), 613-23.

Interruptions and the incidence and severity of medication administration errors

In breakthrough research undertaken by the CHSSR, we demonstrated that the more interruptions nurses experienced while undertaking medication administrations in hospitals, the greater the frequency and severity of medication errors.

We observed a total of 4271 drug administrations for 720 patients. Only 19.8% of administrations were free of procedural failures or clinical errors. Interruptions occurred in 53.1% of all administrations and, overall, 25.0% of administrations had at least one clinical error. The risk of a patient experiencing a major clinical error doubled in the presence of four or more interruptions.

This is the first large-scale study to empirically show this relationship in real-world clinical settings.

The converging evidence of the high rate of interruptions occurring during medication preparation and administration, and their adverse effects, suggests the need to develop and implement strategies to improve communication practices and to reduce unnecessary interruptions on hospital wards.

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Westbrook JI, Woods A, Rob M, Dunsmuir W, Day RO (2010) **Association of interruptions with increased risk and severity of medication administration errors.** Archives of Internal Medicine. 170 (8), 683-690.

Westbrook JI, Woods A (2009) **Development and testing of an observational method for detecting medication administration errors using information technology.** Studies in Health Technology and Informatics. 146: 429-33.

Without interruption, the estimated risk of a serious medication error was 2.3%. With four interruptions this risk doubled to 4.7%.

On e-MMS wards, review activities by pharmacists were more frequent and faster, fewer ‘in-transit’ tasks occurred and more work was completed alone.

Impact of e-MMS on hospital pharmacists’ work

The CHSSR has an extensive body of research on the development of new approaches to measuring the impact of eHealth interventions on work and communication patterns of health professionals.

In 2010, an observational time and motion study was conducted to quantify the ways in which patterns of work of hospital pharmacists on wards using e-MMS differed from those without e-MMS. This early research has shown these systems have the potential to dramatically change hospital pharmacists’ work.

Pharmacists on e-MMS wards had lower rates of interruptions and multi-tasking than colleagues on wards without e-MMS. On e-MMS wards, review activities were more frequent and faster, fewer ‘in-transit’ tasks occurred, and more work was completed alone. Patient care tasks took longer but occurred less often on e-MMS wards.

Pharmacists on e-MMS wards spent more time clarifying medication orders but did it less often than pharmacists on wards without e-MMS.

References

Lo C, Burke R, Westbrook JI (2010) **Comparison of pharmacists’ work patterns on hospital wards with and without an electronic medication management system (eMMS).** Journal of Pharmacy Practice and Research. 40 (2), 108-112.

WORK INNOVATION AND eHEALTH

The uptake of information and communication technology (ICT) in the health care sector has been slow. To date, the focus has been on automating clinical work practices. Integration of ICT into existing complex work processes is challenging, and innovation in the use of ICT to support new ways of working is limited. A key focus of the CHSSR's work is to examine how ICT can be applied to the health system in a way that facilitates real reform and improved quality of care.

There is little evidence of the impact of ICT on work practices. Researchers at the CHSSR are conducting a multi-site project to investigate the extent to which health services have harnessed ICT to create new, sustainable models of service delivery which increase capacity and provide rapid, safe, effective and affordable health care.

This research focuses on three large-scale commercial ICT systems being adopted in Australia and overseas: critical and emergency care information systems, computerised ordering systems, and ambulatory electronic medical record systems.

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Work innovation in Emergency Departments

ICT is ideally suited to the pressured environment of the Emergency Department (ED) where doctors are frequently interrupted, provide episodic care to patients with diverse clinical problems, and need to communicate with various health professionals across different care settings. However the uptake of ICT in health care has been slow and fewer than 2% of EDs in the USA use a fully functional Emergency Department Information system (EDIS). Given that some studies have reported negative impacts - proposing that clinical information systems can actually facilitate clinical errors - it is important to explore their use in-depth in real world clinical settings.

We are conducting a large multi-site study, the first of its kind, to explore in-depth how physicians and nurses work with a commercially developed integrated EDIS and to identify the impact on quality of care and work practices. Our results indicate technology contributes to improvements in the delivery of quality care by facilitating access to patient-specific information and knowledge databases providing decision support at the point of care. Technology reduces the need for unnecessary interruptions of other clinical staff and allows nurses to take on extended roles in patient management. These significant results highlight the value of technology in facilitating improved ease of access to clinical, patient flow-related, knowledge-based and administrative information supporting ED care.

Another key finding is that clinicians are reporting new, improved ways of working using the technology. Both doctors and nurses explained that the sequence in which they undertook tasks had shifted as a result of the introduction of ICT – for example, doctors were more likely to order tests before seeing the patient. Doctors and nurses felt this made them better informed and helped to speed up the patient's journey through the ED.

The rich qualitative data set has also revealed both doctors and nurses report difficulties in integrating technology with documentation work practices and information workflow. This problem occurs both within the ED and with external departments, in particular due to the data entry demands of the system.

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Creswick N, Callen J, Li J, Georgiou A, Isedale G, Robertson L, Paoloni R, Westbrook JI (2010) **What impact do emergency department information systems have on nurses' access to information? A qualitative analysis of nurses' use and perceptions of a fully integrated clinical information system.** Proceedings of 18th National Health Informatics Conference. Hansen DP, Schaper L, Rowlands D. (Editors) Melbourne: 23-27.

The impact of technology on delivery of care and work practices in Intensive Care Units

Health systems face considerable challenges in meeting increasing demands for highly sophisticated services with limited resources and a shortage of health professionals. The introduction of ICT is a key strategy to improve the productivity and effectiveness of the health workforce and thus to meet these challenges.

