



centre for health informatics

annual report 08/09



science change analysis online **patient** tool study
informatics surveillance evidence focus aging technology mining safe
safety medical model system microbiology identity
pattern **care** hospital incident policy **chi** modelling explore social biosurveillance cognitive
clinical consumer management text translational simulation journal
bioinformatics research search infectious datum knowledge
complex control international trial gene method detection **disease**
institute discovery university **health** internet decision association quality improve
cancer **national image healthcare practice** retrieval human medicine
computer information lung

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What We Do

Post-genome the next healthcare revolution is in information and systems, or informatics. Building a sustainable health system for the 21st Century will require the reinvention of much of the present day system, and require the intelligent use of information and communication technologies to deliver high quality, safe, efficient and affordable health care.

The Centre for Health Informatics (CHI) is Australia's largest academic research group in this crucial emerging discipline. **CHI conducts fundamental and applied research in the design, evaluation and application of decision-support technologies for healthcare and the biosciences.** To do this, we need to model the complex nature of health systems and the bioscience research enterprise, and design scientifically rigorous and system wide interventions to sustain tomorrow's health system.

The Centre's work is internationally recognised for its groundbreaking contributions in the development of intelligent systems to support evidence-based healthcare, developing evaluation methodologies for IT, and in understanding how communication shapes the safety and quality of health care delivery.

Centre researchers also are working on safety models and standards for IT in healthcare, mining complex gene microarray, medical literature and medical record data, building health system simulation methods to model the impact of health policy changes, and developing novel computational methods to automate diagnosis of 3-D medical images.

A research centre of the University of New South Wales, and a member of the new Australian Institute of Health Innovation, CHI is supported by the Faculty of Medicine. We partner with major healthcare providers, research institutions and governments, including the New South Wales Department of Health, the National Institute of Clinical Studies and the Commonwealth Department of Health and Ageing.

CHI will drive change in healthcare and biomedicine by making contributions to:

SCIENCE

break-through discoveries in information, communication, cognitive and organisational science needed to support health service innovation at a system level

POLICY

providing expert input and leadership into government, shaping policy priorities and goals

INNOVATION

invention of novel technologies and methods that can transfer into industry and health services

EDUCATION

training future researchers through research degree programs to educate clinicians, technologists and policy makers in health informatics

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Director's Report

The UNSW Centre for Health Informatics remains Australia's largest, longest running and most successful academic health informatics research group. It has a long and successful research grant track record with both the ARC and the NHMRC, and carries out a broad multidisciplinary research program. Its focus on decision support is also a unique national strength, and widely recognized internationally.

This year CHI joins with the Centre for Clinical Governance Research at UNSW and the Simpson Centre at Liverpool Hospital, to found the Australian Institute of Health Innovation. The new institute represents the largest collection of dedicated health services researches in Australasia, and is uniquely committed to the transformation of the health system through evidence-based redesign. Each of the Centres will retain their independence and traditional disciplinary foci, but together we hope to undertake major new collaborative programs, and create a rich and energetic research environment, which will become an engine for radical and effective change of the health system internationally. CHI is relocating to UNSW's main campus from its Coogee home of the last few years, into a new purpose built space for the Institute which will also provide us for the first time with experimental laboratory space to support our research programs.

Our research programs continue to develop in response to emerging technologies, and evolving health priorities. With significant funding support from the HCF Health and Medical Research Foundation, we are now well underway with our major new consumer e-health project. We are exploring the design and evaluation of a new 'Facebook for Health' system that will bring together many emerging

elements from Web 2.0 like social computing, Wikis, blogs, and embedded and context sensitive information retrieval. Called *healthy.me*, our goal with this system is to develop tools that support consumers in the decisions they face as they interact across the health system. This innovative idea was presented at the 2008 2020 Summit in Canberra, and 'Healthbook' became a final Top 5 health idea. The new work has attracted unprecedented interest and community support, with national radio coverage on ABC's PM, an interview with Margaret Throsby, and extensive print coverage.

Our investment in translational bioinformatics, exploring how the genomics and bioscience revolution will translate into clinical practice, has started to bear fruit. We are currently focussing on infectious disease, in partnership with the Centre for Infectious Diseases and Microbiology at Westmead Hospital. Our researchers have developed novel gene annotation and discovery tools, focussing on tasks such as the identification of virulence genes for Group B Streptococci and the identification of gene cassettes that carry antibiotic resistance genes in gram-negative organisms. Our work in public health surveillance of infectious diseases has also generated important work in the spatiotemporal detection of outbreaks.

Patient safety is an increasingly important thread of our research at the Centre, and this has been reinforced through our successful application for a major NHMRC Program grant in patient safety, with local colleagues in Clinical Governance, and the Universities of Sydney and South Australia. The program will see new work in clinical decision support and health system simulation directed at modeling the relationship between clinical practice and poor safety outcomes.

