AUSTRALIAN HEALTHCARE DESIGN 2000–2015

A critical review of the design and build of healthcare infrastructure in Australia

Design &Health
International Academy for Design and Health

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Acknowledgements

The board of the International Academy for Design & Health would like to acknowledge the visionary and expert efforts of all those involved in the planning, procurement, design, construction, engineering and operations of the many projects featured in this publication.

We are indebted to Kate Copeland who skillfully managed the role of guest editor to provide leadership and local knowledge in the development of the book, and to the expert opinion and intellectual contribution of the authors of the essays.

We would also like to give a special thanks to the Kathleen Armstrong and Emily Brooks whose technical editorial expertise and attention to detail guaranteed the quality of the publication, and to Adam Arnold, Jo Fenwick, Danielle Ward and the team at Graphic Evidence for their high standards of professionalism, creativity and imagination.

Marc Sansom, chief operations officer,
International Academy for Design & Health

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Preface

Australian Healthcare Design 2000–2015 is a review of past, current and future projects and trends in healthcare design in Australia. It is a unique reference publication for researchers and practitioners working in the field of healthcare design, both within the region and internationally.

Fronted by a collection of essays from prominent Australian academics and practitioners, it also contains a comprehensive catalogue of projects delivered during the most remarkable period of capital investment in health infrastructure ever seen in the region.

The publication coincides with the International Academy for Design & Health's 9th World Congress in Brisbane in July 2013. Australia's successful bid to host the event reflects the huge amount of new healthcare building that is taking place across the region, and the body of research and knowledge that has developed there as a result.

Many of these experts will be represented at the congress, but this book aims to communicate to the rest of the world that the region has some of the most advanced healthcare buildings of our time. It will add to the ongoing dialogue that the Academy has developed over the last two decades – an international, interdisciplinary knowledge-sharing network.

Design and health is changing. In Australia, as healthcare experiences an incredible revival; from a once-traditional stance, it is now creating inspiring healthcare environments that attract users with fascinating, inspirational spaces that support the healing process and promote health. Over the last 15 years, the philosophical shift in thinking in both models of care and health facility design in Australia has been profound and, as a result, we are seeing new and innovative hospital design emerging in cities across the country.

The shift is driven by health providers, who are struggling with rising costs and increased demand for services, and have developed new models of care that are delivering seamless and focused outcomes for users. In the past, public buildings such as airports and hospitals were often designed to accommodate functionality, and their planning was based on quantitative criteria. Now, functionalist planning models have been replaced by new paradigms that prioritise the experiences of patients and staff, and match consumer expectations of a supportive healthcare environment.

I am excited to see that the hospital is being reborn as an inspiring, authentic and intrinsic architecture of our society. This new approach

is based on salutogenic concepts, where the main goal of design is to promote health and wellbeing. It is an approach that offers designers possibilities that they did not have before.

There has also been an overarching change in philosophy, supported by evidence-based research, that healthcare environments can play a direct and critical role in promoting wellness and preventing disease. Salutogenic concepts, while still emergent, are now underpinning and informing current and future health facility design.

This book celebrates the people who share this dream – their thoughts and concepts, and their vision of our world. As academics, practitioners, health planners, designers and architects they have a huge responsibility to shape the buildings that impact on our behaviour, and thereby shape our creativity, satisfaction, enjoyment, health and wellbeing.

The International Academy for Design & Health supports the realisation of these dreams. It encourages knowledge-seeking in a broader perspective – a more interdisciplinary, holistic approach to design that challenges the designer and planner to shape our society by the meaningful application of salutogenic innovations.

In understanding the forces that have driven change in Australia, we can better support and predict the new service-delivery models and facility designs of the future. The levels of innovation presented in this book bode well for the design of humanist and sustainable facilities in the coming decades.

My thanks are due to the editorial team, led by editor Kate Copeland, immediate past president of the Australasian College of Health Service Management and the Academy's chief operating officer, Marc Sansom, and associate editors, Kathleen Armstrong. and Emily Brooks. Thanks are also extended to this book's contributors for sharing their own knowledge and views on a broad range of subjects: Dr Liz Paslawsky, Professor Tony Capon, Dr Jennifer Kent, Dr Susan Thompson, Dr Paul Barach, Warren Kerr, Professor Ian Forbes, Professor Corbett Lyon, Dr Jan Golembiewski, David Peters, David Grace, Professor Ray Green, Dr John Holm, James Grose, John McGuire, Dr Keith Joe and Dr Brendon Lovelock.

I wish to express my gratitude to the Academy's leadership and its president Dr Ray Pentecost for his support and enthusiasm in leading our knowledge community. The publication, which has been produced in collaboration with state government health departments and the Australian partners of the 9th Design & Health World Congress, will strengthen our knowledge community, and be the catalyst for further innovation that will truly enhance our lives. I wish you lots of inspiration reading it.

Professor Alan Dilani, PhD
Founder and Chief Executive Officer
International Academy for Design & Health

Editor's foreword

At the end of the last century, Australia embarked on an unprecedented level of capital investment in its healthcare infrastructure that has never been seen before and may never be seen again.

It has been a period of great achievement, although there have been some tough lessons along the way, and only time will truly tell how much we got right and where we could have done better.

This book, which was conceived during the preparation of a proposal to host the 9th Design & Health World Congress, organised by the International Academy for Design & Health in Brisbane in July 2013, has been designed to capture the essence and spirit of this period of development and advancement, as well as the buildings themselves. It is both a celebration and a critique.

My personal interest in the planning, design and construction of health facilities was built on years of working in hospitals across four states of Australia. In 1996, a move to Queensland Health's Capital Works and Asset Management Branch provided a once-in-a-generation opportunity to actively participate in this major investment in hospitals and health facilities in Queensland, and to work with colleagues in leadership roles across Australia.

Although each of the Australian states operates autonomously, there was recognition that the rapid developments in all states provided an opportunity to share learning across and between jurisdictions. Vision and leadership were demonstrated – David Jay in Queensland, David Gates in New South Wales, Barry Paice in Victoria, plus representatives from South Australia and Western Australia. Arrangements were made for the exchange of information – informally at first and later through the establishment of the Health Capital & Asset Management Consortia, the forerunner to today's Australasian Health Infrastructure Alliance.

The massive investment in planning, design and construction also supported the growth of consultants who specialised in the planning and design of hospitals and health facilities, to the long-term benefit of the health sector.

This period also coincided with significant changes in the underlying philosophy of hospital design and construction, and many of the resulting projects are featured in the essays within this book. The complexities of healthcare, and the impact on individuals, their families and carers and the broader community, make this one of the most challenging environments – but the facility is also a workplace, often for large numbers of people in a wide range of roles.

The reorientation of thinking from addressing the management of illness and disease to enhancing the health and wellbeing of all, including

consideration of the needs of patients, staff and visitors, provided opportunities to create hospitals that provide natural light, access to courtyards, gardens and views, suppression of excessive noise and access to art works. The increasing availability of specialised imaging and diagnostic equipment, together with advances in communications and information technology, created additional challenges.

Concurrent with this approach was the development of new models of care. Care was redesigned: it was patient-focused rather than suiting the convenience of the care providers; it was as close as possible to where people live and work, with an increased provision of ambulatory and home based services; and it was planned around 'patient journeys' to enhance service efficiency and minimise waiting times for patients and their families.

The implications of our increasingly sedentary lifestyle, together with an individual reluctance to eat sensibly, exercise regularly and avoid tobacco and alcohol, have led to a major increase in the prevalence of non-communicable diseases. The design implications for the increasing number of bariatric patients is one of the vexing issues being addressed in today's hospitals.

However, the risks of communicable diseases remain severe, and the management debate continues. The use of design and operational policies to influence an increase in handwashing has been welcomed. The issue of individual patient rooms versus shared rooms continues to be hotly debated, with competing factors including the impact on transmission of disease between patients, the privacy needs of individuals and their families and caregivers, the benefits and disadvantages of isolating individuals, and the various cost considerations of increased provision of space and bathrooms.

All these and many other issues have exercised the hearts and minds of funders, planners, designers, managers and constructors – and the results that they have achieved, across our wide brown land and across all aspects of health facilities, are featured in the pages of this book.

As many people will already know, it's one thing to have a good idea, but quite another thing to bring it to fruition. It has been a privilege to have the opportunity to translate my strong support for a publication that provided an overview of hospital and health facilities in Australia into reality with the technical, publishing and financial support of the International Academy for Design & Health, particularly through Marc Sansom and his publishing team.

I would like to thank all of those who have participated in the planning, intellectual development, and production of this book. I hope everyone who picks it up finds something interesting, stimulating or thought-provoking in its pages. Thank you to the Australasian working group for the 9th Design & Health World Congress, and to all the authors, sponsors and those whose projects have been undertaken during this period and are featured here.

Kate Copeland
Health Infrastructure Branch
Queensland Health

Sponsors' foreword

The period 2000–2015 has seen a remarkable evolution and revitalisation of healthcare buildings in Australia. It is an era characterised by ongoing changes in models for health services delivery, a need for greater connectivity between health services, a boom in large hospital projects and an increased conversation between science and art to inform the design of our recent healthcare facilities.

With vast distances between cities in Australia, the push has been to bring care closer to where people live by considering alternatives to the major acute hospitals in the centre of the large capital cities. At the same time, design leaders and healthcare professionals have developed a new generation of facilities that focus on patients and their carers, based around principles of sound and simple wayfinding, the introduction of natural light and the provision of external views, aimed at creating less institutional and more inviting and caring environments.

A hundred years ago, the patient environment was front of mind in the design of healthcare buildings. Hospitals – particularly country hospitals – all had verandas, balconies and gardens for patients to recuperate in and relatives and staff to enjoy, and buildings responded to climatic needs and the principles of restorative environments. When post-war migration triggered a boom in hospital construction and expansion, budget constraints and the need to embrace advances in medical technology appeared at times to prioritise the needs of the machines over those of patients and staff. In the late 20th century, building footprints deepened further in the name of economical workflows, spatial adjacencies and capital efficiency. As technology and models of care changed, many of these buildings faced the need for redevelopment or replacement. This presented an opportunity to refocus on the wellbeing of patients and the staff who care for them, a challenge that has re-energised care providers and designers to work together to create this new generation of healthcare buildings.

The introduction of the Australasian Health Facility Guidelines has reduced the need to debate the many spatial requirements, and instead allows design teams to focus on improvements in spatial quality. Demystifying healthcare design has allowed new players to take what was once considered to be a sector of marginal design innovation to become one that is now embraced by schools of architecture and the wider design community. In addition, the increasing body of research into the effect of environments upon the healing process has opened up a dialogue between the design and care professions. Many Australian design professionals have travelled around the world learning from projects and sharing ideas at international conferences, which has bought a freshness to their work.

