

Submission for the Australian Digital Health Agency on the National Digital Health Strategy by Cumberland.au

Signatories

Name	Title	Organisation
Professor Robert Adams	Professor in the Discipline of Medicine	University of Adelaide, Faculty of Health and Medical Sciences
Professor Campbell Thompson	Professor in the Discipline of Medicine	University of Adelaide, Faculty of Health and Medical Sciences
Professor Jon Karnon	Professor in School of Population Health	University of Adelaide, Faculty of Health and Medical Sciences
Professor Leonid Churilov	Head, Statistics and Decision Support Platform Honorary Professor Adjunct Professor	Florey Institute of Neuroscience and Mental Health University of Melbourne RMIT University
Dr Kathryn Zeitz	Associate Director	Health Outcomes International
Dr Mark MacKay	Acting Head, Health Care Management	School of Medicine, Flinders University
Dr Shaowen Qin	Senior Lecturer	Flinders University School of computer science, engineering and mathematics
Mr Keith Stockman	Management Consultant	Iridium Consulting Pty Ltd
Mr Peter Bodon	Director	The Simulation Group
Mr Ian Gibson	Founder	Healthcare Delivery Modelling

Contents

Executive Summary.....3

About Cumberland.au.....4

Computer simulation4

Computer simulation in healthcare.....5

A model for diffusion of computer simulation in healthcare in Australia7

Proposal8

Scale of operation9

Executive Summary

Computer simulation modelling is a digital technology that can improve the delivery of patient care, job design and reduce costs.

This technology has been used to improve quality, efficiency, safety, productivity and customer focus in other sectors for decades. Similar benefits to the Australian health sector can be delivered rapidly through leadership and investment by the Australian Digital Health Agency. The technology enable models to link the medical research findings, social determinants of health, prevention, models of care, capital investment and operating costs.

Computer simulation uses development of virtual models to enable understanding of systems and development of improved systems. This technology is often confused with the use of simulators using manikins and computers to train clinical staff.

This submission is by the Cumberland.au. This is a collaborative of clinicians, academics and industry practitioners that is developing and promoting the use of systems thinking, operations research, predictive analytics and computer simulation in healthcare. Signatories include professors of medicine, nursing and mathematics. These technologies are being adopted in the US, UK and Europe.

Cumberland.au proposes that the Australian Digital Health Agency includes the diffusion of computer simulation technology in the National Digital Health Strategy through inclusion of the following:

1. Establish an Advisory Group on Computer Simulation including representatives of patients, clinicians, health service managers, change management, simulation engineers and project managers.
2. Develop and implement a ten-year plan for development and diffusion of these technologies into healthcare.
3. Budget funding to enable resourcing of the central coordination.
4. Implementation through research, training programmes and exemplar projects.
5. Provide research grants to advance the development of computer simulation in healthcare. Current research grants focus on life science and clinical practice rather than health system reform.
6. Collaborate with Australian and International partners to support the adoption of this technology.
7. Enable opportunities to market this approach internationally.

The potential benefits from such as strategy warrants consideration of a scale of operation comparable with the Agency's current budget. The Strategic Review of Health and Medical Research in Australia estimated that waste and adverse events cost are 20 to 30% of the cost of healthcare in Australia.¹ If Australia's health system was as effective and efficient as Japan and France, the cost would be reduced approximately 23% with increased life expectancy². The suggested strategy may provide the key to achieving a significant part of these savings and benefits. The mechanism for achieving the benefits include developing systems views, improved access to services, better

¹ Department of Health and Ageing. Strategic Review of Health and Medical Research. Canberra : Australian Government, 2013.

² Bloomberg. Bloomberg. Most Efficient Health Care 2014: Countries.
<http://media.bloomberg.com/bb/avfile/rhpTqieX4Fuc>.

designed jobs, reduced capital and operating costs, and transformation of research into healthcare services.

About Cumberland.au

Cumberland.au was formed in May 2014 by multi-disciplinary group of Australian academics and industry experts with a strong interest in health care modelling, service improvement and design, and passion to create a better health care system for patients, health care professionals and the wider community.

The founding membership base includes a mix of 19 clinicians, academics and industry consultants, and advisors across Australia. They stem from medicine, medical science, engineering, mathematics and statistics, computer science, psychology, business and health care management.