The CHSSR is undertaking a multi-site study in five Intensive Care Units (ICU) to investigate the uptake of ICT including Picture Archiving and Communication Systems (PACS) in this busy and complex environment. In-depth interviews with 114 ICU clinicians and extensive observation of clinical work suggest that the use of clinical information systems in the ICU can alter the conduct of ward rounds and innovate the role of nurses.

ICU clinicians felt their decision making was more informed with the quick availability and accuracy of information at the bedside. Clinical information systems changed the sequence of tasks, particularly for junior doctors, and enhanced communication and promoted collaboration between ICU clinicians and other groups.

Additionally, a review of the impact of PACS on ICU work practices is in progress, an area which has not previously been reported on.

References

Creswick N, Hains I, Westbrook JI (2011) **Innovation in intensive care nursing work practices with PACS.** Studies in Health Technology and Informatics; (in press accepted April 2011). Amsterdam: IOS Press.

Hains I, Creswick N, Westbrook JI (2011) **Does PACS facilitate work practice innovation in the intensive care unit?** Studies in Health Technology and Informatics; (in press accepted April 2011). Amsterdam: IOS Press.

> "PACS I think is the bright point of the IT revolution in the sense that it provides previous information in a more timely fashion, in a way that's consistent, you can't lose it."

The development of an electronic medical record in an outpatient clinic

Drug monitoring for chronic disease patients is time consuming and complex, involving communication between doctors, nurses and laboratories and documenting the process in multiple manual and electronic information systems.

An electronic monitoring tool developed within the Cerner Millenium Powerchart system was introduced into the outpatient Rheumatology Department of a large teaching hospital staffed by seven rheumatologists and three clinic nurses.

The drug monitoring system forms part of the outpatient Electronic Medical Record (EMR) and allows physicians to electronically order a tailored drug monitoring plan for each patient at their consultation. It also automatically alerts the nurses when pathology results should be available for that patient.

The system was designed for patients prescribed disease-modifying anti-rheumatic drugs (DMARDs). These are potentially dangerous drugs, which if not monitored closely can have serious side effects for patients.

The aim of this study was to evaluate the impact of the electronic drug monitoring system on the proportion of patients appropriately monitored; the amount of time nurses were required to spend monitoring patients, and the impact of the system on clinicians' work processes, responsibilities and communication.

Results showed that the new electronic system changed the work of nurses, with drug monitoring activities taking up less time. This then allowed them to spend more time on patient care-related activities and to increase the number of nurse-directed clinics. Nurses also perceived that the drug monitoring process was more systematic and communications with doctors had improved with the new system.

Monitoring rates were sustained with the introduction of an electronic system requiring physicians to place an electronic monitoring order. Complex paper processes were replaced by a single electronic system streamlining the monitoring process and facilitating training of new clinical staff.

Nurses spent significantly:

Less time on drug monitoring tasks (33.1% to 26.4% of their day)

More time on patient care (6.5% to 18.1%)

More time with patients (7.7% to 19.8%)

Less time with administrative staff (11.2% to 2.5%)

Electronic ordering improves communication, efficiency and appropriateness of patient transport services

While the use of ICT has been shown to support many areas of health care, little research has been conducted regarding its impact on patient transport processes.

A systematic review undertaken in the CHSSR led us to develop a framework which identified key issues impacting on the quality and safety of non-emergency patient transport, namely communication, efficiency and appropriateness.

We conducted a case study to determine if an electronic ordering system supports key factors that impact on the quality and safety of non-emergency patient transport services. The setting was a large Area Health Service (AHS), which provides healthcare for 20% of the population of NSW and conducts approximately 20,000 non-emergency patient transports a year. Transport services in the AHS have used an electronic ordering system (Cerner Powerchart, modified to accept transport orders) to support the process since 2004.

The study found that the introduction of electronic ordering had improved and streamlined the communication process within and between facilities. Errors associated with miscommunication were reduced due to better information flow. Resources, particularly transport vehicles and staff, were used more efficiently and there were significant cost reductions associated with the implementation of electronic ordering.

Additionally, more efficient use of non-emergency transport services reduced outsourcing to the emergency ambulance service, allowing emergency services to concentrate on urgent cases.

As a result of the enhanced communication, the appropriateness of transport also improved, ensuring that patient transportation was conducted using the most suitable mode of transport and the correct personnel.

This research clearly demonstrated the value of ICT in supporting and enhancing non-emergency patient transport processes. The electronic ordering system implemented in this AHS transport service has facilitated standardisation of the transport process and improved communication, efficiency and appropriateness of transport.

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Hains I, Marks A, Georgiou A, Westbrook JI (2011) **Non-emergency patient transport – what are the quality and safety issues? A systematic review of the literature (1990-2009).** International Journal of Quality and Safety in Health Care 23(1): 68-75.

PATHOLOGY AND IMAGING INFORMATICS

Pathology and medical imaging departments provide services across primary, secondary and tertiary care. These departments make major contributions to critical decisions about the diagnosis, care and treatment of patients. ICT can have a major impact on the efficiency, effectiveness and quality of service delivery.