In addition to the series of new mega projects – Queensland Children's Hospital, Gold Coast University Hospital and Sunshine Coast University Hospital in Queensland; the Royal North Shore Hospital in Sydney; the Royal Children's Hospital and the Victorian Comprehensive Cancer Centre in Melbourne; the new Royal Adelaide Hospital; and the Fiona Stanley Hospital and New Children's Hospital in Perth – are a large number of infill projects on tight urban sites, which have tested the skills of the design and delivery teams to rethink the whole hospital to bring in light, address views and provide better wayfinding.

Regional hospitals have always been a challenge in Australia because of the vast distances between centres. Acute city hospitals have

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grown as specialist care has advanced, taking away critical mass from the regional centres and forcing patients to travel long distances for care. Over the last five years, the Commonwealth and state governments have funded regional cancer centres and the rebuilding of old regional hospitals to offer better services. Often hospitals are the biggest employer in our regional centres, but the attraction of specialist staff remains a challenge in order to maintain their viability. High-speed digital links from regional centres to our major city hospitals will allow a wider range of services to be provided in the regional centres via technological links. This will be as important to regional and remote health delivery as the iconic Royal Flying Doctor Service has been in the past. Further innovations include community health and general practice 'super clinics' offering follow-up services to outer suburban and regional areas, avoiding the need for patients to return to acute hospitals and providing an opportunity for the early detection and management of chronic disease within the community. Many of these smaller facilities have been exploring innovative design solutions that depart from traditional hospital forms.

Co-locating acute mental health facilities on acute campuses in the 1990s often resulted in compromised single-storey design solutions on constrained sites, as well as compromising future acute hospital development on these sites. More recent buildings have focused on a more sophisticated understanding of patient and staff risks, the need to create a restorative environment, and an urban design response that respects the site context and does not set the building apart.

Up until the 1970s, most doctors finished their medical training, and all nurses were trained, on acute hospital sites; most hospitals therefore typically included staff accommodation. For the next 30 years, this training returned to the universities. But in the last five years, new accommodation and facilities have been built to attract staff to regional towns to complete their training, such as at Geelong, Bendigo, Mackay and Rockhampton. Medical research facilities are being built in and around hospitals and they are often being integrated with universities creating precincts, or centres of excellence, to promote information exchange between clinicians and researchers.

Hospitals are major consumers of energy and water and can provide an enormous opportunity to be leaders in creating sustainable environments. Buildings of the last five years are starting to take up this challenge, but more can be done. The period 2000–2015 marks an era of rejuvenating healthcare design in Australia. This book seeks to acknowledge the major contribution made by a wide range of health professionals, administrators and design professionals, including architects, interior designers and engineers, together with builders and developers and many more, all working together to deliver better places for the care of our patients. It is a demonstration of the expertise and knowledge that now exists in Australian healthcare design.

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Leading academics and practitioners from across Australia have contributed a unique collection of essays on trends and developments in healthcare design

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Paradigm shift
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A history of growth
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Generational design

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Blind spot

Jan Golembiewsi

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Going the extra mile

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A director at Conrad Gargett Riddel, David Peters has been a practising architect for more than 30 years. For the last 20 years, he has specialised in health architecture, and during the past decade has worked exclusively on regional and remote facilities.

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Close to nature

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The digital evolution

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Paradigm shift

As health policy shifts from curing disease to maintaining wellness, how will health promotion, self-care and community-based delivery sit alongside traditional hospitals and clinics – and how will this impact on healthcare design?

Liz Paslawsky
International SOS

Healthcare policy in Australia (and internationally) is influenced by key drivers of change in healthcare. These drivers include escalating hospital operating costs, ageing populations, rapid advances in medical technology, skills shortages, the growth of chronic disease and widening inequality – Figure 2 outlines the principles behind the major policy trends in Australia, and around the globe.

Australia has a healthcare system that has been built around an acute episode of care. Considering the continuum of care for public healthcare types in 2012, approximately 2% of government-funded total health expenditure was on health promotion or preventive services. The desired future budget allocation is favouring more spending on prevention and home care to stop the admissions, readmissions and escalating cost of hospital care. Ideally this involves a reallocation from the acute care sector.

The demands of a rising number of ageing people in the population with an increasing range of co-morbidities, as well as technological change, are enabling the management of increasing patient acuity. Furthermore, while greater advances in the management of some diseases are expected, aged populations will require complex care for dementia, diabetes and other morbidities associated with longevity, as well as palliative and end-of-life care.

The bulk of hospital treatment is used for patients with advanced chronic illness. The nine chronic diseases that are having the greatest impact on the Australian health system are coronary heart disease, stroke, colorectal cancer, depression, diabetes, asthma, lung cancer, chronic obstructive pulmonary disease and chronic kidney disease. Most chronic illnesses are preventable, caused or aggravated through lifestyle-related behaviours such as smoking, obesity, physical inactivity, alcohol and stress.

Federal health policy development in Australia has as its framework the National Health and Hospital Reform Commission (NHHRC) publication *A Healthier Future for all Australians*, published in 2009. The report relied on the following key statistics from the Australian Institute of Health and Welfare:

- In Australia it is anticipated that the over-85s age group is expected to quadruple between 2007 and 2047. People over 60 have, on average, three or more chronic conditions
- Chronic conditions now consume 70% of the health sector's spending in Australia. Diabetes expenditure alone is projected to increase 436% from AU$1.6bn to AU$8.6bn from 2002/03 to 2032/33
- For each person over 60 years old in 2007, there were five working-age people. In 2050 there will be fewer than three working-age people for every person over 60. Implications for the economy include the constrained supply of informal carers, a decrease in the health workforce, and a reduction of the taxation base to fund expenditure on healthcare
- Australians are 20-30% more likely to be admitted to hospital overnight than persons in Britain or the US
- In Australia, 54% of adults and one in four children are overweight or obese.

Figure 1: The Kinghorn Cancer Centre in Sydney is a model of holistic, people-friendly design

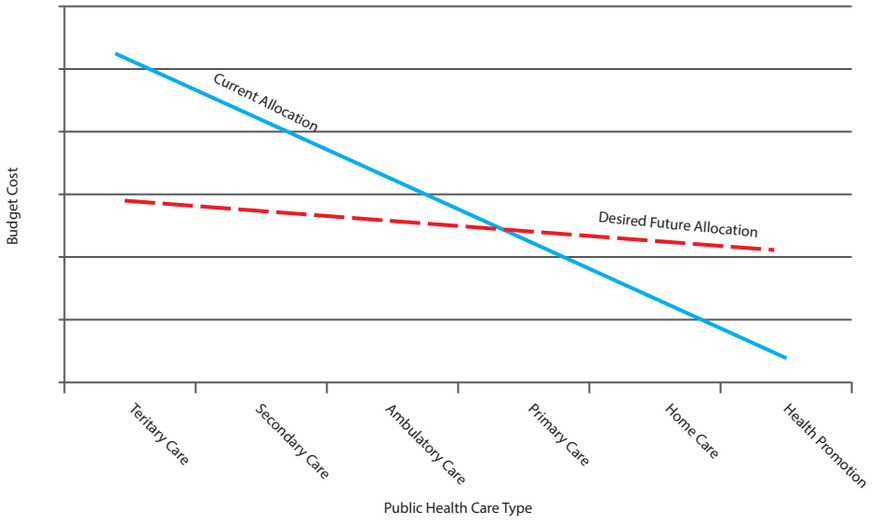

Figure 2: Budget costs along the continuum of public healthcare

The two key principles behind the National Health and Hospitals Reform Commission's health reform agenda, and all federal policy direction, are: shared responsibility ('The health system has a particularly important role in helping people of all ages become more self reliant and better able to manage their own healthcare needs') and strengthening prevention and wellness ('Our health system also needs greater emphasis on helping people stay healthy through stronger investment in wellness, prevention and early detection and appropriate intervention to maintain people in as optimal health as possible').

More day surgery

Particularly in tertiary and larger teaching hospitals, advances in medical technology and clinical management techniques will lead to more sophisticated surgery being able to be performed on a higher number of acutely ill patients with an increasing range of co-morbidities.

In Australia, both federal and state health policy directions in hospital care are often aligned with the development of models of care focusing on quality and safety. Most state health policies favour moving to few larger hospitals, for the following reasons:

- based on evidence-based protocols outlining a minimum throughput to maintain quality specialist skill set
- having scale for the efficient utilisation of high-cost technology, and to enable further technological growth
- economies of scale leading to more efficient operational cost
- to enable modern infrastructure
- to ensure sufficient scale for teaching and research.

The individual state policies are a reflection of addressing demographic needs and transport access issues within each state. Current hospitals are not always in logical places when considering areas of population growth and transport networks. This difficulty is made more problematic with the political challenges associated with closing hospitals.

Key policy directions in the distribution of models of care usually involve:

- the adoption of state-wide models of care for key service areas such as emergency and intensive care services
- metropolitan-wide service delivery models for key clinical specialties and clinical support services
- clinical networks established for all major clinical specialties to ensure evidence-based quality of care is provided at each hospital.

Many states have policies that are centralising elective day surgery, away from tertiary sites to the district hospital. The percentage of total surgical caseload performed in day surgery facilities will continue to increase as hospitals become more confident that patient outcomes are not compromised with improvements in anaesthesia, and analgesia, surgical technology and the earlier postoperative mobilisation of patients. It is anticipated that in the long term a greater number of procedures will be managed within 23-hours-a-day surgery centres, with all patients being admitted on the day of surgery and the majority being discharged directly from the unit.

Access to care: a political imperative

For public hospitals throughout Australia, having speedy access to care – the timely assessment, treatment and discharge of patients – is a key priority. Being politically driven implies the priorities and solutions could change as government priorities change. This is evidenced most in access to assessment in emergency departments, with surgery waiting lists a close ally.

Emergency medicine is one of the key disciplines in hospital service delivery that will be continuously evolving with advances in technology and policy shifts. Increasingly, emergency departments are designed to accommodate growth and increasingly designed in 'zones'. For example, services accommodated within New South Wales (NSW) emergency departments may include the following zones: acute, emergency medical unit (EMU), adult fast track, paediatrics fast track, mental health assessment, medical assessment unit, resuscitation and sexual assault.

Emergency departments are also now integrated with short-stay 24-hour observation wards/medical assessment

units (MAU) designed for patients who, with proper assessment and treatment, are likely to be discharged within 24 hours. This includes patients who require tests to determine the seriousness of their condition (for example, minor head injury, chest pain or drug overdose) or a short course of treatment for conditions that may be rapidly resolved (for example, asthma, allergic reactions and renal colic).

Strategies to reduce demand of attendances within the emergency department have seen the emergence of ambulatory care units, presentation directly to the specialty for ongoing management, increases in outpatients, hospital substitution and home care. The success of these strategies is dependent on the acuity of patients presenting.

The growth of ambulatory and home care

All states are moving policies and funding to ambulatory care. The range of services that can be delivered through ambulatory clinics that do not require an admission to hospital are continuously expanding, including the range of outpatient clinics, diagnostics, medical assessments and day treatments. They are principally medically focused, such as day oncology, endocrinology, medical day procedures, ophthalmology, rheumatology and rehabilitation. They will include pre- and post-care as an alternative to acute care.