2008 Key Performance Indicators:

- > We were **awarded multiple new grants and contracts**, including a portion of a major new NHMRC Program grant in *Patient Safety: enabling and supporting change for a safer and more effective health system* (Braithwaite, Westbrook, **Coiera**, Runcimann, Day) which was awarded to UNSW, and worth a total of \$8,400,000 over 2009-2013; a Faculty of Medicine Goldstar award worth \$30,000, and contracts with the Federal Department of Health and Ageing (\$291,000) and the Commission for Safety and Quality in Healthcare (\$203,000).
- > In 2008, our research generated **48 publications**, with 22 international journal papers, 23 conference papers and 3 book chapters.
- > Our research staff gave **six invited presentations** including Keynote or invited addresses to Consilium, run by Centre for Independent Studies, the 13th National Nurse Education Conference, the 3rd Latin American Congress in Medical Informatics in Buenos Aires, the ARCS (Association of Regulatory & Clinical Scientists) Annual Scientific Congress, and the National Forum on Safety and Quality in Health Care.
- > CHI **research featured heavily in the press** and news wires with **four radio interviews** including Mark Colvin on ABC Radio National, Richard Aedy on Life Matters, and Margaret Throsby on ABC Classic FM. Press articles included: Healthbook could be online soon, *AAP News*, and carried on 60 national and local news sites including *The Australian*, *Sydney Morning Herald*, *The Age*, *Ninemsn*, *Yahoo7*, *Canberra Times*, April 20 2008; Internet users prefer information that match their pre-existing beliefs, *Science Daily*, *The Economic Times*, *Malaysia Sun*, 24-25 Jan 2008, Health Search Engine Planned, *Australian Financial Review*, 18 Jan 2008; Social networking may improve your health, *AAP News*, *Ninemsn*, *The Age.com.au*, *Sydney Morning Herald.com.au*, *Canberra Times*, *Brisbane Times*, *Gold Coast News*, 15-16 Jan, 2008; Internet search may up health risk, *The Times of India*, *Malaysia Sun* 2 Jan, 2.

Partners and Major Funders

We are grateful to our partners and funders for their ongoing support of our research program. CHI's research is supported by the following organisations:

- > NSW Health
- > Australian Research Council (ARC)
- > National Health and Medical Research Council (NHMRC)
- > Federal Department of Health & Ageing
- > HCF Health and Medical Research Foundation
- > The Cerebral Palsy Institute

Highlights and Achievements 2008

Our research continues to receive significant attention nationally and internationally.

- > Our paper on patient safety markets was published in the BMJ journal *Quality and Safety in Health Care* with **four accompanying editorials** and a senior editorial comment. The paper proposes a radical new way to enhance patient safety, based upon carbon trading, applied to patient safety trading. The paper resulted in significant press including an interview on ABC Life Matters, and an accompanying opinion piece was published by ABC News online.
- > CHI papers have been highlighted in the international literature. For example one paper was selected as one of the **best papers of the year** and republished in the *IMIA Yearbook of Medical Informatics 2009*, another was designated a **highly accessed** online paper within the Biomed Central system, indicating that the article has been especially highly accessed, relative to age, and the journal, and a conference paper presented in San Francisco was **given a best paper award 2008** and selected for extended publication in *BMC Bioinformatics*.
- > CHI researchers have contribute editorials to the *Medical Journal of Australia*, on the safety of clinical IT, and the peak field journal the *Journal of the American Medical Informatics Association*, on national e-Health policy and the Obama stimulus package.

We were partners in **major new NHMRC Program Grant** *Patient Safety: enabling and supporting change for a safer and more effective health system* (Braithwaite, Westbrook, Coiera, Runcimann, Day) which was awarded to UNSW, and worth \$8,400,000 over 2009-2013. This is one of the largest NHMRC program in

health services research to date. Three of the program's four streams have an informatics focus, and two of them will be led at CHI.

CHI was awarded a contract by the Federal Department of Health and Ageing to develop a general practice information management (IM)/information technology (IT) capacity building resource. CHI led a consortium comprising of the Royal Australian College of General Practitioners (RACGP), the Centre for Clinical Governance Research at UNSW, and Pen Computer Systems. We also partnered with the Australian Patient Safety Foundation on a contract for the Quality and Safety in Healthcare Commission, looking at automatically identifying critical incidents associated with clinical handover and patient identification.

CHI held **two short Courses in Health Informatics**. One, on Health system simulation, was held 27 and 28 November, 2008.

Titled *Systems Thinking and Modeling for Health: Simple models for Complex System Dynamics*, the course was very well attended and received, with a strong representation from the clinical community. The second was the CHI Winter Workshop on *Next-Generation Technologies for Decision Making in the Health and Biosciences* held over 7-8 August 2008. Keynote presenters included Professor Bill Runciman and Dr Vitali Sinchenko and sessions focused on Clinical Systems Safety Engineering, Future Clinical Systems, Translational Bioinformatics, and Biosurveillance.

CHI again hosted two Danish Master's students from Aalborg University and a German practicum student, for approximately 6 months. Our visiting student program is always a highlight of our year, and we enjoy the energy and perspectives that our visitors bring.