Our research investigates the information and communications infrastructure and social-technical networks that underpin each organisation. We utilise multi-dimensional and system-oriented approaches including qualitative, observational and quantitative methods to encompass the perspectives of multiple stakeholders involved in medical imaging and pathology processes. Our world-leading work on the impact of ICT on delivery of pathology services includes:

- Systematic reviews of the key evidence of the impact of computerised provider order entry (CPOE) systems on medical imaging and pathology services to show how the provision of electronic decision support can lead to greater adherence to guidelines and improved service effectiveness.
- Research evidence which has demonstrated that the introduction of computerised pathology ordering systems can significantly reduce the time it takes for test results to be available for clinical care. For example, our study of four hospitals showed reductions in test result turnaround by between 9% and 23% over two years.
- Measurement of the positive impact that declines in pathology test result turnaround times in Emergency Departments (ED) can make on reducing patient length of stay and improved ED efficiency.
- Research showing how electronic decision support prompts in CPOE systems can significantly improve the provision of essential patient information to pathology laboratories, thus enhancing their contribution to quality patient care.

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Georgiou A, Prgomet M, Markewycz A, Adams E, Westbrook JI (2011) **The impact of computerized provider order entry systems on medical imaging services: a systematic review.** Journal of the American Medical Informatics Association 18(3): 335-340.

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Westbrook J, Georgiou A, Dimos A, Germanos T (2006) **Computerised pathology test order-entry reduces laboratory turnaround times and influences tests ordered by hospital clinicians: A controlled before and after study.** Journal of Clinical Pathology. 59:533-536.

Georgiou A, Greenfield T, Callen J, Westbrook JI (2009) **Safety and efficiency considerations for the introduction of electronic ordering in a Blood Bank.** Archives of Pathology & Laboratory Medicine. 133(6):933-937.

Westbrook JI, Georgiou A, Lam M (2009) **Does computerised provider order entry reduce test turnaround times?** A before-and-after study at four hospitals, in Medical Informatics in a united and healthy Europe: proceedings of MIE 2009, K.-P. Adlassnig et al, Editors. IOS Press: Amsterdam. 527-531.

Use of technology for safe and efficient test management

Missed test results are a critical safety issue. It has been estimated that 10-15% of diagnoses are incorrect and poor follow-up of critical diagnostic tests is identified as a major preventable cause of this problem. Doctors acknowledge that the way they manage test results for their patients is not systematic. It has been reported that 17-32% of physicians have no reliable method of ensuring that results of all tests were received, and that only 15% are satisfied with their system of notifying patients of abnormal results. The aim of our research in this area is to evaluate technological applications which support the efficient and safe management of test results.

The significance of this work is underscored by the substantial costs associated with ordering multiple tests for patients. Diagnostic testing accounts for a large proportion of health care costs and is increasing. Our research has shown that, on average, hospital patients have over 100 test assays performed during their inpatient stays. Effective test management procedures are essential to ensure that results of all tests ordered are reviewed with appropriate follow-up action initiated and communicated to general practitioners.

As many as three in four tests conducted on patients while in hospital are not followed up once the patient has been discharged.

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Callen J, Georgiou A, Li J, Westbrook JI (2011) **The safety implications of missed test results for hospitalised patients: a systematic review.** BMJ Quality and Safety. 20:194-199.

Callen JL, Paoloni R, Georgiou A, Prgomet M, Westbrook J (2010) **The rate of missed test results in an Emergency Department. An evaluation using an electronic test ordering and viewing system.** Methods of Information in Medicine. 49 1: 37-43 10.3414/ME09-01-0011.

Callen J, Georgiou A, Westbrook J (2010) **Can electronic health records improve the reliability of test result follow-up for clinicians? An evaluation of on-line test result endorsement.** 3rd International Conference Diagnostic Error in Medicine. October. Toronto Canada. [Poster].

COMMUNICATION AND WORK PATTERNS

Two priority areas of health reform internationally are to improve the productivity of the workforce to address growing service demands and the shrinking health workforce, and increase the level of inter-disciplinary care and communication to enhance the quality and safety of services.

A major challenge has been the limited number of measurement techniques which are able to account for the complexity of clinical work and the different ways in which health professionals interact and collaborate. The CHSSR's research in this area has made considerable advances in both methods design and application to produce new evidence.

Social networks

Good communication and effective teamwork are core to high quality patient care. They depend on effective information networks to connect clinicians. Breakdowns in communication processes have been identified consistently as major causes of errors.

Despite their central role in the provision of safe health care, information networks connecting clinicians in hospitals have rarely been studied. Yet insights into how professionals relate, and the social and professional structures they form, has potential benefit to health professionals, their leaders, policymakers and researchers.

The CHSSR has studied 13 communication networks connecting 211 staff from three hospital units, showing that most interaction occurs within professional groups (see Figure 1).

The next phase of this research is to examine networks across hospital wards, departments or health care organisations. Intersections between different departments of a hospital are where the greatest risk of error occurs, and coordination of care between departments is a major challenge.

In particular, we aim to assess the effectiveness of ICT to improve information transfer at these intersections in order to increase the quality of patient care.