Specialised ambulatory care facilities are moving away from being located in acute hospital facilities into purpose-built community settings. The definition of ambulatory care is extending from day care to include 23-hour day centres, with technological growth and improved models of care leading to a greater number of medical services and procedures being managed within these centres.

Hospital in the home (HITH) is defined as a service that provides active treatment by healthcare professionals, in the patient's home, for a limited period. Home diagnostic devices are available to monitor physiological, behavioural and clinical data about an individual at home. This supportive technology is complementing advances in medicine, and means that HITH is increasingly becoming a viable alternative for in-hospital treatment for chemotherapy, wound care, genito-urinary tract, respiratory tract infections, cellulitis, venous thrombosis, kidney or urinary tract infections, and less complex post-surgical conditions.

Federal legislative changes in all sectors are moving towards, or encouraging, home-based care. For example:

- Aged care legislation over the last 10 years has been towards supporting the aged to live longer in their own home. 'Ageing in place' and the growth in diversity of community care packages are just two examples
- Legislation has strengthened the role of the general practitioner. The introduction of Medicare Locals, for example, aims to support health professionals (but mainly general practitioners) to provide more coordinated care, improve access to services, and drive integration across the primary healthcare, hospital and aged care sectors, making it easier for patients to navigate the local healthcare system
- Private health funds can develop chronic disease management programmes (CDMP) and share the burden of cost through the 'risk equalisation pool'.

Figure 3: The 'reflection garden' on the roof at the Kinghorn Cancer Centre is an example of salutogenic principles in a health-promoting environment

The health system move towards an integrated care model is tied in with the introduction of the electronic medical record connecting all services along the continuum of care. The boundary-free hospital is no longer a futuristic term – in fact, it is almost outdated. Many hospital departments no longer define their systems framed in bricks and mortar but these now extend beyond the built environment. The trend is that hospitals are being redefined away from the

Figure 4: The domestic-style, tranquil environment of the Wellness Centre at Victoria's Olivia Newton-John Cancer Centre is designed to reduce patient stress

number of beds they have to include a continuum of care, which includes home-based services and the support of the person to manage their own disease. The reputation of a hospital is increasingly based on its value-added services.

Care coordination will increasingly move from the hospital specialist to the community-based medical professional. For chronic disease management and complex treatments regimes such as cancer, nurse care coordinators are increasingly being appointed.

Self-management

Health policy usually lags behind the most fundamental driver of change – human attitude and behaviour. How consumers define what health means to them as individuals, and the choices they make, will influence future health policy direction and building design. The Australian population is able to access very detailed information on their condition including the following:

- personalised medicine. With genomics, individuals know their genetic sequence and can predict their own risk of acquiring many diseases
- access to electronic health records. Today the question is, who owns your medical record? Soon the question will be, how well are you managing your own EHR?
- more transparent information in healthcare, with greater transparency surrounding patient access, costs, waiting lists, patient satisfaction measures and patient safety measures (such as hospital error rates and infection rates)
- health providers' coordinated patient care and consumer-directed services
- self-help groups, disease-specific associations and advocacy groups
- social media – blogs, Twitter, Myspace. The breadth and depth of conversations are extending the definition of healthcare. Discussion about quality of life, emotions and feelings are as relevant as: "What treatment should I be seeking?"

This ethos of self-care, and patients' increasingly sophisticated medical knowledge, will allow consumers to make informed choices. The trend is that consumers are also considering the options on offer from both eastern and western medicine. More Australian hospitals are embracing integrative medicine in response to consumer demand. Complementary and alternative medicine (CAM) recognises the importance of quality of life and placing patient values and lifestyle at the core of any design and delivery of care.

The changing health paradigm

Government policy shifts towards prevention, self-care and community-based service delivery and the ability of consumers to make more informed decisions, will change the way health design will be considered. It will no longer be sufficient just to consider current hospital and community health-based organisational boundaries that are restricted within a medical disease paradigm. The vital role of diagnosis and treatment will be complemented with action and incentives to maintain wellness, create supportive environments to encourage disease prevention and self-care.

The salutogenic approach is 'health-creating' rather than 'health-eroding'. It is closely aligned to the wellness paradigm and the belief in treating the person, not just the disease. This could include planning to take into consideration:

- the physical body, and its physical comfort
- emotions (expressed as feelings) – the importance of artwork and lighting, for example
- mental wellbeing: self image and encouraging the involvement of informal care givers
- spiritual or religious/cross-cultural beliefs: calmness, creativity, inner knowing and a belief in higher power.

Human interaction in a hospital setting will change. 'Knowledge navigators' may become more relevant, to assist the consumer in synthesising the knowledge gained from multiple sources and multimedia channels. The demand will be toward practitioners from different paradigms working together cooperatively. This will continue to expand as consumers' needs, expectations and characteristics become recognised as relevant to patient health outcomes.

The role of the medical practitioner will also evolve. They will no longer be expected to know all the answers. The western-trained practitioner will need to develop an ability to be more open and embrace change. Consumers will expect their practitioner to expeditiously find answers to patient queries. Patient management will involve interpreting information and acting as an information navigator.

The consumer thirst for knowledge will lead to hospital design to consider patient education facilities as standard in design. Health literacy-friendly environments may converge into, or replace, traditional patient waiting areas.

Areas of improvement in facility planning

State health policy facility planning guidelines are written in each state, and the majority often lag behind changing medical practices. For example, in most new builds, the debate is around theatre size, but many state guidelines have not taken into account the increasingly complex surgery being performed in tertiary hospitals. For example, a road trauma victim may require a neurological, surgical, plastic and orthopaedic team concurrently in one theatre, as well as diagnostic equipment.

In most states, health facility guidelines are often only relevant to the hospital environment. The difficulty is that the hospital environment is only a small component of the models of care that are defined along a health service continuum.

International best practice, best practice guidelines, medical provider experts and evidence-based medicine all are aligned to the medical paradigm. Facility design consultation is pseudo consultation while a few key clinicians have the balance of power in design considerations. In future, the paradigm will have the balance of power shift to patients, patient support groups, multi-modal service provider groups and extended multidisciplinary teams.

Traditional evidence-based and quantitative analysis as the foundation for facility design decision-making ignores the importance of being flexible to accommodate individual experiences. Qualitative research methods will become more credible examples of evidence as they become relevant to examining and understanding individual experiences. Consumer 'stories' reflecting the complexity of interrelationships in healthcare settings will be paramount in the future design of health service delivery. Focus groups, surveys and recorded observations of care practices in use will also become more important.

There is often misalignment of the requirements of key stakeholders in hospital designs. The clinicians have a key consideration to the immediate future: what works now in patient experience, and what is predictable in trends in medical technology. Clinicians have often not been taught how to work in an environment of uncertainty. Change management is not often spoken outside the medical paradigm.

Health administrators have fiscal responsibility as a key consideration. The definition of a patient model of care is often policy driven by the key administrators at the time of construction. Architects and builders are appointed to maintain, scope, schedule and budget, their actions based around numbers rather than patient experience.

Figure 5: At Sydney's Royal North Shore Hospital larger theatre design takes into consideration the multidisciplinary complexity of trauma-related surgery

To bridge the misalignment, leadership qualities in health policy and design will need to strengthen and include leaders who:

- are intrinsically motivated to the cause and purpose to improve health. This will require a belief in the broader definition of healthcare to include social, mental and emotional experience as well as absence of disease
- can create or enhance connectivity between disciplines
- can create strategies to engage collaborative activity
- are prepared to listen to the end user – the patient – and respect patient values and experiences
- Are less concerned with holding a position of power, but have an enhanced ability to influence others
- Reframes processes, understanding and integrating new concepts.

In conclusion, the trends in the Australasian health policy environment impact both the health built environment and also the planning considerations in the urban environment. Health policy development lags behind advances in the most fundamental driver of change, which is human attitude and behaviour. The social context provides a guide to future policy direction. The traditional paradigm of hospital design, or 'making sick people better', will need to change to a far greater emphasis on the federal health reform agenda of 'keeping people well'.

Promoting health

As health policy shifts its focus to disease prevention and health promotion, researchers in Australia are developing the concept of 'healthy places' – building on the links between health, the built environment and urban planning

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As the health costs associated with epidemics of obesity, diabetes and other lifestyle diseases continue to escalate across Australia, recent interdisciplinary research has demonstrated links between these lifestyle diseases and the way we negotiate and experience life in urban areas. Car-dominated transport, reduced opportunities for physical activity, increased fast food availability, and the lack of social connection have all been implicated. It follows that the way in which our urban areas are planned has a strong connection to human health, and significant potential to prevent disease. Taking this recognition forward into policy development and practical change requires that both health and urban planning professionals understand the relationships between the built environment and health.

Health, the built environment and urban planning

In recent decades, conceptualisations of health and disease have shifted from individual treatment to acknowledge the importance of disease prevention and health promotion in populations. This has included increased attention given to the impact of environments on collective wellbeing and on the interdependence of physical environments and human behaviour.[1]

From a theoretical perspective, this shift reflects the increasingly ecological orientation of the health promotion field.[2] Ecological models of health promotion are underpinned by the understanding that interventions need to be considered across multiple levels and contexts. Often these contexts are simplified in the literature as the individual, social and environment. However more comprehensive theorisations of health ecology also recognise the role of the large-scale economic and political influences that shape local context.[3]

The ecological orientation emphasises that the most effective health interventions will be tailored to place and the people living in that place, respecting that individuals of different ages, socioeconomic and cultural backgrounds and genders will respond to interventions differently. Furthermore, ecological theories recognise the role of educational programmes, policy change and economic incentives, while acknowledging that environmental change can also be a relatively low cost platform on which to build later targeted interventions.[4]

Built environments have emerged as a focus in health research which explores the links between the modern epidemics of chronic non-communicable diseases and the way we live in cities. Health professionals increasingly recognise the importance of the built environment as a foundation for human health and there is growing appreciation of the central role that urban planners play in providing environments which support healthy behaviour. Built environment professionals are also embracing this call, arguing for public health and the planning of the built environment to be closely aligned.

While urban planning has extensive potential to contribute to health promotion, conceptualising and operationalising this potential is not a straightforward task. Making specific reference to the interdisciplinary research evidence for

Figure 1: The park at Kangaroo Point Cliffs, Brisbane. Paths along scenic natural routes encourage recreational walking and cycling

healthy built environments (as reviewed by Kent et al[5]), the following section provides an overview of some ways the built environment might be modified to promote human health.

What makes a healthy place?

Chronic non-communicable diseases, depression and anxiety currently account for the majority of the burden of disease in Australia.[6] Physical inactivity, poor diet and social isolation are major risk factors for these diseases. Planning is in a particularly strong position to effect built environment interventions that encourage and support physical activity, promote social connectedness and increase exposure to healthy food, making it easier to access and incorporate into the diet.