Research Programs

CONSUMER INFORMATICS

Our national E-Health policy aims to provide “consumers with electronic access to the information needed to better manage and control their personal outcomes”¹. Like most Western countries, there is an increasing shift of responsibility onto individual consumers to look after their healthcare needs.

Growing numbers of Australian consumers turn to the Internet to search for health information, and becoming their own “care integrator” because they may be the only person with a complete view of their care. Yet, the Internet has delivered a glut of information, not all of it timely or correct, increasing the chances that consumers may make the wrong decision, or creating anxiety about what to do².

Our research show that when consumers search for online information they experience cognitive biases that influence their healthcare decisions³. In particular, pre-existing beliefs are likely to make individuals discount information that is correct. We also found that those who lack confidence are more likely to change their decisions after receiving social feedback online, which has significant implications for the use of social networking technologies⁴.

We have been awarded \$1 million in funding from the HCF Health and Medical Research Foundation to develop a new research platform for consumers, called *healthy.me*, to answer compelling questions on how Internet technologies shape and support the way healthcare consumers manage their health and

decision-making. We think of *healthy.me* as a “Facebook for healthcare”, where consumers are encouraged to actively engage in the management of their health in a trusted environment. ‘Healthbook’ was one of the **top 5 health ideas at the 2020 summit** and has generated unprecedented interest and community support, with national radio coverage on ABC radio’s PM and Margaret Throsby shows, and extensive print coverage.

healthy.me will contain an online personal health record that will allow consumers to store their personal health information, share it with those they have given consent, and utilise the available services to manage their health together as a team. We are planning several novel designs using Web and social technologies to enrich consumers’ online experience, and to provide tailored support and promote safer approaches to managing health and making decisions. We are also interested in promoting an online social environment, where consumers actively engage and interact with each other, generating networks of communities over time and tracking their behaviour on a longitudinal basis.

Construction of the *healthy.me* is underway and we are actively building collaborations with consumer groups and research partners to help us develop and evaluate the system. The first evaluations of *healthy.me* will be completed by the end of 2009.

1. National E-Health Strategy Summary: Australian Health Ministers’ Advisory Council (AHMAC), 2008.
2. Coiera E. Information Economics and the Internet. *J Am Med Inform Assoc* 2000;7(3):215-221.
3. Lau AYS, Coiera EW. Do People Experience Cognitive Biases while Searching for Information? *J Am Med Inform Assoc* 2007;14(5):599-608.
4. Lau AYS, Coiera EW. Impact of Web Searching and Social Feedback on Consumer Decision Making: A Prospective Online Experiment. *J Med Internet Res* 2008;10(1):e2.

IT SAFETY

Our Clinical Systems Safety Engineering program seeks to understand the ‘side-effects’ of information technology, and the situations in which their use might lead to unacceptable clinical risk. We employ a range of approaches including observational studies, controlled laboratory experiments and cognitive engineering models to systematically examine the safety of CDSS (computer decision-support systems).

As we approach five years since the first paper was published internationally, identifying deficiencies in the safety features of clinical software, little has changed in clinical software governance in Australia. Internationally, the lack of clear evidence about the causation of computer-related failures of CDSS on their own, or in the hands of typical users, is also hampering progress on this crucial issue. We continue to push for IT safety to be taken seriously.

Our examination of critical patient safety incidents is providing valuable insights about the causes, consequences and outcomes of computer-related failures. Analyses of 111 computer-related patient safety incidents in hospitals that were taken from the South Australian Advanced Incident Management System (AIMS) database, showed that 45% of incidents were directly related to human factors. This is the first such analysis of patient safety incidents specifically related to computers.

In partnership with St. Vincent’s Hospital we have also completed a controlled laboratory experiment to examine the safe use of electronic prescribing. Dr. Simon Li, an experimental psychologist with a doctorate from University College London has joined our team. Simon’s work is bringing valuable insights into the different kinds of errors associated with clinical tasks and their cognitive basis. Our approach to using cognitive architectures for modelling clinicians’ interactions with electronic prescribing systems received much interest at the Annual meeting of the Association for Computing Machinery Special Interest Group on Computer-Human Interaction.

In related work, we have demonstrated the feasibility of using machine learning to automatically classify critical patient safety incidents reported by health professionals. With 10% of patients admitted to hospital being harmed, critical incident monitoring systems are now central to patient safety initiatives worldwide. However, examination of adverse events and near misses to inform policy and practice for safer care is generally based upon retrospective manual classification, which is highly resource intensive limiting timely surveillance and response. Our success with the use of statistical text classification methods to identify broad classes of incidents such as clinical handover and patient identification with accuracy of 92% and 96% based on a training set of around 300 incidents indicates that these methods could be applied to identify other broad types within the thousands of incidents collected in incident monitoring system databases.

using hospitals systems **safety** culture quality healthcare staff practice health analysis patients

We successfully led a Consortium tasked by the Department of Health and Ageing to develop a national resource to improve the quality of clinical data in general practice computer systems. In partnership with the Royal Australian College of General Practitioners (RACGP), the UNSW Centre for Clinical Governance and Pen Computer Systems we designed the "Tool for Information Management Enhancement"(TIME). We sought input from clinical leaders, undertook preliminary testing of TIME with practice staff and formally consulted sixteen general practice stakeholder organisations across Australia to ensure clinical acceptability of the tool.