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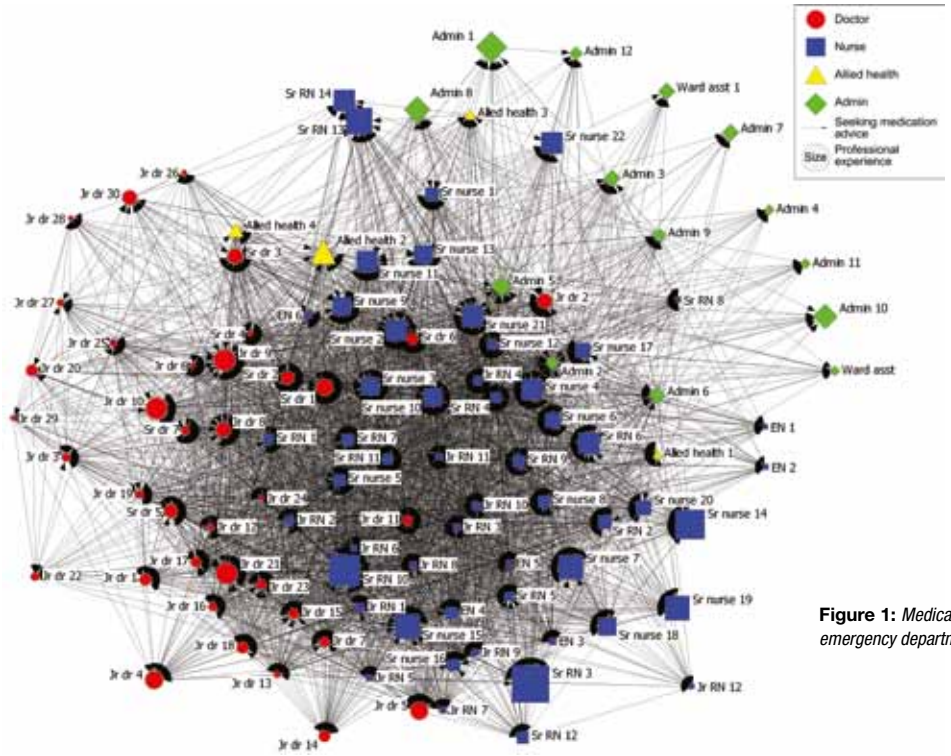

Figure 1: *Medication advice-seeking network in an emergency department*

Work Observation Method By Activity Timing (WOMBAT)

The CHSSR has published a body of research measuring health professionals' patterns of work and communication, including task time distribution and rates of interruptions and multi-tasking. We test how patterns of work and communication change following the introduction of interventions such as large-scale clinical information systems.

A particular strength of this research has been the development of new methods and software for data collection. The Work Observation Method by Activity Timing (WOMBAT) technique, developed by the CHSSR, has now been applied by several international research teams and was most recently validated in a collaborative study conducted in Canada.

This approach is innovative in capturing multiple dimensions of work. It collects information about the nature of tasks completed, with whom and what information and other tools are involved in the task. It also concurrently collects the number of interruptions to work and how frequently health professionals multi-task and conduct tasks in parallel.

In 2011, the WOMBAT software will be upgraded with a view to expanding its availability for use by other research teams.

This multi-dimensional approach has required the development of new statistical techniques. Its application in an Emergency Department study showed that doctors were interrupted 6.6 times every hour; 11% of all tasks were interrupted – 3.3% more than once – and doctors multi-tasked for 12.8% of time.

Applying new statistical approaches to control for length-biased sampling (the likelihood that longer tasks have a greater risk of interruption) we showed for the first time that when interrupted, clinicians tend to complete tasks in a significantly shorter time. This suggests that when interrupted, doctors may hurry tasks and potentially miss steps in order to catch up for lost time, which may have significant implications for patient safety.

Task shortening may occur because interrupted tasks are truncated to 'catch up' for lost time, which may have significant implications for patient safety.

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CONTINUITY OF CARE ACROSS HEALTH SETTINGS

One of the most pressing problems facing Australia and many other countries is how best to deliver appropriate, quality and sustainable health and community services for an increasingly ageing population. Current services in this area are inadequate and are failing to deliver continuity of care across the community aged care spectrum.

The use of information and communications technologies (ICT) is integral to achieving the much needed transformational reform to meet the future needs of older Australians.

Information and communication technologies supporting integrated aged care

Australia spends over $10 billion each year on aged care services. Yet the evidence about the best way to integrate services which meet the complex needs of older Australians is not readily available.

Our research in this area is focused on the how ICT can be used as a catalyst for new service delivery models to effectively coordinate services for older Australians. The research aims to identify and measure the individual, organisational and community benefits of technology-enabled integrated community care services.

The task of establishing integrated models of aged care is a complex one involving major structural changes. One of the main hurdles to achieving this is a lack of clarity about what is meant by integration and the failure to adopt effective ways to monitor and assess its achievement. Our research in this area will make innovative and novel contributions to produce outcomes of practical utility to the aged and community care service sector.

References

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STAFF

Director

Professor Johanna Westbrook
BAppSc (MRA) Cumb, MHA UNSW, GradDipAppEpid NSW VETAB, PhD USyd, FACHI, FACMI

Johanna Westbrook, Professor of Health Informatics, established the Centre for Health Systems and Safety Research in the Australian Institute of Health Innovation at the University of New South Wales (UNSW) in August 2010. In 2006, she established the Health Informatics Research & Evaluation Unit, Faculty of Health Sciences at the University of Sydney. Previously she was Professor of Health Informatics in the Faculty of Medicine at the University of NSW, where she was also Deputy Director of the Centre for Health Informatics.

Professor Westbrook's research interests and expertise centre on evaluating the impact clinical information systems have on health care delivery, health professionals' work and patient outcomes.

Her substantial body of research has included studies of the use of online evidence systems, the use of telemedicine applications in Emergency Department settings, and the impact of ICT on professionals' work and communication patterns. She has developed and applied new observational techniques, analyses and interpretation of the resulting data, challenging existing assumptions about work and communication patterns, and contributing theoretical advances about complex evaluations in the health sector.

Professor Westbrook has published many papers on health care evaluations and health technology assessments as well as epidemiological studies. She has qualifications in epidemiology, health information management and health administration, has over 200 refereed publications, and has attracted in excess of $26 million in research funding. In 2005, Professor Westbrook was elected as a Fellow of the American College of Medical Informatics. Only two other Australians have received this honour. She has received several awards for her research work, as well as a national award for the innovative use of technology in tertiary education.