Physical activity: First, the built environment can increase opportunities for, and reduce barriers to, physical activity. The varying needs of different population groups (such as children, the elderly and disabled), the purpose of the activity (transport or leisure) and the characteristics of the built environment (such as residential and commercial densities, land use mix, open space, connectivity and accessibility) must be considered in understanding how the environment can best support physical activity. Specific ways that built environments can support people being active include integrating land use and transport to promote walking and cycling for transport, preserving a variety of green open spaces for recreation, designing street networks and providing infrastructure for walking and cycling.

Strengthening communities: Second, the built environment plays an important role in strengthening and connecting communities by facilitating social interaction in public spaces – gardens, town squares, parks and lively streets. Such spaces need to be safe, inviting and meaningful for local communities. Specific ways that built environments can

Figure 2: Community gardens provide multiple health benefits, including social wellbeing

strengthen and connect communities include providing streets and public spaces that are safe, clean and attractive; encouraging residential development that is integrated, yet private; and enabling community empowerment through meaningful participation in land use and design decisions.

Providing healthy food options: Third, through zoning and land use regulation, the built environment can support access to healthy food. Examples include reducing exposure to fast food (both food stores and advertising of fast food) in the vicinity of school environments; encouraging the establishment of farmers' markets and community gardens; and retaining peri-urban agricultural lands as a source of local healthy food.

Healthy urban planning in practice

We have established that there is a growing appreciation of the central role that urban planners play in providing environments which support healthy behaviour. We have outlined three key built environment domains that support human health. Using case studies from around Australia, we now progress to detail some of the contemporary ways health and built environment professionals are starting to work together.

Urban planning is no stranger to health. The discipline originated out of concerns for human health[7] and a century ago was strongly aligned with public health objectives. Nevertheless, this close relationship was not sustained as planning moved to focus on urban policy development, design and environmental sustainability, while public health largely pursued a medical model.[8]

Internationally, recognition of the need to embrace a broader understanding of health goes back to the 1970s when the World Health Organization (WHO) commissioned a programme of public health reform which today is known as Health21.[9] In 1986, this led to the declaration of the Ottawa Charter for Health Promotion and the establishment of the WHO Healthy Cities Project. In 1992, the United Nations' Agenda21 emerged from its conference on environment and development in Rio de Janeiro, linking environmental sustainability and human health.[9] Both Health21 and Agenda21 today underpin the WHO Healthy Cities initiative, which links health and sustainable development at the local level.

Figure 3: Well-designed and safe town centres enhance opportunities for social interaction

Planning for legislative recognition: While health organisations have spearheaded much of the early work in healthy built environments in Australasia, built environment professionals are showing increasing interest in incorporating concerns for health into urban planning. A notable example is the current review of the urban planning system in New South Wales (NSW), Australia's largest state. If the exposure bill for the new planning legislation is passed, human health will be one of the key objectives of legislative planning. The significance of this change should not be underestimated. Urban planning is an extremely practical and busy discipline, operating in highly politicised arenas at numerous scales. Indeed, although the legislation remains in draft form at the time of writing, the proposal of this new planning objective, in itself, is a milestone.

In 2009-10, the Australian government undertook a major review of the health system, including the approach to prevention. The views of urban planners and designers informed key recommendations in various reports produced from this review. Notably, in 2011, the Australian government included health as a key consideration in new national urban policy, referencing academic work of the Healthy Built Environments Program (further discussed below).

Milestones such as legislative recognition have only been reached in the wake of substantial contributions by both government agencies and non-government organisations (NGOs) which have rallied for practical and policy change in an array of arenas.

The work of NGOs: The National Heart Foundation of Australia is at the vanguard of thinking about relationships between the built environment and health behaviour. Since the launch of its Healthy by Design guidelines in 2004, the Foundation has developed other valuable guidance to assist planners and designers in implementing healthy built environments, including walkability checklists and guidelines for food sensitive urban design. These are all available free to download from the Foundation's website (www.heartfoundation.org.au). The Foundation has also lobbied the urban development industry to promote the concept of healthy urban environments as highly marketable and good for business.

Australia's professional planning body, the Planning Institute of Australia, has also made a substantial contribution to the promotion of healthy built environments. In 2009, the Institute launched Healthy Spaces and Places – a

national healthy planning initiative developed with the Australian Local Government Association and the National Heart Foundation, with financial support from the Australian government's Department of Health and Ageing.[10] This web-based resource includes practical tools, case studies and guidelines for planning and developing sustainable communities to encourage healthy ways of living.

State government support: The Victorian Health Promotion Foundation (VicHealth) was an early advocate of the importance of addressing links between health and the built environment, supporting the work of the Heart Foundation and other NGOs. In 2012, the Legislative Council's Environment and Planning References Committee released a landmark report on Environmental Design and Public Health in Victoria.

Established in 2004, the NSW Premier's Council for Active Living aims to build and strengthen the physical and social environments in which NSW communities engage in active living. It comprises senior representatives from across government, industry and the community sector. The Council has played a leading role in workforce development and policy integration for active living. One of its key accomplishments has been the development and release of a comprehensive development assessment checklist designed specifically for use by urban planners in NSW, Development and Active Living: Designing Projects for Active Living.[11]

Creating environments that promote health and wellbeing is now one of the key preventive health priorities for the NSW State Health Plan. The Ministry of Health has developed a Healthy Urban Development Checklist to support health professionals in evaluating and commenting on urban development policies, plans and proposals in relation to health.[12]

An interdisciplinary approach: In 2009, the NSW Ministry of Health established the Healthy Built Environments Program (HBEP) at the City Futures Research Centre in the Faculty of the Built Environment at the University of NSW. This five-year initiative has brought together an interdisciplinary team from academic, government, private sector and non-government organisations with expertise across health, urban planning and design. The HBEP is led by an urban planner (Susan Thompson) with strategic input from a public health physician (Tony Capon). An innovative feature of the HBEP is that it is situated in one of Australia's largest faculties of the built environment. The programme encompasses policy-relevant research, capacity building, and leadership and advocacy. Further information is available from the HBEP website (www.be.unsw.edu.au/programmes/healthy-built-environments-program/about).

Situating a health-funded programme in a university built environment faculty sends a strong message about the importance of interdisciplinary approaches in this field. Other related initiatives in Australasia include the New Zealand Centre for Sustainable Cities (hosted by the School of Public Health at the University of Otago), the Centre for the Built Environment and Health at the University of Western Australia and the McCaughey VicHealth Centre for Community Wellbeing at the University of Melbourne.

Figure 4: Productive agricultural land must be protected to ensure a supply of fresh food close to where it is consumed

Contemporary research in this area actively informs tertiary and professional education, contributing to the critical need for interdisciplinary learning in undergraduate and postgraduate courses, and in continuing professional development in this area. Undergraduate and postgraduate healthy planning courses at the University of NSW are examples of practice-based education that uses an interdisciplinary approach to understand and address increasingly common lifestyle-related health problems. Through interdisciplinary research, fieldwork and educational models, these courses examine the relationships between urban planning, city form and human health. Students from a range of built environment and health/medical disciplines work in interdisciplinary teams to explore these issues. Field work includes a detailed neighbourhood audit where students observe, and survey, selected urban areas to determine the level of support for healthy behaviour. Learning outcomes are focused on interdisciplinary knowledge and potential application for professional practice.

The success of these approaches can be attributed, at least in part, to the willingness of health professionals to share 'sovereignty' of knowledge about health with other disciplines. This opens up discussions about differences in research traditions in the sciences and social sciences.

Challenges moving forward

Progression of the healthy built environments agenda requires sustained interdisciplinary relationships. This process will inevitably encounter practical and theoretical discord that needs to be acknowledged and addressed.[13] Common themes of friction identified through our experience relate to different ways of thinking about the nature of evidence required to justify policy change, different understandings of the complexity of context and more general misconstructions about ways to mix policies and disciplines.

The question about evidence cuts to a core division between the health and urban planning traditions. The nature of evidence planners use to develop policy is traditionally different from that used by public health officials. While building a rigorous evidence base is important, policymakers and practitioners should not be hamstrung by a lack of 'causal' evidence. Every day in Australia, thousands of important planning and policy decisions are made. These decisions should be informed by the best available evidence and we should build our evidence base by evaluating the impact of these decisions, learning as we go.

The need for consistent and objective measurement of built environment and physical activity variables is a commonly cited weakness in research on the built environment and health. We caution, however, that policy responses will differ according to spatial context, demographic and cultural character, environmental quality and temporality. Recommendations for standardised measurements risk underestimating the diversity of people and place, particularly when attempts are made to compare results between and across populations and locations.

Research on the links between health and the built environment often concludes with the acknowledgement that structural modifications to the built environment need to be part of a broader policy mix if they are to be successful. This conceptualisation reflects the increasingly ecological orientation of the health promotion. To change practices, however, an ecological approach requires consistent and meaningful interdisciplinary collaboration. This necessitates seeking new, potentially more comprehensive ways of understanding the impacts of policy development, amendment and implementation. It also demands that both researchers and practitioners from the built environment and health recognise that their accepted wisdoms and assumptions are not necessarily shared, nor understood, beyond their own disciplinary boundaries. Successful healthy built environment partnerships rest on deliberative interdisciplinary engagement. At its heart is an eagerness to listen and learn about the other. This extends from disciplinary culture to ways of collecting and measuring data, reporting results and translating results into policy.

Figure 5: Farmers' markets sell an array of fresh, local and seasonal healthy food

Conclusion

There are myriad connections between the health of people and the built environments in which they live, learn, work and play. These relationships are complex and contextual. Translating this understanding into action requires the development of genuinely interdisciplinary working relationships which must be based on mutual understanding and respect.

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Critical engagement

Consultation with clinical staff early in the design of healthcare facilities in Australia is critical to the healthcare quality improvement agenda, enhancing the care process and creating a safer environment for patients

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Now more than ever, the designed environment in healthcare is proving its increasingly vital role in the health and wellness of Australians. New research shows just how important investing in the designed space can be when it comes to promoting psychological wellbeing and economic responsibility.[1] Australians, however, still experience needless harm and often struggle to have their voices heard, processes are not as efficient as they could be, and costs continue to rise at alarming rates, while quality issues remain.

The hospital industry in Australia is in the throes of the largest building boom in its history. In this decade, an estimated AU$20bn will be spent on new hospital construction across Australia. Prompted in part by constrained national budgets, Australian federal and state governments are increasingly partnering with the private sector to underwrite the costs of constructing and operating public hospitals and other healthcare facilities and delivering services. But the research indicates that to date, experience with these partnerships has been mixed. A radical rethink is required to devise new ways of procuring and delivering healthcare facilities in Australia.[2] Despite unprecedented levels of capital spending on health infrastructure – for example, over AU$1bn each for the Royal Adelaide Hospital and for the Melbourne Royal Children's Hospital – the facilities planning process and its design outcomes continue to frustrate patients, providers and communities.