Our work continues to receive local interest. Dr. Magrabi was invited to write an editorial about prescribing decision support for the *Medical Journal of Australia*⁵. We received invitations to present at the ARCS (Association of Regulatory & Clinical Scientists) Annual Scientific Congress, in May 2008 and the National Forum on Safety and Quality in Health Care, October 2008, in Adelaide. Our paper on the long-term patterns of online evidence retrieval use in general practice has been selected for the "best paper selection" of the 2009 IMIA Yearbook of Medical Informatics⁶ and Dr. Magrabi received a 2009 UNSW Goldstar awarded by the Vice Chancellor to investigate the safety of computer decision support systems in general practice.

TRANSLATIONAL BIOINFORMATICS

Translational bioinformatics is the use of bioinformatics and computational biology tools, techniques and data in support of clinical decision-making.

Our technical focus is on the use of machine learning and computational discovery methods, and we are applying these in the domains of infectious diseases and human cancer.

Our Translational Bioinformatics Group has developed unique technology based upon computational grammars for the annotation, discovery and analysis of *larger-than-gene structures* in bacterial DNA. These structures, such as integrons and gene cassettes, are the primary mechanism for the spread and rapid evolution of multi-resistant bacterial strains, commonly known as "super bugs".

The WHO General Assembly recently named antibiotic resistance as one of the top three global health threats. Resistant infections are linked to excess health costs and are associated with a two-to-threefold increase in mortality. More than half of the infections acquired in hospitals in the US (more than 2 million per year) are due to antibiotic-resistant bacteria, costing up to USD \$50 billion annually (and equating to about AUD \$2.5 billion, in our population). In Australia, 12% of patients admitted to Intensive Care Units (ICU) develop severe sepsis; of these 27% die in ICU.

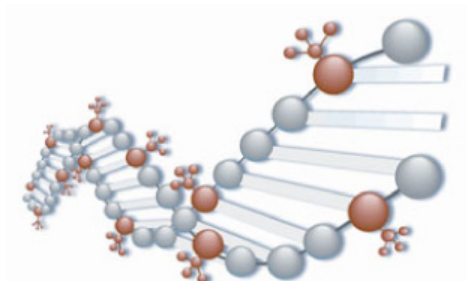
-
5. Magrabi F, Coiera E. Quality of prescribing decision support in primary care: still a work in progress. *Med J Aust.* 2009 Mar 2;190(5):227-8.
 6. Magrabi F, Westbrook JI, Kidd MR, Day RO, Coiera E. Long-Term Patterns of Online Evidence Retrieval Use in General Practice: A 12-Month Study. *J Med Internet Res.* 2008;accepted Feb 2008.

Working with our close partners at the Centre for Infectious Diseases and Microbiology at Westmead Hospital, our system has discovered two new gene cassettes and has facilitated the largest survey of resistance gene cassettes ever undertaken, which has been published in the prestigious *FEMS Microbiology Reviews* journal⁷.

An exciting new collaboration with researchers from Tel Aviv University in Israel was established with the goal of developing the world's first genetic antibiotic prescription decision support system, and building on the work we have already done on identifying the mobile genetic elements associated with antibiotic resistance. We hosted three visiting students from Aalborg University in Denmark and Fachhochschule Weihenstephan in Germany to work on this project in 2008.

Our interest in human cancer focuses on epigenetic mutations which are inheritable changes to DNA that don't change the code or sequence of bases. The addition of a small chemical compound – a methyl group – in select regions of DNA can turn off or silence genes and result in some forms of cancer. Scientists from the Garvan Institute have recently discovered that methylation is not always isolated to individual genes but can operate on long stretches of the human genome, and such *long-range methylation* is associated with at least one type of cancer.

Genome-wide *in vitro* investigation for epigenetic variation of the entire human genome for many types of cancer is estimated to cost over \$100 million and would take at least 6 years. We have established a new collaboration with geneticists from the Garvan Institute to develop automated mechanisms to identify regions of the human genome where long-range epigenetic gene silencing may cause cancer. We intend to reduce the amount of DNA sequence that needs to be explored by scientists by one thousand fold, thus reducing the number of biological assays required and cutting research time by a third.



7. Partridge, S. R.; Tsafnat, G.; Coiera, E. & Iredell, J. R. Gene cassettes and cassette arrays in mobile resistance integrons *FEMS Microbiol Rev*, 2009, in press, accepted 18/02/2009



BIOSURVEILLANCE

Our program of biosurveillance research is focused on developing new approaches to rapidly detecting and responding to outbreaks of communicable diseases.