Senior Research Fellows

Associate Professor Joanne Callen
BA UNSW, DipEd Sydney Teachers' College, MPH (Research) USyd, PhD UNSW

Associate Professor Callen's research centres on exploring how ICT can improve health outcomes for patients and support health professionals in the delivery of high quality, safe, and efficient patient care. Her work centres on the barriers to the implementation of clinical information systems in the workplace, and on the use of technology to improve communication regarding laboratory and radiology test results. Prior to her role at the CHSSR, Professor Callen was Head of the Discipline of Health Informatics at the University of Sydney.

Dr Andrew Georgiou
BA LaTrobe, DipArts USyd, MSc Southampton, PhD USyd, FCHSM, FACHI

Having been awarded his PhD in 2009, Dr Georgiou is involved in investigating the impact of electronic ordering systems in clinical and hospital ancillary settings. He has worked as a senior researcher in a number of areas including primary care, health informatics and outcomes measurement. He has occupied a number of high level executive positions including as the UK NHS Assistant Director of Classifications (1995-1997) and as the Co-coordinator for the Coronary Heart Disease Programme for the Royal College of Physicians in London (1999 – 2002). Dr Georgiou has widely studied pathology IT systems, contributing over 25 papers and studies to the area.

Research Fellows

Dr Melissa Baysari
BPsych, PhD USyd

In addition to her role at the CHSSR, Dr Baysari is located within the Department of Clinical Pharmacology and Toxicology at St Vincent's Hospital. She has a background in behavioural psychology and post-doctoral experience in human factors – the identification and classification of errors leading to rail incidents and accidents. She has a particular interest in understanding human error and the factors that contribute to error occurrence. Dr Baysari is currently involved in a research program investigating the decision making process of selecting medicines for prescription.

Dr Isla Hains
BSc (Hons1), PhD Heriot-Watt

Dr Hains' research involves examining the use of ICT in supporting work practice innovation in the health care system. She is currently leading a project to investigate the role of ICT, such as clinical information systems, computerised provider order entry systems, picture archiving and communication systems, in intensive care units and how these systems can innovate and impact on clinician work practices.

Dr Ling Li
BEcon Beijng Wuzi, MComBus, MComIT Macq, MBiostats USyd, PhD Macq

Dr Li is a biostatistician whose research interests include multilevel modelling and applying statistical methods in health and epidemiological research. She is currently involved in a controlled time series study to assess the safety and effectiveness of two electronic prescribing systems (e-PSs) to reduce prescribing errors in two Australian hospitals. Dr Li previously worked at the NSW Health Department, collaborating with other health and epidemiological researchers in various research areas and applying statistical methods in health and epidemiological research.

Dr Marilyn Rob
BSc South Africa, MA Macq, PhD UNSW, CStat

As a biostatistician, Dr Rob undertakes statistical analyses and consultation within the CHSSR. She is currently working on a large study examining errors in hospital medication administration. Her previous extensive research and statistical experience includes working at the NSW Health Department, where she applied statistical and epidemiological techniques to a wide range of health issues.

Postdoctoral Research Fellow

Dr Nerida Creswick
BAppSc(HIM)(Hons1), PhD USyd

Prior to her current role, Dr Creswick was a Postdoctoral Fellow in the Health Informatics Research & Evaluation Unit at the University of Sydney. She completed her PhD at the University of Sydney in 2008, examining the problem-solving, medication advice-seeking and socialising wards of hospital staff. Her research interests are in health informatics evaluation and using network analysis in healthcare settings. She is currently working on a project examining work practice innovation in intensive care units and emergency departments.

Research Officers

Dr Naomi Malouf
RN, BN (Hons), PhD, USyd, MRCNA

Dr Malouf has been a registered nurse since 1998 and has worked in both public and private hospitals in medical and surgical areas. Being awarded her doctorate in Nursing (2010) entitled “Transition and the New Graduate Nurse: From beginning practice to seamless practitioner”, she is primarily a qualitative researcher with an interest in how nurses operate within large health institutions.

Dr Malouf works with Professor Johanna Westbrook on a project investigating the impact of electronic medication administration records on nurse medication administration safety.

Ms Margaret Reckmann
BSc, BPharm UTAS, TTC

As a Clinical Pharmacist Researcher, Ms Reckmann contributes to research projects focused around medication safety and is responsible for undertaking medication error data collection within nominated study sites. She is currently involved in a series of studies assessing the safety and effectiveness of two electronic prescribing systems (e-PSs) in reducing prescribing errors in two Australian teaching hospitals.

Ms Reckmann has a broad professional base spanning pharmacy, teaching and medical publishing. She is a registered pharmacist who has experience in public and private hospitals and in community pharmacy. She spent a number of years as Pharmacist in Charge of the Tasmanian Drug Information Centre and as Deputy Editor at MIMS Australia Pty Limited.

Mr George Toouli
BSc UNSW, MPH UWS

For 39 years, Mr Toouli was the Laboratory Manager of the large Microbiology Department at Liverpool Hospital, NSW, providing microbiology services to all the public hospitals in the south-western area of Sydney. He is now a consultant microbiologist advising on the introduction of LEAN processes in to the laboratory setting.

As a research assistant with the CHSSR, Mr Tooli is studying the introduction of a new laboratory information system into the Microbiology Laboratory of Liverpool Hospital, and the effect of late requests for tests in a Pathology Department especially if the specimen has already been collected and processed by the laboratory (Add-On tests).