Without reform, Australia's ability to maintain the high level of service currently provided will be compromised. Increasingly across Australia, a more fundamental design question is being asked about what value these new hospitals provide to the community and to the welfare of Australians, given that Australia is being 'overwhelmed' by rising healthcare costs, with nearly 30% of state budgets expended in the delivery of healthcare. Many are asking how these facilities align with community- and hospital-based care. In NSW, for example, the Treasury estimates that total spending over the next 20 years will exceed 55% of the state budget.

The discontentment of clinicians remains a big obstacle in addressing the growing implementation gap. Several studies have identified engaging physicians as a challenging area – for example, in mobilising key stakeholders to support hospital-based efforts to improve care transitions and reduce avoidable rehospitalisations.[3] Physician involvement is key to accelerating the adoption of new care models, in large part because new care models will require doctors to significantly change their behaviour.

There has been an important reconceptualisation in healthcare about clinical risk through emphasising how upstream 'latent factors' enable, condition or exacerbate the potential for 'active errors' and patient harm.[4] Understanding the characteristics of a safe, resilient and high-performing microsystem requires research to optimise the relationship between people, tasks and dynamic environments.[5] The socio-technical approach suggests that adverse incidents can be examined from both an organisational perspective that incorporates the concept of latent conditions and the cascading nature of human error commencing with management decisions and actions. Organisational resilience is found in the responsiveness of delivery crews to an emerging hazard.[6] Moving, for example, from multi-patient rooms

Figure 1: Austin Hospital Melbourne, Victoria: Engagement of clinical staff in facility design is critical to healthcare quality improvement

to single-patient rooms can offer great benefits in privacy, infection control and noise attenuation, but only if there are sufficient healthcare personnel to attend to patients.

Innovation in health facility design is thus best done in concert with those on the front lines of healthcare delivery – patients and clinicians – and incorporating relevant knowledge from other scientific disciplines such as operations research, organisational behaviour, industrial engineering and human factors psychology.[7]

Hospital design process

Designing attractive, safe and consumer-centred hospitals is complex and costly. The physical environment in which that complexity exists has a significant impact on health and safety; however, enhancing patient safety or improving quality has been integrated only recently into aspects of the planning and design of hospital buildings.[8] Despite the recent discussions in architectural literature regarding design of patient-centered healthcare facilities and evidence-based design, little assessment of the impact of the built environment on patient outcomes has been conducted. Research shows that healthcare physical environment factors including noise, poor lighting, inadequate ventilation and building layout and design contribute to these negative outcomes in healthcare.[9]

Global performance in terms of outcome, risk management and safety is influenced to a great extent by local interactions and synchronisation of system components (eg providers, patients, technologies, information and material resources, physical and temporal constraints). Conditions in which we work – such as fatigue from 24-hour duty rotations, double shifts, high workloads, confusing labels, noisy environments,[10] lookalike names, poor handwriting, poorly designed equipment and healthcare builds – can lead to errors and harm. These are open or ill-posed problems that are best understood through controlled observations, cases studies and modelling, with insights drawn from other complex adaptive systems such as emerging economies and dynamic social systems.

The traditional hospital design process requires that architects be given programme objectives (function programme), which are then translated in room requirements (space programme) and followed by the creation of department adjacencies (block diagrams). Once this preliminary information has been provided, room-by-room adjacencies are developed and then a detailed design of each room is completed (schematic and design development). Architects then convert room-by-room designs to construction documents that represent how individuals, equipment and technologies in hospitals will function together. Equipment and technology planning generally occurs in the later stages of the design process. In many Australian recent projects, little meaningful discussion of patient safety or design around precarious events is raised at this stage. This creates an opportunity to repeat the latent conditions existing in current hospital designs that contribute to active failures (adverse events or sentinel events).[11] Human factors, the interface and impact of equipment, technology and facilities are also not typically discussed or explored early in the process.

Figure 2: Orthopaedic operating theatre, Townsville Hospital, Queensland: The impact of equipment and technology on human factors is not discussed early in the design process

Risk management framework

A healthcare system includes several subcomponents. Foremost are the medical or clinical processes which are undertaken. Another component is technology – medical and non-medical. This would include information systems, diagnostic systems and imaging systems, as well as mundane technologies such as floor cleaning equipment, supply ordering and distribution technologies. Next there is organisation: the administrative arrangement that includes policies, procedures, strategies and tactics, management tools, business plans, etc. Providers are another subsystem. They include professional, technical, administrative, management, patient, public, government and others. Finally, the designed, built environment is a subcomponent and includes a large number of characteristics.

Charles Perrow studied major accidents and discovered that systems, rather than individuals, were often at fault.[12] Perrow and James Reason redefined how we should proceed to understand causes of accidents and fix problems.[13] One of Perrow's contributions was to describe how the components of systems relate. He defined two scales, complexity and coupling, which explained how components of systems react. There are many subcomponents – some

characteristics of the system are hidden and require 'operators' to use a great deal of short-term memory or computing power.

Healthcare facility planning and designing are also tightly coupled, in that there is no 'wiggle room' in the connections. If one component fails, the adjoining components are immediately impacted, sometimes in unforeseen ways.

A recursive process of planning is required with flexibility and futureproofing the key elements. The lengthy time horizon from initial determination of the scope of a project in the project definition plan (PDP), through design and construct phases and on to commissioning creates the risk that any built solution will be inadequate and dated. During the project implementation phase, there needs to be a revisiting and review of operational and functional decisions, potentially made many years before, or service innovation will be stifled. Innovation in healthcare facility procurement is not necessarily about innovations in construction alone but about creating physical environments that support changing service delivery models and professional and therapeutic practice.

Figure 3: Royal North Shore Hospital, NSW: Understanding the characteristics of a safe, resilient and high performing system requires research to optimise relationships between people, tasks and dynamic environments

The challenge to the future of hospital design in Australia is to change the traditional hospital design process to incorporate the safety-driven design principles early in the design process, and ideally to use the planning process to address and enhance the culture of quality, designed with clinicians around the patient's needs.[14] In planning for the new facility, we approach the hospital design process with a blank sheet of paper, an appreciation of the evidence that there is ample opportunity to improve hospital patient safety. Organisational accidents in Australian hospitals have multiple causes involving many people operating at different levels. This translates into failures at the point of service (eg a physician ordering an allergenic drug for an allergic patient, falls, etc).Based on this idea, exceptional design of healthcare institutions can provide an environment of patient safety, as well as a safety-oriented organisational culture.[15]

Currently, variations from the Australasian Health Facilities Guidelines (AHFG) are discouraged and need formal bureaucratic approval. A number of stakeholders perceive the guidelines as a cost control tool, not transparent and not as responsive to innovation and the realities of local conditions. To attempt entirely rule-based development control is not an effective risk management strategy. Resilience and agility need to be built into the process of user engagement. In any context, flexibility and futureproofing are key drivers for universal adoption of clinical standards, guidelines and mandating the reporting of outcomes. The AHFG is a very useful guide for planning but is generic, lacks specificity and cannot accommodate the range of potential variations and site constraints at each local level. The current process for developing and updating AHFGs is also rather slow but improving. The process could be streamlined and made responsive to user and community needs and opened to public input as the Facility Guidelines Institute guidelines in the US.[16]

For example, a functional programme may be created by the owner and stipulated to the designer as a given, especially in a public-private partnership (PPP) arrangement. Limited opportunity exists to question or test the contents of this programme or to work with clinicians, community and others involved in care and support of care to find better methods. The process of design commonly used in healthcare is linear. It starts with the architect working with the givens, proceeds to a greater definition of the floorplan and massing, then adding equipment, information technology, building systems, furnishings and other components. There is a natural and financial inclination not to loop back to look at evolving issues in a holistic light. If the plan is done, the solution must be a different piece of equipment, a different furnishing or, even worse, a process change. Likewise, after the equipment and technology are selected, usually just before construction begins, there is a determined resistance to changing any part of the design which has been determined before.

These characteristics of the process are further exacerbated by the fact that it is generally led by a single component of the design team, most frequently the architect. Alternatively, but in closely related scenarios for the purpose of this discussion, the team is led by a 'programme manager', by a 'construction manager', or by an 'owner's representative'. The problem with this form of leadership is that it tends to focus on one aspect of the project (ie the budget, the schedule or the 'design') to the detriment of others. Australia needs to find methods which avoid these pitfalls, so that the resulting physical and operational environment is as safe and effective as possible. Rather than trying to improve a process, which has demonstrably yielded inadequate results, we suggest that a new process be created.

Design process for patient safety

The proposed design process for patient safety should consider these strategies:

- Reduce, remove or minimise hazards, which increase the enterprise and patient risk of healthcare-associated (caused by treatment) injury to patients and healthcare providers ('vision zero')
- Treat the creation of safety as part of a process that addresses the safety and integration of all system components, ie as part of the culture
- Involve users and stakeholders at all levels of the institution, including the patients and the community in which the facility will reside, in the creation of safety processes in transparent and meaningful way
- Ensure there is a complete array of disciplines and knowledge at the start of the project
- Use a wide range of risk management tools, including failure modes effect analysis (FMEA), root cause analysis (RCA), mock-ups, simulation, testing, data modelling, etc
- Create and require team education about human factors and systems thinking and how they affect patient safety, the process of building design, and the process of collaboration with others to derive effective and efficient solutions
- Gain appreciation that designing for safety is an iterative and emerging process
- Build in formative and summative feedback milestones that is transparent and widely disseminated.

The building codes and regulations need to be modified to allow these changes to occur.[13] Building design-related contributors to hospital-acquired infections, for example, can include: inadequate maintenance of filters; use of floor, wall or ceiling materials which are hard to clean; poor placement of handwashing stations; and insufficient space to maintain sterile separation.

Figure 4: The New Royal Adelaide Hospital, South Australia: The move to single-patient rooms will offer great benefits if there are sufficient healthcare staff to attend to patients

Sense making in complex healthcare design

The relationship between services will change as models of care change, and the decision to pursue a built solution is the outcome of a broader services planning and consultation process. This may involve complex organisational and clinical practice changes that join with the community, needing careful time, and trust and psychological safety management of the team members.[17] A comprehensive change management and communications strategy must accompany the implementation of the project definition plan, and stakeholder expectations managed through transparent and authentic communication. Facility development is a service improvement process, and state health departments need to work with facilities to ensure effective change management during procurement implementation. Funding for change management must be included in the project budget and not be discretionary.

The challenge for hospital executives and policymakers in Australia is that there is no readily available process for controlling future events or predicting how clinicians might respond to uncertain situations. Knowing the clinical workplace, attending to what clinicians value and hold dear to their hearts, and making sense of what needs to be done is the key to the successful engagement of clinicians and thus to meaningful patient safety improvement.[18]

The weaknesses of the present planning and procurement process in Australia are exactly the opposite of its strengths. Because of the rigid structure, disciplines that would benefit from crosspollination and collaboration rarely have the ability or headroom to have that opportunity – for instance, a decision about a medical process might be made before all available technologies and equipment are considered. Opportunities to improve processes to achieve greater efficiency and quality are artificially limited. Rarely in these instances have we seen adequate research. Because the design/bid/build process is led by a representative of either the architect or the owner, there is little incentive to engage specialised consultants, including behavioural scientists, who can help understand how best to design spaces that engage and respect the clinicians who will occupy these spaces.