Cumberland.au has shares objectives and has established linkage with the UK Cumberland Initiative (www.cumberland-initiative.org)

"We can't solve problems by using the same kind of thinking we used when we created them." - Albert Einstein

Most have been working in health care or tackling health care problems for many years. We see the need for innovative thinking to improve healthcare in Australia. We have been involved in promotion, advocacy and application of systems and design thinking; operations research; predictive analytics and computer simulation in health in South Australia, Victoria, New South Wales and Tasmania.

Computer simulation

Computer simulation is a digital technology that enables a deep and shared understanding of complex systems that can enable experimentation to optimise the design of health services and facilities. Computer simulation has evolved over the last 50 years. Techniques include system dynamics, discrete event and agent based modelling. These are now merging into multi modal modelling. Computer simulation models can represent complex systems including resource constraints, variation, dynamics and interdependence. The result of the simulation is data and animations of the operation of the system. Models must be developed and validated in collaboration with clinicians and executives working with operations research practitioners. Validation of the model shows the results are reasonable representations for the purpose of the model and experimentation. Experiments enable systems to be understood, improved and optimised in collaboration with clinicians and executives. These experiments can be carried out in a risk free environment. By modelling the system unintended consequences can be identified. In addition the model helps describe visually the outputs of the intended change in an easily understood way.

"Computer simulation is this mind-blowing advance that will increase the rate of innovation." - Bill Gates

Computer simulation is widely used in science including astrophysics, particle physics, materials science, engineering, fluid mechanics, climate science, evolutionary biology, ecology, economics, decision theory, medicine, sociology, epidemiology, and many others³.

Computer simulation is often confused with training of clinicians with simulators consisting of mannequins, supporting computer systems and involving role play.

A US Government strategy paper describes the technologies position in science:

³ Stanford Encyclopaedia of Philosophy Computer simulation in science
<https://plato.stanford.edu/entries/simulations-science/>.

“Modelling and simulation has for some time been seen as a true peer, standing beside theory and experiment, in the scientific process.

Data-intensive computing is beginning to emerge as a separate discipline and is being viewed by some as a “fourth paradigm” for scientific discovery, complementing discoveries made by theory, experiment, and simulation.

Thus, for many scientific disciplines, the issue is not whether to use data or simulation, but how the two will be used together.”⁴

The wide use of computer simulation is shown by the tracks / themes at a recent leading international conference on computer simulation.

- Social and Behavioural
- Environmental and Sustainability Applications
- Healthcare
- Manufacturing
- Logistics, Supply chain management and Transportation
- Military and Emergency Response
- Networks and Communication
- Project Management and Construction⁵

In Australia we know that computer simulation is widely used in defence, mining, transport and telecommunications.

Computer simulation in healthcare.

Healthcare in Australia faces enormous challenges including increasing costs, an ageing population, workforce shortages, changing technology and developments in health science. The existing system is fragmented and it needs redesign to meet current demand. Access, quality and safety of care need to be improved. Computer simulation provides a powerful, relatively cheap and very safe tool to develop sustainable solutions to all these challenges.

The potential of systems engineering methods including computer simulation to improve healthcare delivery was recognised in the 2005 report by the US National Academy of Sciences, Building a Better Delivery System: A New Engineering/Health Care Partnership.

“Systems-engineering tools have been used in a wide variety of applications to achieve major improvements in the quality, efficiency, safety, and/or customer-centeredness of processes, products, and services in a wide range of manufacturing and services industries. The health care sector as a whole has been very slow to embrace them, however, even though they have been shown to yield valuable returns to the small but growing number of health care organizations and clinicians that have applied them”.⁶

⁴ Future Directions for NSF Advanced Computing Infrastructure to Support U.S. Science and Engineering in 2017-2020: Interim Report 2014 <https://www.nap.edu/catalog/18972/future-directions-for-nsf-advanced-computing-infrastructure-to-support-us-science-and-engineering-in-2017-2020>.