Working with Centre for Infectious Diseases and Microbiology at Westmead Hospital, the biosurveillance team has explored three different approaches to infectious disease surveillance (1) laboratory initiated infectious disease notification, (2) syndromic surveillance based on health indicators, and (3) genotyping based surveillance of biothreats. Our central argument is that co-ordination syndromic and laboratory surveillance can optimise the detection and monitoring of biothreats. This merging of three distinct approaches offers a new opportunity to develop effective and rapid biosurveillance methods.

We have specifically been focusing using genotype data, enabled by advances in molecular diagnostics and rapid genotyping of biothreats. We introduced a set of definitions of a disease cluster based on temporal and spatial associations between genotypes of pathogens⁸. These clusters can be adjusted to reflect changes in local disease prevalence and the availability of public health resources. Our prospective studies of community outbreaks of food borne salmonellosis have shown a significant enhancement in the detection of these moderate and small epidemics, which are often the hardest to detect. A web-based

biosurveillance system, which includes temporal and temporo-spatial clustering of genotypes, is currently in development.

In related work, our analysis of syndromic presentations to the Westmead ED has generated clinical decision rules that can improve the choice of point-of-care pathology testing and can lead to a reduction in patient length of stay. Specifically, we assessed the utility of chief complaints data to guide point-of-care testing (POCT) and demonstrated that diagnostic algorithms based on chief complaints data can improve the POCT utilisation in ED and patient outcomes, by selecting patients for targeted testing. Naïve Bayes classifiers generated a diagnostic POCT algorithm for legionellosis that predicted positive urine antigen result with 95% accuracy based on presence of headache, dyspnea and being a male over 60 years old.

Results of our research are being published in the leading journals in the field of infectious diseases (3 papers and 2 book chapters) and presented at major national and international conferences (5 presentations). Dr Vitali Sintchenko was invited to deliver keynotes on biosurveillance at the Wellcome Trust "Applied Bioinformatics and Public Health" conference in Cambridge, UK, in August of 2008. Dr Vitali Sintchenko has been also invited by Springer Life Sciences to edit the first text on Infectious Disease Informatics which will be published in 2009.

8. Gallego B, Sintchenko V, Wang Q, Hiley L, Gilbert GL, Coiera E. Biosurveillance of emerging biothreats using scalable genotype clustering. *Journal of Biomedical Informatics* 2009;42(1):66-73.

BIOMEDICAL TEXT MINING

The Centre is engaged in several text mining projects that aim to improve the quality of decision-making in health. Text mining exploits computational approaches to natural language understanding and machine learning to extract information from texts such as patient records or biomedical journal papers.

The importance of text mining is increasing given the complexity of the biosciences and the wealth of information embedded in text scattered across different domains. By integrating such information we hope to provide clinicians and consumers with concise, relevant, and timely information that contributes to improved patient outcomes.

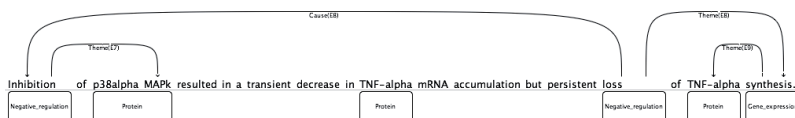
One strength area of our text mining group is the extraction of key facts from journal report of Randomised Controlled Trials (RCT)⁹. This is an important task, given that these studies constitute the most reliable form of evidence available to practitioners. The automatic extraction and linking of evidence related to interventions and experimental findings has many applications. These applications include not only the decision support tools made available to practitioners but also the potential for new scientific discoveries. We are currently working on building summaries of RCTs in the form of decision trees, which can then be used in decision support systems¹⁰.

Relationship extraction is another key area of the biomedical text mining group. Identifying the cause and effect of biological events plays an important role in the discovery of causal pathways that hold the key to unlocking the processes by which diseases and infections occur.

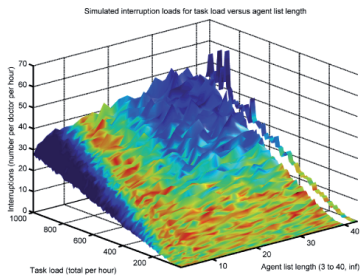
We are working with the support of a grant from the Cerebral Palsy Institute to explore the different causal pathways that may underpin the development of cerebral palsy. The hope is that we may 'join the dots' between different islands of medical knowledge to uncover new causal pathways, that can then be verified by researchers.

Extracting such biological events from research texts relies on the recognition of named entities such as proteins, genes, RNA, and DNA. Biomolecular events related to these entities are then identified through the use of NLP methods such as syntactic parsing and semantic processing. The relationships extracted from textual sources are then compiled into structured resources such as networks and databases that are more readily digested by practitioners and researchers.

Unlike other **Comparisons** **antiarrhythmic class I drugs** **Comparison**, **Intervention** **amiodarone** **Intervention** showed in preliminary studies, benefits also in **Patients** **patients with left ventricular dysfunction** **Patient**. These positive results have induced the development of large randomised controlled studies: their results are reviewed and the controversial points are discussed. In a meta-analysis of randomised controlled trials the use of **Outcome** **amiodarone in heart failure was associated with an approximate 20 to 25% reduction in deaths** **Outcome**. However, **Harm** **amiodarone was also associated with a 120 to 124% increase in side effects** **Harm**.