Effective hazard reduction and risk management in Australian healthcare facility planning will require meaningful efforts to address the trust gap that has undermined the success of many projects.[19] It will require reframing patient care from one that is task-oriented at the level of the practitioner to a systems-based, team-based, patient-centred model that looks to the actual relationships within the socio-technical microsystems in which care is actually delivered.[20] At the most basic level, this will involve a reconceptualisation of the patient from the passive object of medical intervention to an active 'consumer' or 'user' of health services who co-produces and 'owns' their own health. Healthcare services are currently too fragmented for this patient-centred model of quality improvement.

Conclusion

Achieving highly valued, safe healthcare is much more than just building new facilities but about creating community and country wellbeing. Dogett has said, that: "Australia is preoccupied with hospitals, not health. Hospitals should be a last resort, not the first."[21] Healthcare facility planning and design in Australia needs to make further improvements to meet the challenges ahead and address the unchecked financial costs of care. The current healthcare design process is overly linear, rigid, time consuming and costly. It tends to copy past mistakes, is driven by compliance, tends to pay only lip service to community needs and precludes meaningful innovation. The physical environment for healing (salutogenesis) is an integral subcomponent of the care delivery process. Like other tools and resources, its design, use and application either promotes or hinders the attainment of safe, patient-centred and highly valued care. The building must support the model of care with appropriate physical, social and symbolic environments.

We are moving from a decade of highly structured top-down programmes to local ownership and more transparent community partnerships. Engagement strategies need to:[17] get clinicians experimenting with their own systems; provide permission, space and time for clinicians to find purpose and set their own direction in partnership with their patients and consumers; direct attention through hyper-transparent measuring, collating and sharing of data about what is happening at the service delivery level; and, facilitate respectful interaction between clinicians and managers.

Reform is increasing pressure on Australian healthcare organisations to improve quality while reducing costs. As the next generation of activity is framed in patient safety, it is critical to consider the language we use, as it can either be a source of clarity or confusion, or worse, perpetuate the illusion that progress is being made where none is evident. The environment has a significant impact on the ability of clinicians to build trusting, therapeutic relationships. At the same time, inefficiencies in existing systems cause problems for providers and patients alike. Developing and testing bold and transparent new and creative ideas is critical for Australian healthcare to thrive in this new environment. The focus of Australian healthcare improvement efforts should be on bringing even more scientific discipline and measurement to the procurement and design of healthcare facilities, developing innovative care models that highlight community-based care and thus lower the complexity and cost of delivering healthcare, while simultaneously improving clinical outcomes and the patient experience.

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A history of growth

In 200 years, the development of Australia's hospitals has grown into an integrated system focused on patient-centred care – and supported by a knowledge-based industry at the leading edge of design innovation

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When Australia was colonised by European settlement in January 1788, there was adequate planning for health services but apparently no provision made for a hospital. With the first fleet containing 10 doctors for 1,363 passengers, the colony commenced operations with a doctor/population ratio of 1:136 – a figure that has never been equalled since.

However, soon after the fleet arrived in Sydney, a tent hospital was required to care for the many convicts who were suffering from the ill-effects of their long sea voyage, including dysentery, smallpox, scurvy and typhoid. The tents were only replaced when a prefabricated hospital made from wood and copper arrived with the second fleet in 1790.

These makeshift facilities continued in use for 26 years until construction commenced in 1814 for Sydney's first permanent hospital. It is unclear who prepared the design for the three colonial Georgian buildings that comprised this hospital, but when it opened in 1816 the result was far from satisfactory, prompting an adverse report from the first Government Architect for New South Wales, Francis Greenway.

As other colonies were established in Australia – Tasmania in 1803, Queensland in 1824, Western Australia in 1826, Victoria in 1834 and South Australia in 1836 – the need for hospitals in each of these locations was recognised. In these early days, one of the first government departments established was a Public Works Department (PWD) to provide the struggling colonies with the basic infrastructure of roads, bridges, water systems and buildings. As a result, many of the early hospitals were designed by these PWDs, a practice that continued in many states until the 1980s. From these inauspicious beginnings a sophisticated architectural design industry has emerged, which today is responsible for the design of health facilities totalling over AU$7bn per annum throughout Australia.

Healthcare and hospitals

While hospitals today represent the ultimate sophistication in healthcare delivery, it is important to recognise that prior to the 20th century, hospitals were normally only used by the poor and destitute, or those near death. The wealthy and 'well-off' were treated at home.

With advances in medical technology and treatment techniques in the late 19th century, the role (and perceptions) of hospitals changed. As healthcare advanced, hospitals became a symbol of these medical advances and were used by both rich and poor members of the growing Australian population. Salubrity became a priority in hospital design, with the role of sunlight and fresh air in the curing of disease playing a crucial design role.

The impact of Federation

Under the Federation system of government adopted by Australia in 1901, when each of these colonies united to form Australia, each state retained responsibility for the provision of healthcare services. As a result, each state government also retained responsibility for the provision of the healthcare facilities required to provide these health

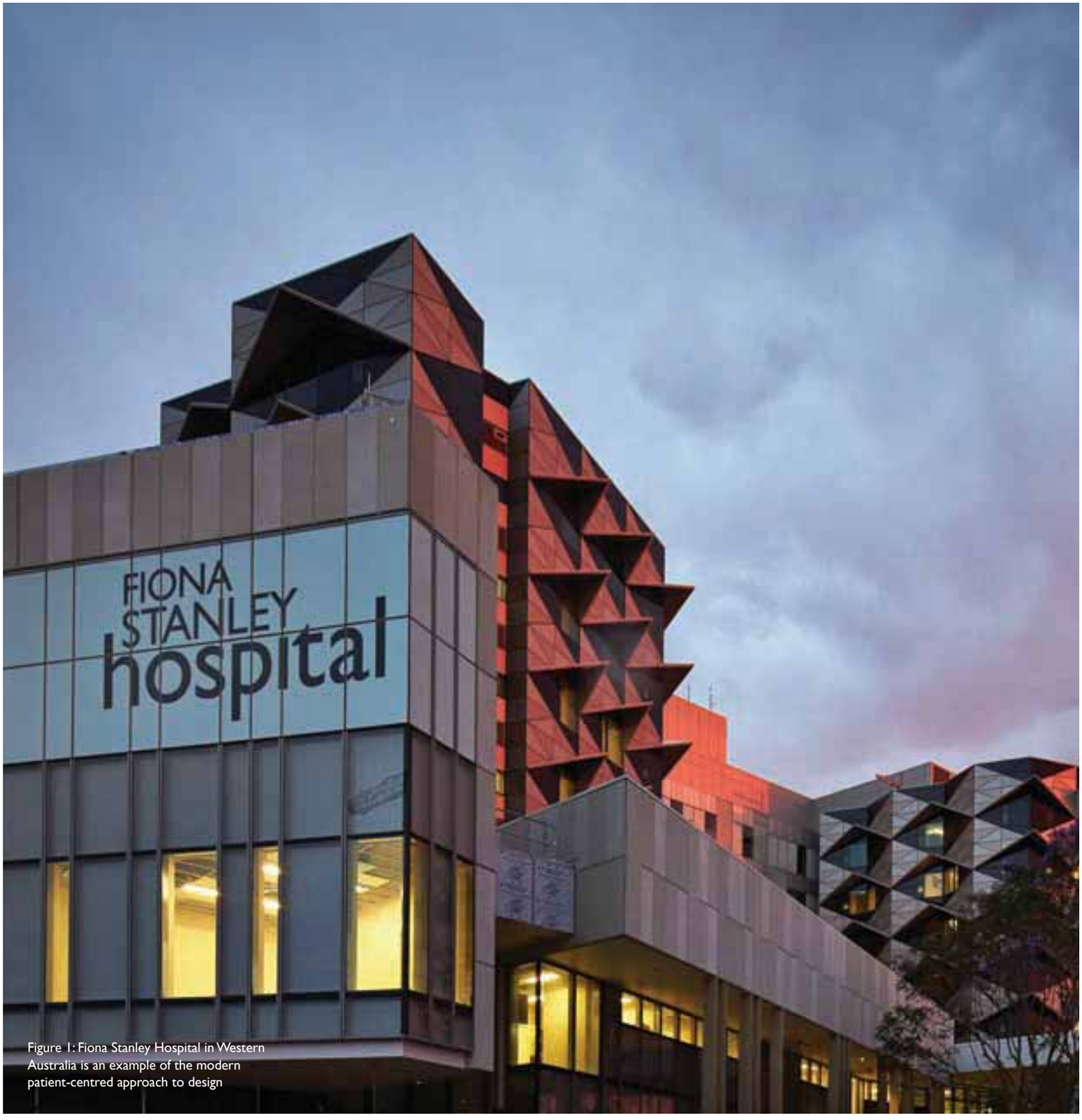

Figure 1: Fiona Stanley Hospital in Western Australia is an example of the modern patient-centred approach to design

services. This method of governance initially created six different healthcare systems and six different arrangements for the provision of healthcare facilities. With the creation of the Northern Territory and the Australian Capital Territory in 1911, and the subsequent entry of the federal government into the provision of healthcare services, this was expanded to nine public healthcare systems. The subsequent development of private hospitals provided another layer of complexity and the recognition of a need for standards given that a government agency wasn't directly involved in the provision of these facilities.

Following Federation, the newly formed states came to grips with their responsibilities for the provision of government services, including healthcare delivery, at the same time as developments in the provision of healthcare services led (some time later) to improvements in the standard of hospitals.

Hospital architecture as a specialisation

During the 1920s and 1930s, innovations in the design of European hospitals and sanatoria were gradually reflected in Australian hospitals, and the demand for additional (or upgraded) hospital beds led to a minor boom in hospital development in the capital cities of the Australian states. With the strong connections between hygiene and function, hospitals became the ideal building type to express the clean lines of architectural modernism and, therefore, were among the first large-scale civic buildings to adopt this style.

Figure 2: Sydney Hospital, the oldest hospital in Australia, opened in 1816. The building almost immediately had to be extensively repaired, due to its poor-quality construction

The rapid changes in hospital design led to this field becoming one of the first specialisations in architecture, at a time when the architectural profession was very parochial – well before the development of national firms. Those who recognised this opportunity and undertook the research were able to corner the market.