Research Assistants

Ms Sarah Gaskin,
BA, BSc (Hons1) UNSW

Ms Gaskin graduated from UNSW with a Bachelor of Science/Arts. In her final year she completed an honours project at the Oncology Research Centre (POWH) where she undertook a year of laboratory research in prostate cancer. She has since worked as a laboratory research assistant at the Westmead Institute of Cancer Research (USyd), working on a project that studies the familial inheritance of melanoma. She is completing a Masters in Public Health at the University of Sydney. She is currently working on a study that examines work and information processes in residential aged care facilities.

Ms Antonia Hordern
BAppSc (HIM), MHlthSc (CDM) USyd

Ms Hordern is currently involved in an ARC Linkage Project, where she is specifically focusing on the implementation of an electronic toxic drug monitoring system in a rheumatology Outpatient Department in a large suburban hospital, and evaluating the impact that this will have on patient outcomes and work processes. Prior to this, she was heavily involved in a qualitative study which evaluated the trial of the HealthCube Comprehensive Medical Assessment Service in a residential aged-care facility. Ms Hordern completed a Master's Degree in Health Science (Clinical Data Management) through the University of Sydney and previously completed a Bachelor's Degree in Applied Science (Health Information Management), also through the University of Sydney.

Ms Anne Marks
AssDip(MRA), MHlthSc(Education) USyd

Before her role as Research Assistant at the CHSSR, Ms Marks was a Research Assistant in the Health Informatics Research and Evaluation Unit, University of Sydney. She is currently involved in a project investigating the use of IT to improve work process efficiency and effectiveness in aged care facilities. She has also participated in an ARC Linkage Project examining the use of ICT in supporting work practice innovation in the Australian health system. Ms Marks has previously held a number of roles in the Discipline of Health Informatics, Faculty of Health Sciences at the University of Sydney, and had been employed as a full-time academic staff member since 2003. She has professional and academic qualifications in health information management and education, and has held senior HIM positions in both public and private health care facilities.

Mr Michael Stewart
BIntS USyd

Mr Stewart is currently involved in an ARC Linkage project, specifically focusing on the use information and communication technologies in the Emergency Department. Prior to joining the CHSSR, he worked for a health consultancy firm where he was heavily involved in the development of clinical indicators for cancer care in South Australia. He also assisted in an evaluation of the National Rural Locum Program for the Commonwealth Department of Health and Ageing. Mr Stewart is in the process of completing a Master of International Public Health at the University of Sydney, having previously completed a Bachelor of International Studies, also at the University of Sydney.

Mr Elia Vecellio
BPsych(Hons), MSc(Research) UNSW

Before his role at the CHSSR, Mr Vecellio was a Research Assistant in the School of Psychology (UNSW), Injury Risk Management Research Centre (UNSW) and School of Risk and Safety Science (UNSW). He is currently investigating how the implementation of Computer Provider Order Entry (CPOE) in hospital imaging departments has influenced their efficiency. Mr Vecellio trained in research psychology at UNSW.

Business Manager

Ms Sheree Crick

Ms Crick's role encompasses the provision of financial and administrative support to the Directors of the CHSSR and the Australian Institute of Health Innovation. This involves providing advice and assistance to all Institute academic and administrative staff and undertaking a diverse range of tasks including development of the Centre and Institute budgets, assisting in the submission of grant proposals, supporting the Centre's management board and project steering committees and preparation of the Centre's annual report. Ms Crick has held a range of administrative roles in the higher education sector, having previously been employed in a research group support capacity at the University of Sydney. Prior to this, her roles supported learning and teaching activities, including distance education coordination and school administration.

PhD Candidates

Ms Yu Jia Julie Li

Supervisor: Professor Johanna Westbrook

Co-supervisors: Associate Professor Joanne Callen
Dr Andrew Georgiou
Dr Richard Paoloni

PhD topic:

Innovation in the ED: An exploration of the impact of Information Communication Technology in facilitating the role of Nurse Practitioners

This PhD project explores the influence of ICT on the clinical work practices and role of Nurse Practitioners in the Emergency Departments of two large metropolitan hospitals. The results will contribute to a more holistic insight into the disruptive impacts of clinical IT implementation on clinical roles and work. In addition, it will identify the factors that influence optimal functioning of clinical departments and advise on the future implementation of information technology in the shift towards full computerisation of the healthcare system.

Ms Mirela Prgomet

Supervisor: Professor Johanna Westbrook

Co-supervisors: Associate Professor Joanne Callen
Dr Andrew Georgiou

PhD topic:

An investigation of the use and impact of mobile information and communication technology (ICT) on clinical work practices

This PhD topic is an investigation of the use and impact of mobile ICT on clinical work practices. The study seeks to examine clinicians' use of ICT and how they interface and integrate these technologies in their work, with the aim of understanding the relationship between clinical task, role, and selection of ICT device. It will allow understanding of what will work, for whom, where, and in what circumstances and will aid in assessing the role of mobile ICT in supporting work practices.

Ms Stella Rowlands

Supervisor: Associate Professor Joanne Callen

Co-supervisors: Professor Johanna Westbrook

PhD topic:

What information do general practitioners need to care for patients with lung cancer? An exploration of the flow of clinical information within a hospital's lung cancer care team and between the team and the patient's general practitioners.

This study uses a multi method design combining qualitative and quantitative methods to explore the patient information needs of general practitioners in the management of their patients with lung cancer, and to identify possible strategies for improving the quality, timeliness and format of this information. This is the first study to explore how patient information is communicated between members of a hospital-based cancer care team and how this exchange of information could be improved.