9. Chung G. Sentence retrieval for abstracts of randomized controlled trials. *BMC Medical Informatics and Decision Making* 2009;9(1):10.
 10. Chung G, Coiera E. Are decision trees a feasible knowledge representation to guide extraction of critical information from randomized controlled trial reports? *BMC Medical Informatics and Decision Making* 2008;8(1):48.



MODELLING AND SIMULATION IN HEALTH

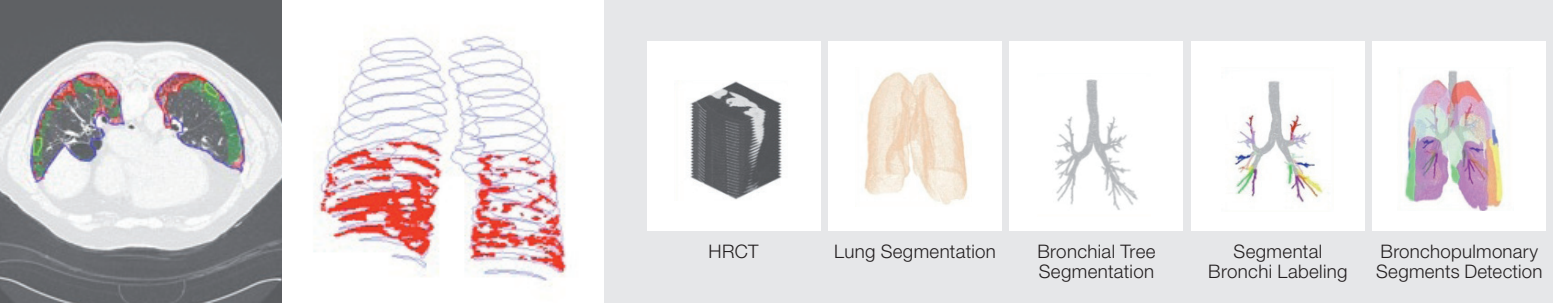
For many years scientists and engineers have used modelling and simulations of complex dynamic systems for the purpose of analysis, training and prediction. Given the complex and multi-scale nature of health systems, there is now growing interest in using computer models to represent our best understanding of the nature of healthcare delivery. At CHI we develop leading-edge applications for the purposes of improving patient safety and patient care, bringing together expertise in healthcare, medicine, IT, mathematics and social science.

Our health systems are under stress from an ageing population and advances in expensive medical technology and drug therapies. Isolated solutions have become obsolete and new methods to inform changes in management and practice are required. For example, it is now internationally accepted that there are significant problems with the safety and quality of healthcare delivery, and that 10% of admissions to acute care hospitals are associated with an adverse event.

Current measures to address preventable adverse events do not work because a) they fail to capture the complex and dynamic behaviour that arises from the interaction of individual actions and/or system components, and b) they lack the necessary knowledge derived from good quality and comprehensive data. We intend to address these shortcomings by using modelling and simulations that are driven by the best available empirical data to help identify practices and organisational components that fail tests of safety and quality. We use these models as predictive tools to guide research and policy about the safety and quality remedies most likely to succeed in given contexts. Some of our specific research projects include:

- > A model of health system safety that integrates our best knowledge of healthcare delivery and is set up to predict the likely effects of new safety and quality interventions.
- > A simulation-based model of interruptions and multitasking between doctors in a hospital unit. This model looks at the effect of patient load, staffing levels, communication cultures and policies on efficiency and safety.
- > A health systems simulation that acts as a decision support tool for managing Methicillin-resistant *Staphylococcus aureus* (MRSA) in hospitals. This tool integrates the different spatial and time scales involved in hospital infection control and explores the role of simulations in aiding decisions that take place in dynamic and complex environments.
- > Tools to test whether health decision makers are able to determine a correct simulation from an incorrect one and how this is influenced by the level of feedback complexity inherent in the decision task.

Our work takes place in collaboration with key players in the research of healthcare quality and safety including: our colleagues at the Centre for Clinical Governance Research in Health and the Simpson Centre for Health Services Research at UNSW, the Health Informatics Research & Evaluation Unit at the University of Sydney, the Australian Patient Safety Foundation and St Vincent's Hospital. Our research also aims to inform government health organisations such as the Australian Commission on Safety and Quality in Health Care and the Australian Institute of Health and Welfare.



IMAGING INFORMATICS

Computerised image analysis is an essential part of the rapidly developing field of imaging informatics. Imaging informatics includes the full range of activities from image formation and storage to image analysis, exchange and utilization. Its main goal is to improve the efficiency, accuracy and reliability of radiologic services. Our research focuses on computer-aided disease detection, image interpretation and three-dimensional visualization.