⁵ Winter Simulation Conference 2016 <http://meetings2.informs.org/wordpress/wintersim2016/tracks/>

³ 28 May 2013 Source: Q&A ABC <https://www.youtube.com/watch?v=Edhd9WIIpmY>

⁶ Building a Better Delivery System: A New Engineering/Health Care Partnership Proctor P. Reid, W. Dale Compton, Jerome H. Grossman, and Gary Fanjiang, Editors, Committee on Engineering and the Health Care System, National Academy of Engineering, Institute of Medicine 2005 <http://www.nap.edu/catalog/11378.html>

An overview of the use of a computer simulation technology in healthcare clinics and integrated healthcare systems over 40 years concluded that:

“Discrete-event simulation offers perhaps the most powerful and intuitive tool for the analysis and improvement of complex health care systems.”⁷

The success of the development of the Leg Ulcer Telemedicine Project in the UK illustrates the use of computer simulation in service improvement. The project resulted in better patient care, improved job satisfaction for staff and lower cost. The project was recognised by awards for the innovative use of IT in healthcare.⁸

A review of the use of computer simulation in Health Care in 2011 concluded that:

“Computer simulation offers a diverse, powerful and flexible set of tools for the analysis and improvement of healthcare systems.”

“As simulation has found routine use in many industries, it can be expected to be used routinely in healthcare, especially as the need to deliver efficient and cost effective healthcare continues to demand attention.”

“In healthcare, the modeller must work as a member of a team and address the needs and interests of the various stakeholders. To this end, new educational programmes will be needed to train and educate people who understand both modelling and healthcare.”⁹

Major healthcare organisations known to use computer simulation internationally include the US Defense Health Agency, Mayo Clinic, Johns Hopkins, NHS Wales and US health architects. In Australia, Cumberland.au has had discussions with the SA Health about the establishment of health care modelling units that will work with hospitals to undertake simulation and operations research; St Vincent’s and the Sax Institute have made limited use of computer simulation.

The US Defense Health Agency has adopted the use of computer simulation for design of infrastructure. They have commenced a \$9.8 million study to develop the strategy to roll out this approach across their system that services 10 million people. A consultant has used computer simulation on 42 capital projects, reports a return on investment in using the approach of \$10 to \$20 for each \$1 invested.¹⁰

⁷ Source: Discrete-Event Simulation of Health Care Systems, Sheldon H. Jacobson, Shane N. Hall and James R. Swisher http://link.springer.com/chapter/10.1007%2F978-0-387-33636-7_8#.

⁸ Three Wins: Service Improvement using value stream design. Simon Dodds https://books.google.com.au/books?id=7qykNKHZHHcC&pg=PA69&lpg=PA69&dq=three+wins&source=bl&ots=hr_sBRNWFq&sig=SKsBYMPRIIOS1DMhhjuFUjMJYsg&hl=en&sa=X&ved=0ahUKEwjvgf7--v7QAhUFjpQKHeebDNEQ6AEIRTAK#v=onepage&q=three%20wins&f=false.

⁹ Computer Simulation in Health Care, Sean Carr and Stephen D. Roberts, An Introduction to Optimization Models and Applications in Healthcare Delivery Systems, Wenhua Cao and Gino J. Lim Handbook of Healthcare delivery systems edited by Yuehern Yin CRC Press 2011 <https://www.crcpress.com/Handbook-of-Healthcare-Delivery-Systems/Yih/p/book/9781439803332>.

¹⁰ Morgareidge David L. Comprehensive Operational Modeling and Simulation Policy Development: Private Sector Healthcare Systems and the US Military Healthcare System Winter Simulation Conference 2015, http://informs-sim.org/wsc15papers/by_area.html#ptrack110

Activities in healthcare that would benefit from use of computer simulation include:

Patient outcomes	Information technology
Design of jobs	Technology assessment
System management	Population health
Service redesign	Medical decision making
Service planning	Workforce planning
Facility design	Education and training

The application of computer simulation in healthcare is shown by the list of topics covered in that same conference:

Admissions and control	Epidemic modelling
Ancillary services	Medical decision making
Appointment scheduling	Outpatient access
Emergency room access	Outpatient capacity analysis
General healthcare simulation	Payment/Payer models
Global Health	Performance improvement models
Optimization	Pricing models
Healthcare systems	Resource scheduling

11

A model for diffusion of computer simulation in healthcare in Australia

Widespread use of computer simulation in healthcare is an innovation that needs to be developed and efficiently diffused through the healthcare sector to enable the benefits to be achieved as early and effectively as possible. Health is a complex system with many stakeholders requiring a strategic approach and investment to achieve the benefits.

Success in diffusion of the technology needs to consider a number of factors. A systematic literature review for the UK Department of Health developed a model for diffusion of services innovations that is relevant to large scale implementation of computer simulation in healthcare in Australia.

The resulting conceptual model includes the following:

- The innovation
- System antecedents for innovation
- System readiness for innovation
- Adopter – needs, motivation, skills
- Assimilation
- Communications and influence
- Implementation process
- Linkages
- Outer context¹²

That model provides a basis for diffusion of computer simulation in healthcare in Australia.