Ms Amina Tariq

Supervisor: Professor Johanna Westbrook

Co-supervisor: Dr Andrew Georgiou

PhD topic:

A study exploring the information exchange between residential aged care facility (RACF) staff and community pharmacies for coordinating residents' medication procedures by developing an in-depth understanding of how, when, what and where information is exchanged. This will allow an analysis of how and where ICT can be employed to improve the effectiveness of medication procedures, reduce the possibility of medication errors and thus improve patient safety and quality of care.

In-depth semi-structured face to face interviews, focus groups and directed observations will be conducted with a purposive sample of RACF and pharmacy staff across three selected metropolitan RACF sites in Sydney.

Ms Yaqoot Fatima

Supervisor: Professor Johanna Westbrook

Co-supervisors: Professor Ric Day
Dr Melissa Baysari

PhD topic:

The main objective of this research is to measure the extent to which hospitalized patients at risk of venous thromboembolism receive recommended prophylaxis, and to evaluate the impact of different factors related to patients, health providers and the organisation on the provision of recommended care. These findings may also be used to identify interventions which are best suited for the given hospital, and to assess post-interventional changes in the delivery of recommended care.

Visitors

Dr Dave Parry

Dave Parry is a Senior Lecturer and Director of the Auckland University of Technology Radio Frequency Identification (RFID) Laboratory (AURA) in the School of Computing and Mathematical Sciences, Auckland University of Technology. His research interests include Health Informatics: Ontology based information retrieval and RFID applications for pervasive computing. Dave completed his sabbatical in 2010 at the Centre for Health Systems and Safety Research.

Mr Svend Lyhne

Svend spent a research semester at the CHSSR as a part of his Master's degree in Clinical Science and Technology at Aalborg University, Denmark. Svend participated in a study of the handover process in an aged care facility in Sydney.

FINANCE

STATEMENT OF FINANCIAL PERFORMANCE

For the period 1 January 2010 to 31 December 2010

	2010 $
Income	
External Funds*	752,099.00
UNSW Contribution	300,000.00
Total Income	**1,052,099.00**
Expenses*	
Payroll	811,729.61
Equipment	48,463.45
Materials	33,218.35
Travel	17,975.56
Total Expenses	**911,386.97**
Operating result for the period	140,712.03
Surplus (Deficit) Bfwd from Prior Period	420,149.86
Retained Funds Surplus (Deficit)	560,861.89

*Excludes income and expenditure from NHMRC Program Grant

Notes to the Statement of Financial Performance

1 The Centre acknowledges the University's in-kind contributions in rental, heat, light & power and two academic positions, which also contribute to its teaching commitments.

2 In-kind contributions from various grants, including ARC Linkage programs, are not brought to account in this Statement.

3 The value of visiting staff, and various contributions from staff who support the Centre, are acknowledged but are also not brought into account in this Statement.

GRANTS

2007-2010	**$665,100**
Funding body:	National Health & Medical Research Council (NHMRC)
Subject:	Electronic portable health file (PHF) to promote quality of care and workflow through continuity of care
Project type:	Project grant 455467
Chief Investigators:	Lassere M, Westbrook JI, Johnson K, Iedema R, Rubin G, McCauley V. Relinquished due to NHMRC Program Grant.

2007-2010	**$1,340,000**
Funding body:	Australian Research Council, Industry partner: ACT Health
Subject:	An action research project to strengthen inter-professional learning and practice across the ACT health system
Project type:	Research linkage grant LP0775514
Chief Investigators:	Braithwaite J, Westbrook JI, Foxwell AR, Boyce R, Budge M

2010-2015	**$2,350,000**
Funding body:	Aged Care and Standards Accreditation Agency , Australian Commission on Safety and Quality in Health Care, Australian Council on Healthcare Standards, Australian General Practice Accreditation Limited, The Clinical Excellence Commission
Subject:	Strengthening organisational performance through accreditation research: the ACCREDIT project
Project type:	ARC Linkage LP100200586
Chief Investigators:	Braithwaite J, Westbrook JI

2009-2012	**$2,149,160**
Funding body:	Australian Research Council; Sydney South West Area Health Service
Subject:	Use of information and communication technologies to support effective work practice innovation in the health sector: a multi-site study
Project type:	ARC Linkage LP0989144
Chief Investigators:	Westbrook JI, Braithwaite J, Gibson K, Paoloni R

2009-2013	**$8,400,000**
Funding body:	National Health and Medical Research Council (NHMRC)
Subject:	Patient safety: enabling and supporting change for a safer and more effective health system
Project type:	Program grant 568612
Chief Investigators:	Braithwaite J, Westbrook JI, Coiera E, Runciman W, Day R

GRANTS Continued

2009-2013	**$1,580,000**
Funding body:	Australian Research Council
Subject:	Evaluating communities of practice and social-professional networks: the development, design, testing, refinement, simulation and application of an evaluation framework
Project type:	Discovery DP0986493
Chief Investigators:	Braithwaite J, Westbrook JI

2011-2014	**$512,051**
Funding body:	Australian Research Council
Subject:	Advancing understanding of health professionals' work and communication patterns and the effectiveness of work reform initiatives
Project type:	ARC Discovery DP110100090
Chief Investigators:	Westbrook JI, Dunsmuir WT, Duffield CM

FACULTY RESEARCH GRANTS

2010	**$40,000**
Funding body:	ARC Goldstar Award 2010
Subject:	Can technology make healthcare safer and more efficient? Measurement of the effectiveness of an electronic test management system
Chief Investigators:	Callen JL, Georgiou A

PUBLICATIONS AND PRESENTATIONS

Refereed Journal Articles

2010

Aarts J, Callen J, Coiera E, Westbrook JI (2010) **Information technology in health care: socio-technical approaches.** [Editorial] International Journal of Medical Informatics. 79 (6), 389-390.