A computer-aided detection system can assist radiologists by analysing images and suggesting regions of interests that contain abnormal patterns e.g. suspicious regions of interest that might have overlooked. Currently we are working on a system for the detection of disease patterns demonstrated on HRCT images of the lung. To automate image analysis we use background knowledge such as that used by radiologists, such as the anatomical structure of the lungs. Anatomical features and landmarks are first extracted from images¹¹. This information, together with the structure and regions of the lung that are stored in a model of the lungs, is used in detecting disease patterns¹². Rules for recognizing different disease patterns are generated using machine learning.

System performance has been evaluated for detecting structural deformation of the bronchial tree and fibrotic changes of lung parenchyma. With our novel method for determining lung segments¹³, we are able to segment the smallest lung structures, which provide very useful

anatomical information for detection of diseases. Our techniques achieve an average 97% accuracy in segmenting the anatomy. Results for detecting and quantifying Bronchiectasis, which relies on detecting broncho-vascular pairs, are 89% accuracy for bronchial dilatation assessment and 93% for adjacent artery detection. Classification accuracy for detected and quantifying patterns showing fibrotic changes of the lung parenchyma – Honeycombing reaches 94.5% on previously unseen cases. The results show that the system is able to recognize potential lung abnormalities and indicate their size and location. We are performing extensive evaluation of the system and its components to be able to use it in a clinical trial. We are also exploring the potential for using the developed techniques for analysis of HRCT images in the other areas, for example CT based radiation therapy planning.

We have performed a preliminary study applying our modelling and segmentation techniques to HRCT images of the prostate. In collaboration with radiologists of the Prince of Wales Hospital and Liverpool Hospital, the Liverpool Cancer Therapy Centre, we are developing a model-based image segmentation technique for prostate cancer radiation therapy planning. The method is based on templates and stratified atlases generated from an existing database of manually segmented images. A study was performed on data from 40 patients, which were treated with radiation therapy and preliminary results are encouraging.

11. Zrimec T and Busayarat S, A System for Computer Aided Detection of Diseases Patterns in High Resolution CT Images of the Lungs, in Computer-Based Medical Systems, CBMS '07. 2007. p. 41-46.

12. Zrimec T, Busayarat S, and Wilson P. A 3D model of the human lung with lung regions characterization. Paper presented in ICIP 2004 Proc. IEEE Int. Conf. on Image Processing. Singapore. 2004

13. Busayarat S, Zrimec T, "Detection of Bronchopulmonary Segments on High-Resolution CT – Preliminary Results", 20th IEEE International Symposium on Computer-Based Medical Systems, CBMS 2007, Maribor, SLO, June 2007, pp-199-204.

Statement of Financial Performance

FOR THE YEAR ENDED 31 DECEMBER 2008

	2008	2007	Notes
	\$	\$	
Income			
External Funds	1,591,899	1,082,865	1
Faculty Contribution	497,879	491,797	
UNSW Contribution	0	67,450	
Total Income	2,089,778	1,642,112	

Expenses			
Payroll	1,554,661	1,154,282	2, 3
Equipment	30,352	18,897	
Materials	170,560	154,524	
Travel	52,051	51,364	
Total Expenses	1,807,624	1,379,067	

Operating result	282,154	263,045	
Surplus(Deficit) Bfwd from Prior Year	1,256,984	993,939	4
Accumulated Funds Surplus(Deficit)	1,539,138	1,256,984	

Notes to the Statement of Financial Performance

1. Three new substantive research grants from HCF Medical and Research Foundation, Cerebral Palsy Institute and the Commonwealth Department of Health & Ageing
2. Six Research Fellows and a Senior Software Engineer were recruited in 2008
3. Stipends for 4 PhD students to the value of \$132,440 included in payroll in 2008
4. Surplus in agreement with UNSW financial statements

Management Committee

COMMITTEE ROLE

The management committee's role is to monitor the financial performance of the centre and ensure that the business objectives of the centre are pursued. The committee meets at least three times a year and meetings are properly minuted and distributed to committee members.

COMMITTEE MEMBERS

Professor Denis Wakefield (Chair)