¹¹ Winter Simulation Conference 2016 <http://meetings2.informs.org/wordpress/wintersim2016/tracks/>.

¹² (Source: Diffusion of Innovations in Service Organisations: Systematic Review and Recommendations, 2004 Trisha Greenhalgh, Glenn Roberts, Fraser MacFarlane Paul Bate and Olivia Kyriakidou, Milbank Quarterly. <https://www.ncbi.nlm.nih.gov/pubmed/15595944>

Proposal

Cumberland.au proposes that the Australian Digital Health Agency lead the diffusion of the use of computer simulation in healthcare in Australia.

The purpose of the diffusion of computer simulation is to enable the Australian health system to:

- deliver high quality healthcare to patients,
- design roles that attract and retain staff and
- become a financially sustainable healthcare system.

The benefits to stakeholders expected are:

- Patients having improved access to high quality healthcare.
- Staff jobs being better designed to cope with the challenges of healthcare services.
- Clinicians understanding the need to change the system and participate in the development of an improved health system. Simulation provides a transparency in communicating the need and effect of reform.
- Health organisations in managing the risks of change and financial sustainability of the system.

The principles of the approach are:

- always providing patient centred high quality healthcare
- developing staff capability with healthcare operations research and in particular in using computer simulation
- supporting implementation through a knowledge management and a support office.

The diffusion must include the project management of the computer simulation study and implementation facilitation of any mooted change.

Implementation of this approach will depend on harnessing the established knowledge in healthcare and in computer simulation; knowledge that is available particularly in universities and consultancies. The state and federal health agencies would facilitate the diffusion of the technology to the operational areas and engage local managerial and clinical enablers. The Federal and State Governments would be the purchaser of services. The health service delivery agencies would implement at the operational level. It is critical for success, accuracy, feasibility, relevance and efficacy that clinicians and managers responsible for delivery of services are involved in the computer simulation studies and support implementation.

The diffusion of computer simulation would be implemented through the following activities:

- Training of clinicians and managers in computer simulation to enable them to collaborate and apply the technology.
- Training computer simulation specialists to enable engagement, liaison and to work with clinicians and managers in computer simulation projects.
- Research and development of computer simulation methods for healthcare.
- Collection of data and maintenance of a data base to enable use of knowledge from projects.
- Communication with stakeholders to engage and support implementation.
- Funding of computer simulation studies and monitoring progress and implementation.
- Collecting and sharing lessons learned.
- Carrying out research on the impact on healthcare delivery.

Cumberland.au proposes that the Australian Digital Health Agency includes the diffusion of computer simulation technology in the National Digital Health Strategy.

The following steps outline the preliminary strategy for diffusion of computer simulation:

1. Establish an Advisory Group on Computer Simulation including representatives of clinicians, change manager, computer simulation experts and project managers.
2. Establish expert advisory committee including patients, clinicians, health service managers, change management and simulation and project managers.
3. Develop and implement a ten-year plan for development and diffusion of these technologies into healthcare.
4. Budget funding to enable resourcing of the central coordination.
5. Implementation through research, training programmes and initially exemplar projects.
6. Provide research grants to advance the development of the computer simulation in healthcare. Current research grants focus on life science and clinical practice rather than health system reform.
7. Collaborate with Australian and International partners to support the adoption of this technology.
8. Enable opportunities to market this approach internationally.

Scale of operation

The potential benefits of widespread use of these technologies in healthcare warrant consideration of an investment equal to the current investment in digital health. The Budgeted Expenses for the Digital Health Agency in 2016-17 is \$168 million.¹³

The following provides an indication of the scope and benefits of adoption of computer simulation in the Australian health system.

Current annual cost of healthcare	\$162 ¹⁴	billion per annum
Improvement anticipated per annum	5%	
Annual cost saving target	8 billion	
Return on investment	\$5 saving for each \$1 invested	Considered conservative compared with 10 to 20 achieved in some capital projects
Time to achieve benefit	10 years	
Annual investment	\$160 million	

The development and implementation of the programme is expected to take 2- 3 years.

¹³ Australian Digital Health Agency Entity Resources and Planned Performance

¹⁴ AIHW 2016. Health expenditure Australia 2014–15. Health and welfare expenditure series no. 57. Cat. no. HWE 67. Canberra: AIHW.