Bain C, Taylor P, McDonnell G, Georgiou A (2010) **Myths of Ideal Hospital Occupancy.** Medical Journal of Australia. 192(1), 42-43.

Braithwaite J, Greenfield D, Westbrook JI, Pawsey M, Westbrook MT, Gibberd, Naylor J, Nathan S, Robinson M, Runciman W, Jackson M, Travaglia J, Johnston B, Yen D, McDonald H, Low L, Redman S, Johnson B, Corbett A, Hennessy D, Clarke J, Lancaster J (2010) **Health service accreditation as a predictor of clinical and organisational performance: a blinded, random, stratified study.** Quality and Safety in Health Care. 19:14-21 doi:10.1136/qshc.2009.033928.

Braithwaite J, Westbrook JI (2010) **What makes the health system tick?** [Editorial] International Journal of Quality in HealthCare; 22 (1),1-2.

Callen JL, McIntosh J, Li J. (2010) **Accuracy of medication documentation in hospital discharge summaries: a retrospective analysis of medication transcription errors in manual and electronic discharge summaries.** International Journal of Medical Informatics. 79(1), 58-64. doi:10.1016/j.ijmedinf.2009.09.002.

Callen J, Paoloni R, Georgiou A, Prgomet M, Westbrook JI (2010) **The rate of missed test results in an Emergency Department: An evaluation using an electronic test order and results viewing system.** Methods of Information in Medicine. 49, (1) 37-43.

Creswick N, Westbrook JI (2010) **Social network analysis of medication advice-seeking interactions among staff in an Australian hospital.** International Journal of Medical Informatics. 79 (6), e116-e125.

Georgiou A, Westbrook JI (2010) **The implications of e-ordering for the communication environment of hospital laboratory services.** Asia Pacific Journal of Health Management. 5(1), 47-52.

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Georgiou A, Whetton S (2010) **Broadening the socio-technical horizons of health informatics.** [Editorial] The Open Medical Informatics Journal. 4, 179-80.

Li J (2010) **A sociotechnical approach to evaluating the Impact of ICT on clinical care environments.** Open Medical Informatics Journal. 4:202-5.

Lo C, Burke R, Westbrook JI (2010) **Comparison of pharmacists' work patterns on hospital wards with and without an electronic medication management system (eMMS).** Journal of Pharmacy Practice and Research. 40 (2), 108-112.

Nugus P, Greenfield D, Travaglia J, Westbrook JI & Braithwaite J (2010). **How and where clinicians exercise power: Interprofessional relations in health care.** Social Science & Medicine. 71(5),898-909.

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Westbrook JI, Braithwaite J (2010) **Will ICT disrupt the health system and deliver on its promise?** Medical Journal of Australia. 193 (7), 399-400.

Westbrook JI, Coiera EW, Dunsmuir WTM, Brown BM, Kelk N, Paoloni R, Tran C (2010) **The impact of interruptions on clinical task completion.** Quality and Safety in Health Care. 19, 284-289.

Westbrook JI, Georgiou A, Black D, Hordern A (2010) **Comprehensive medical assessments (CMAs) for monitoring and improving the health of residents in aged care facilities: existing CMA coverage and a trial of a new service model?** Australasian Journal on Ageing. DOI: 10.1111/j.1741-6612.2010.00456.x.

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2011 (January - June)

Ballerman MA, Shaw NT, Mayes DC, Gibney, RTN, Westbrook JI (2011) **Validation of the Work Observational Method By Activity Timing (WOMBAT) method of conducting time-motion observations in critical care settings: an observational study.** BMC Medical Informatics and Decision Making. 11:32doi:10.1186/1472-6947-11-32.

Baysari MT, Caponecchia C, McIntosh AS (in press). **A reliability and usability study of TRACEr-RAV: The Technique for the Retrospective Analysis of Cognitive Errors – for Rail, Australian Version.** Applied Ergonomics. (Accepted for publication on Feb 1, 2011).

Baysari MT, Westbrook J, Braithwaite J, Day RO (2011) **The role of computerized decision support in reducing errors in selecting medicines for prescription: Narrative review.** Drug Safety. 34 (4), 289-298.

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Greenfield D, Moldovan M, Westbrook M, Jones D, Low L, Johnston B, Clark S, Banks M, Pawsey M, Hinchcliff R, Westbrook JI. and Braithwaite J. (2011) **An empirical test of short notice surveys in two accreditation programs.** International Journal for Quality in Healthcare. (Accepted 11/07/11).

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Books and Book Chapters

2010

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2011 (January - June)

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Georgiou A (2010) **Can IT help us down the evidence based pathway.** Australian Association of Clinical Biochemists and Australian Institute of Medical Scientists Combined Scientific Meeting 25 - 29 October 2010.

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Invited Presentations

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Georgiou A (2010) **Comprehensive Medical Assessments (CMAs) for monitoring and improving the health residents in aged care facilities.** Aged Care Informatics Symposium, Health Informatics Society of Australia 24 August 2010.

Georgiou A (2010) **Can IT help us down the evidence based pathway.** Australian Association of Clinical Biochemists and Australian Institute of Medical Scientists Combined Scientific Meeting 25 - 29 October 2010 (Invited speaker).

Westbrook JI (2010) **Keynote Clinical information and decision support systems: From paper to electronic tools.** Safety Quality Audit & Outcomes Research in Intensive Care. Melbourne 10-11 August.

Westbrook JI (2010) **Assessing the effects of electronic medication management systems in hospitals.** Victorian Department of Health. 22 September, Melbourne.

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