Professor Paul Compton

Professor Gavin Andrews

COMMITTEE MEETINGS 2008

16 April 2008

7 July 2008

29 September 2009

Staff



Professor Enrico Coiera
Director



Dr Tatjana Zrimec
Senior Lecturer



Gerard Viswasam
Business Manager



Dr Grace Chung
Senior Research Fellow



Dr Guy Tsafnat
Senior Research Fellow



Dr Blanca Gallego
Research Fellow



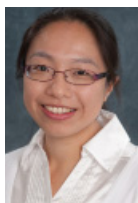
Dr Farah Magrabi
Senior Research Fellow



Dr Geoff McDonnell
Research Fellow



Dr Hieu Phan
Research Fellow



Dr Annie Lau
Research Fellow



Dr Adam Dunn
Research Fellow



Dr Vitali Sintchenko
NICS Research Fellow



Jance Ooi
Administrative Assistant



Denise Tsiros
Finance &
Administration Officer



Danielle Del Pizzo
Administrative &
Executive Assistant



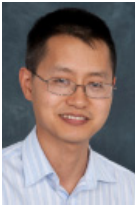
Mahmood Akhtar
Research Associate



Dr Stephen Anthony
Computational Linguist



Farshid Anvari
Software Engineer



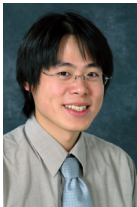
Vitaliy Kim
Java/Jee Programmer



Jay Liu
Java/Jee Programmer



Jingbo Liu
Java/Jee Programmer



Frank Lin
PhD Candidate



Mei Sing Ong
PhD Candidate



Rosemarie Sadsad
PhD Candidate



Zafar Hashmi
PhD Candidate



Jaron Schaeffer
PhD Candidate



David Lyell
PhD Candidate

Line Sanden
Visiting Master Student

Ninna Kæseler
Visiting Master Student

Melanie Wolfe
Visiting Master Student

Janaka Abeysirigunawardana
Masters Student

Grants

NHMRC Program Grant: Patient Safety: enabling and supporting change for a safer and more effective health system

Investigators: Professors J Braithwaite, J Westbrook, E Coiera, WB Runciman, RO Day
Funds: 2009-2013 \$8,400,000

Capacity Building Infrastructure Grants Program Round 2

Funding source: NSW Health
Investigator: Professor E Coiera
Funds: 2006 \$234,041
2007 \$459,058
2008 \$446,755
2009 \$442,000

Agent-based methods for communication system design in complex organizations

Funding source: Australian Research Council (ARC) Linkage Grant LP0775532
Investigators: Professor E Coiera, Professor J Westbrook, Professor W Wobcke, Dr F Magrabi
Funds: 2007 \$182,156
2008 \$202,156
2009 \$169,882

A knowledge-based approach to multi-document text summarization for automated meta-analysis of the scientific literature

Funding source: Australian Research Council (ARC) Discovery Grant DP0666600
Investigators: Professor E Coiera, Professor J Westbrook
Funds: 2006 \$118,000
2007 \$108,000
2008 \$110,000

Engineering safe decision support systems for healthcare

Funding source: Australian Research Council (ARC) Discovery Grant DP0772487
Investigator: Dr F Magrabi
Funds: 2007 \$74,887
2008 \$82,521
2009 \$85,781

Informatics approaches to improving risk assessment and responses to outbreaks of communicable diseases

Funding sources: Australian Research Council (ARC) Linkage Grant LP0667531, NSW Health, Commonwealth Department of Health and Ageing

Investigators: Dr V Sintchenko, Professor E Coiera, Professor G L Gilbert

Funds:	2006	\$154,000
	2007	\$142,000
	2008	\$57,000

HCF Foundation PhD scholarships in health systems improvement through “in silico” simulation experiments

Funding source: HCF Health and Medical Research Foundation

Investigator: Dr G McDonnell

Funds:	2006	\$50,001
	2007	\$66,666
	2008	\$66,666

An Independent National Clinical Evidence Service

Funding source: HCF Health and Medical Research Foundation

Investigator: Professor E Coiera

Funds:	2008	\$509,197
	2009	\$479,658

Accelerating our understanding of the causal pathways to Cerebral Palsy with a computer supported discovery system

Funding source: Cerebral Palsy Institute

Investigator: Professor E Coiera, Dr G Chung

Funds:	2008	\$40,000
	2009	\$40,000

UNSW Goldstar Award

Safety of computer decision support systems in general practice

Funding Source: UNSW
 Investigator: F Magrabi
 Funds: 2009 \$30,000

Faculty Research Grant

A study of the reporting of adverse events in randomized controlled trials.

Funding Source: Faculty of Medicine
 Investigator: Dr G Chung
 Funds: 2008 \$30,000

Contract: General practice information management and information technology capacity building resource

Funding body: Commonwealth Department of Health and Ageing
 Consortium: CHI, Royal Australian College of General Practitioners, UNSW Centre for Clinical Governance Research, Pen Computer Systems
 Funds: 2008-9 \$291,100

Contract: Improving learning from patient safety incidents

Funding body: Australian Commission on Safety and Quality in Health Care
 Consortium: The Australian Patient Safety Foundation; University of South Australia's Human Factors and Safety Management Systems Group; CHI, Joanna Briggs Institute and Communio Pty. Ltd.
 Funds: 2008 \$203,000

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Lyell D, Sadsad R, Gorgiou A, Health Systems Simulation, Health Systems Simulation, Wickramasinghe N and Geisler E editors, *Vol. II Medical Information Science Reference*, Hershey New York.

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science change analysis online **patient** tool study
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safety medical model system microbiology identity
pattern **care hospital incident** policy **chi** modelling explore social biosurveillance cognitive
clinical consumer management **text** translational **simulation journal**
bioinformatics research search infectious datum knowledge
complex **control international trial gene method** detection **disease**
institute discovery university **health** internet **decision** association quality improve
cancer **national image healthcare practice** retrieval human medicine
computer information lung



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