Sir Arthur Stephenson was one architect who foresaw the possibilities and undertook extensive study tours overseas to ensure that the design of Australian hospitals reflected these improvements. Based on this newly acquired knowledge, he was commissioned to design St Vincent's Hospital in Melbourne and then went overseas again to undertake further research. His 1932-33 study tour resulted in knowledge that "laid the foundations for Australian hospital design over the next two decades. This trip across America, Britain and Europe included hundreds of hospitals."[1]

These investigations had a dramatic impact on both the functionalism and the design of the many hospitals he was then appointed to develop. The hospitals he designed following this trip (the Mercy Hospital in 1934, the Freemason's Hospital in 1936, Bethesda Hospital in 1936, the pathology block at the Royal Women's Hospital, the United Dental Hospital in 1940, the Royal Melbourne Hospital in 1942 and the Yaralla Military (Concord) Hospital in 1942) all exhibited the strong tenets of modernism with streamlined broad balconies and large windows sweeping across white rendered facades.

During this period, Australia's population was approximately 6.5 million residents, having slowly grown from the 3.8 million inhabitants present when the Federation of Australia was proclaimed on 1 January 1901. At the outbreak of World War II in 1939, Australia's population had risen to 7 million – an average growth rate of 1.2% per annum over the 38 years since Federation. By the end of World War II, Australia's population was still only 7.4 million, but over the next 20 years, due to post-war migration programmes, it climbed to 11.5 million – a tripling of the average growth rate to 3.57% per annum.

Hospital planning and design skills

With this growth came the need for new residential suburbs and the need for the new infrastructure (including hospitals) to service this increase in population. As a result (after the material shortages of the immediate post-war years were overcome) Australia witnessed its second major boom in hospital construction in 1955-75. During this era, many of the central city hospitals were relocated to suburban sites closer to their catchment population.

Hospital design during this period was strongly based on functional needs, and the requirements of technology and healthcare providers became paramount. Many had an institutional feel. The needs of patients were often not seen as a priority, leading to a reaction by those organisations in Australia that followed the Planetree philosophy, which states that care should be organised around the needs of the patient.

Improvements in air conditioning and other mechanical systems enabled deep-planned buildings to evolve, which permitted improved interrelationships between a myriad of hospital departments. But also meant that many healthcare providers and patients were cut off from access to external views and access.

Following this surge, the rate of hospital construction stabilised for a decade until 1986 when a consolidation of private-for-profit hospital companies fuelled another decade of hospital development. Ramsay Health Care, Healthscope, Hospital Corporation of Australia, Australian Hospital Care, Hospitals of Australia and the major not-for-profit hospital groups all expanded their facilities during this period.

In 1995, Queensland recognised the need to upgrade its health facilities after 25 years of minimal expenditure on capital works in health, and embarked upon an AU$3bn programme of public hospital construction. With the programme complete in 2004, Queensland became one of the first states to undertake an evaluation of the outcomes achieved. The resulting Forster Review provided clear lessons for how the planning, design and development of similar projects could be improved in the future. Unfortunately, because there was no national research centre or mechanisms to share this information, this review was never fully considered by other states about to embark upon similar programmes of major health projects.

Beyond 2000

By the early years of the 21st century, the need was recognised to rebuild those hospitals constructed in the post-war years. Following asset audits and an assessment of business cases, a multi-billion dollar programme of capital works was instituted throughout Australia. However, this time instead of the state governments funding all the capital works required, new procurement arrangements were tested with the introduction of public-private partnerships.

The arrangements trialled on Port Macquarie Hospital in New South Wales were then refined by state government agencies and led to projects such as the Casey Hospital in Berwick, Victoria, the Royal Women's Hospital and Royal Children's in Melbourne, Royal North Shore Hospital in Sydney and Sunshine Coast University Hospital in Queensland.

As hospital design increased in complexity, each of these separate jurisdictions developed their own standards and regulations for both public and private facilities. It was not until November 2006 that the Australasian Health Facility Guidelines were launched as an attempt at national alignment of the plethora of different standards and guidelines that had evolved since Federation.

Development of expertise

During the first half of the 20th century, public hospitals were the mainstay of the provision of health services in Australia, aided by the significant contribution that the not-for-profit hospitals (primarily operated by religious orders) made in the major centres of population. While in many states, the architects and engineers employed within Public Works Departments were responsible for the design of public hospitals, there were exceptions to this. As noted above, one of the early architectural practices specialising in healthcare architecture was Stephenson & Meldrum (then Stephenson & Turner) based in Melbourne, although its founder Sir Arthur Stephenson commenced his illustrious career in hospital design while employed as an assistant architect for the Public Works Department of Western Australia.

The governance arrangements in each state dictated the way in which design consultants were appointed for these projects. In Victoria, for example, the boards of management of hospitals often had the authority to commission their own private architectural and engineering consultants leading to the development of private architectural practices specialising in this field. In many other states, however, the 'power to construct' (and the authority to appoint architectural and engineering consultants) remained vested in the Public Works Departments, which jealously guarded their role in this area.

As a result, it was only during the second half of the 20th century (1980s and 1990s), when state governments around Australia devolved the design roles of their PWDs and outsourced this work to the private sector, that expertise in this field developed in the private sector, often abetted by the acquisition of ex-PWD employees.

Figure 3: Sir Arthur Stephenson's global research-gathering shaped his work on facilities like the Royal Melbourne Hospital

Initially, this expertise was confined to local firms operating individually in the capital cities of the major states due to the parochial procurement arrangements and state government 'buy-local' policies. However, as joint-venture alliances developed between firms in different states, collaborations developed, which then morphed into more permanent arrangements, leading eventually to national firms being formed.

These national firms (with access to each of the health project jurisdictions) could then be assured of the continuity of work needed to underwrite the training and skills development required for health facility design.

The role of the federal government

Initially under the Federation system of government adopted by Australia, the only responsibility for health issues allocated to the Commonwealth government was for quarantine issues. However, after World War II, following the establishment of the Department of Veterans' Affairs, 16 repatriation hospitals were established around Australia to provide healthcare services for returned serviceman. This was the first time that the Commonwealth government had taken on responsibility for the direct provision of healthcare services.

As a result, the Commonwealth Department of Works gradually developed expertise in the design of health facilities. Following the establishment of the Commonwealth Rehabilitation Service and the need for the Commonwealth to provide hospital design services for the Australian Capital Territory and the Northern Territory as well as periodically undertaking overseas aid projects, this department established a central core of hospital design experts.

In order to develop its own expertise in this field, during the 1970s the Commonwealth Department of Works instituted the Hospital Architects Training programme, through which selected architects were outposted to hospitals to gain an understanding of how healthcare services were delivered, before undertaking overseas study tours and a secondment in the design branch of the then Department of Health and Social Security, based in London, UK. This resulted in the exchange of research and guideline material between Australia and the UK when the NHS hospital design guides and the activity database were purchased for use in Australia.

Figure 4: Royal North Shore Hospital. Part of a nationwide drive to replace the facilities originally built to serve the post-war population boom

The establishment, by the Whitlam Labor Government in 1973, of the national Hospital and Health Services Commission headed by Dr Sidney Sax marked the commencement of health planning as a discipline in Australia. It provided the first formal overview of health planning indices in its seminal publication Hospitals in Australia.

The Commonwealth government's expertise in healthcare design was considerably enhanced during this period, when the Whitlam Government created a taskforce to plan and design the 'Any Hospital' project as part of its negotiations with the state governments to introduce a system of universal health insurance. Hospital design experts from around the world were brought to Australia to advise on how best to quickly develop a series of hospitals, to be located in each capital city, that could provide Commonwealth health services.

While the projects were never built, the core of expertise remained, resulting in a joint health-works departmental branch being established to manage the Whitlam government's Hospital Development Program, which was responsible for funding hospital projects throughout Australia, including such iconic projects as the Westmead Hospital in Sydney.

National coordination and research

One of the unforeseen benefits of this programme was the opportunity for the Commonwealth to act as a facilitator of interaction between the health planners, architects and engineers in each state government, so that information regarding hospital planning and design could be shared between what were, up until that point, autonomous groups in each state operating in isolation.

The need for research in the field of health facility planning and design was recognised at this time, with the establishment in 1974 of a Commonwealth government advisory group, the Hospital Facilities Services Branch, to service the growing enquiries for information generated by the Hospital Development Program.

A similar need in our largest state, New South Wales, also sparked the establishment in 1976 of HOSPLAN – the Hospital Planning Advisory Centre of NSW. Because of the success of this advisory centre in fulfilling a national need for research and information regarding the planning and design for hospitals, it was closed in 1990 during the efficiency drives initiated by Premier Nick Greiner, when a review recognised that the majority of queries were by then being received from states other than NSW.

While individuals tried to cover this gap with initiatives such as the Group for Health Architecture and Planning (GHAAP) established by Ian Forbes, the need for a funded centre, although obvious, remained unfulfilled due to the

split responsibilities of the states and territories and, therefore, the lack of a leader to address this issue.

This void for a national research centre and information broker remained in Australia until the Health Capital Asset Managers' Consortium (the predecessor of the Australasian Health Infrastructure Alliance) took the inspired step in 2004 of combining funding from the health departments of all states and territories and from the New Zealand Ministry of Health to establish the Centre for Health Assets Australasia (CHAA) at the University of NSW.

Guidelines and standards

Prior to the creation of CHAA on 1 January 2005, each state in Australia was responsible for the development of its own guidelines and standards. When the centre was formed, each state health department donated the guidelines and standards it had developed in previous years to form the basis for one national centre of knowledge on health facility planning and design. Through research, seminars and its role as an information broker, CHAA was able to deliver substantial economic efficiencies for health projects in Australia and New Zealand at a time when billions of dollars were being invested in health projects.

During the six years it operated (from January 2005 to December 2010), CHAA demonstrated the immense benefits of what could be achieved when the states combined their funding in this field to jointly fund research and to act as a central source of knowledge on the planning and design of health facilities. With the funding from the public health agencies and substantial funding from the University of NSW, more than AU$2m was available to undertake its research, guideline development and dissemination role. CHAA also coordinated interaction with overseas research centres in this field and was so highly regarded overseas that the Europeans copied the concept and created eCHAA (the European Centre for Health Assets and Architecture), which still operates today.

Unfortunately for Australia, in December 2010 funding was not renewed and this major contribution by the Australasian Health Infrastructure Alliance in progressing the state of the art in health facility planning and design has lapsed. While the Australasian Health Infrastructure Alliance still exists, the interaction with the private sector that was so important to the success of CHAA is no longer extant.

The Australian Health Design Council has been established to fill this void, but needs the support of both client agencies and the private sector consultants and contractors if it is to match the success of CHAA. However, the benefits to Australia are still being realised, since many of the projects that benefited from the research and guidelines developed by CHAA during the design stage are now being constructed and commissioned for use throughout Australia.

Impact on current projects

The focus on research during this period also enabled a rapid dissemination of literature on evidence-based design in Australia. The Center for Health Design, which CHAA sought to emulate, is still going from strength to strength in the US and has been pivotal in the worldwide development of the research which underpins evidence-based design.

The information from overseas generated by the seminars and research undertaken by CHAA has also seen a renewed focus on patient-centred care in the design of these new healthcare facilities in Australia. Rather than the institutional models of the past, new designs are focused on the needs of patients and their families (a home away from home) with the planning of hospitals modified to bring services to the patient rather than expecting the patients to traverse the labyrinth of many large healthcare complexes.

Examples of this patient-centred approach can be seen in projects undertaken during this period, such as the Royal Children's Hospital in Melbourne, Gold Coast University Hospital and Queensland Children's Hospital, the new Royal Adelaide Hospital in South Australia and the Fiona Stanley Hospital in Perth.

The combination of evidence-based design and this patient-centred approach has also resulted in a greater realisation by clients of the impact of the built environment on the healthcare services delivered in these healthcare facilities. As a result, the past decade has witnessed a greater involvement by senior health executives and healthcare providers in the planning and design of these facilities, as well as a far more collaborative approach to the future delivery of healthcare services.

As we approach the end of this extraordinary period of hospital development, the challenge facing both clients and project teams is how best to utilise the knowledge and experience gained to date in order to improve the way we undertake the planning and design of health facilities in Australia in the future.

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Gathering knowledge

Australia's research capability is growing, with the establishment of programmes focused on areas such as healthy built environments and dementia care, coupled with the innovative design being developed by engineering and architecture firms

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The use of information and communication technology in the Australian healthcare system has advanced in three distinct phases since 2000. The latest phase is moving healthcare into an era of fluid information and distributed care. It is important to understand that a country with a small population like Australia's is relegated to being an importer of research knowledge rather than a developer. Examination of refereed publications internationally and at the Cochrane level shows only one serious Australian article on health facility research.[1,2] Being a British Commonwealth country with a similar health system to the UK, we have traditionally sourced research from the British National Health Service's research institutions.

Similarly, the US expends a considerable amount of resources in evaluating and developing new approaches to capital investment. Consequently, we have borrowed liberally from its research work with regard to the major acute care, aged care, dementia and mental health facility environments, where it has similar service models to Australia.

With respect to the education provided in the specialist areas of health facility development, and especially the design of all types of health facility, there have been limitations to developing this knowledge. In discussion with schools of architecture and design across the country, they have seen their role as the provider of a generic curriculum for students; it takes all their time to provide a full professional education, so there is no real attempt to develop specialist courses at undergraduate level.

Following this degree, graduates may choose their interest in special areas. As such, Australian universities have not made special provision for health facilities design. This is not to say that many universities have not had electives in hospital design or that funds have not been provided to inspire electives in other areas of health design.

Some universities made attempts to introduce specialist courses and found that there were insufficient students to be sustainable. This applied where academics were already on staff at schools of architecture and design. Examples are Professor Graham Brawn at Melbourne University, who had health facility and prison design expertise; Professor Roger Fay at University of Tasmania, who introduced dementia-specific teaching; and Dr Malgosia Zlobicki, who taught classes involving design of dementia and ageing facilities at Queensland University of Technology, now at the University of Queensland. I have taught hospital design at the University of New South Wales (UNSW) and am currently teaching a dementia design studio project at the University of Technology, Sydney (UTS).

In addition, many architect practitioners have been involved with electives and casual teaching in university architecture schools where health-related issues were taught. However, there have not been undergraduate degrees or Masters degrees with labels for health architecture and design. Graduates who wanted to delve into the area have undertaken the work in generalist Masters of Architecture or Design courses, choosing their own focus on health. There have been several PhD theses done on health aspects of design but the candidates are not necessarily architects or designers. The same situation applies to students who want to be involved in health-related project management, building construction and landscape design.

Figure 1: Gold Coast University Hospital. Home-grown, original research now supplements information gathered elsewhere

Figure 2: Research is tackling climatic concerns: Gold Coast University Hospital was designed to meet high standards of sustainability

Research and training pre-2000

Since our examination begins at the year 2000, the layers of history laid down by others needs to be briefly examined covering education and research activities in Australia.

Because the schools of architecture had only minimal responses to health facility development, this role from the 1970s fell to university schools providing education in the area of health management and health administration. It was here that subjects were provided covering facility and physical planning. There was support for this because it was rare that a manager of a health facility or larger health service would not have a building project with which to contend. Planning and strategy were often covered by a limited number of courses in health services planning. In the management context, health planning covers resource distribution using an epidemiological basis to establish the demand and supply of all health resources, including human, equipment and capital investment. It is in the latter area that some aspects of capital investments were historically covered.

From the 1970s, the dominant programme in health services management was at UNSW in Sydney. Set up under a Kellogg Foundation grant from the US, it was initially focused on the Masters in Health Administration. But because Australian health managers were trained on the job, there was a need to establish a Bachelor's degree to provide graduates who could move to a Masters level.

In the mid-1970s, John Green, a health facility architect from the UK, was employed at UNSW in the School of Health Services Management in the Faculty of Professional Studies (the school later moved to Medicine) to teach courses in health facility planning and design. This was the only course in the country that had a physical planning component. Currently the Masters and Bachelor's degrees in health sciences at the University of Western Sydney is the only course with this component.

Green had worked with the Architectural Unit in the then Department of Health and Social Services (DHSS) in the UK and had been involved in the early development of Greenwich Hospital, the early studies on ward design, the Capricode system, the harness hospital system and a range of management issues such as facility briefing, ergonomics and hospital specific materials. He provided introductory and advanced courses on building design and management of projects.

He was the key health facility researcher in Australia at the time and built a base for health facility research. An example of his research was a major study of ward designs in Australian hospitals using a team for on-site observation recording such aspects as the travel distance of nurses in several ward configurations. He examined the issue of multi-bed versus single-bed wards, a debate that continues to this day.

With the establishment of a role in advice to government, Green became involved with research for the early NSW Health Facility Guidelines (HFGs) – known as the Red Books – and in work being done by HOSPLAN (the NSW Hospital Planning Advisory Service of the NSW Health Department), which was developing various other guides, plus teaching security and fire safety in hospitals.

In 1986 he developed cancer and took medical retirement. He passed away the following year. I took his place, having returned to Australia from Canada where I had designed major hospitals and aged care facilities, and worked part-time at the University of British Columbia. I took over the services planning role as well as facility planning at UNSW until December 2001. By 2000, the health administration programme at UNSW was still the only programme to offer physical planning and design from the 15 programmes that belonged to the Society for Health Administration Programmes in Education (SHAPE) covering education in Australia and New Zealand.

Advice to government continued and a new series of HFGs were underway at HOSPLAN to replace the Red Book HFG series, beginning in 1988.

National responses

In 1995, a research and education unit had been established at UNSW called the Group for Health Architecture and Planning (GHAAP) and funded from NSW Health Capital Asset Branch. Its objective was to carry out research in aspects identified by NSW Health and to run evening education sessions for staff working in the field to share experiences and to learn from new research-based information.

In mid-2000, GHAAP hosted a workshop for the capital asset managers from each Australian state and territory health department as well as New Zealand. This allowed many common capital asset issues to be placed on the table. From this meeting, an alliance of capital asset managers from all health departments in Australia and New Zealand was established, which continues today. The New Zealand Ministry of Health has continued to be a partner with the Australian states and territories in the development of capital assets. An agreement was made in 2004 regarding a funding formula to pay for the shared development of the new HFGs, which were badly needed. In the meantime, due to the pressing need for a revised set of private hospital guidelines, the Victoria Department of Health moved to appoint a consultant who developed a computer-based guideline for the Victorian private hospital system that it finally applied to both private and public hospitals. This system became the foundation for the new national HFGs.

In 2004, GHAAP moved from UNSW to UTS. Joining with the Faculty of Nursing, Midwifery and Health (later to become the Faculty of Health) provided opportunities to conduct original research in birthing unit design, aged care and mental health facility design. This continues today and produces research for refereed academic papers.[3].

With funding issues resolved, following a tender by the capital asset manager's alliance, a new university unit was created at UNSW called the Centre for Health Assets Australasia (CHAA). It was formed in January 2005, essentially to develop the new HFGs and provide other research. This unit prepared and updated the new HFGs and carried out its research and teaching activities until it was closed in December 2010.

One example of primary research conducted by CHAA was the Australian Research Council (ARC) funded Climate Change Project,[4] which assessed the adaptive capacity of hospital facilities to cope with climate change related to extreme weather events using a risk management approach. Other work included literature reviews on flexibility in hospitals[5] and work with researchers at the Faculty of the Built Environment at UNSW, which overlapped

Figure 3: At BVN Donovan Hill's Robina Hospital, beds for palliative care patients can be moved outside – just one result of a more people-focused approach

Figure 4: The new Royal Women's Hospital, Melbourne, built as a public-private partnership (PPP)

with CHAA.[6] Research included a focus on digital technologies, and exploration was made of building information modelling (BIM) using gaming avatars for simulations in health spaces. The education focus for CHAA was to provide several conferences, some with the Australasian College of Health Service Management (ACHSM) in 2009 and 2010 and it developed a repository of health and environment related literature.

Healthy environments

In July 2010, following the closure of CHAA, UNSW established the Healthy Built Environments Program (HBEP) with funding from the NSW Ministry of Health of AU$1.5m over five years. This unit arose from concerns with increasing health costs due to rising rates of obesity, diabetes and other lifestyle diseases. Health workers are seeking to influence the design of cities to make them more supportive of healthy ways of living. The HBEP is intended to reach a broader area of concern through urban development by creating healthy built environments. The unit's objective is to: carry out research by fostering interdisciplinary research; provide education and workforce development by delivering innovative, cross-disciplinary education and capacity building; and offer leadership and advocacy to create closer links between health and the built environment.

Research on the relationship between the use of arts in health and wellbeing has been conducted and outcomes evaluated by the University of Queensland's Health and Arts Research Centre, where artists have been involved in engaging with the community and its cultural development. There are several research institutions involved in this area,

including the Arts Health Centre for Research and Practice at the University of Newcastle and the Arts and Health Foundation at the College of Fine Arts at UNSW.

Dementia and aged care

The whole area of aged care, and specifically an emphasis on dementia, has been researched at many universities through public health and health science courses. While the predominant research has been focused on quality of care, quality of life and resident management, issues have arisen around people-centred care, which overlaps with the need to address the whole environment and, therefore, physical space. The aspects of sub-acute and community care are now a federal government priority and some well-founded research has been conducted in this areas.[7]

In 2006, the Australian government established five university-based Dementia Training Study Centres (DTSCs) covering each state and territory. The centres' objective was to strengthen the capacity for research and training in the health and aged care sectors. The University of Wollongong in NSW (under the direction of Professor Richard Fleming, a well-renowned researcher in the area) is the one centre that has been designated to cover environmental design and assistive technology. Its services include the provision of tools and consultancy to help in planning new facilities or refurbishing old ones. The educational activities range from lectures and workshops on environmental design and access to information about design. DTSC launched a new publication, the *Australian Journal of Dementia Care*, which allows for the distribution of dementia-related knowledge as well as the development of a dementia wiki that informs followers about the research programme and how best to put research into practice.

The DTSC recognised that the information concerning dementia design principles had not been incorporated into university design courses, and in 2012 grants were given to three pilot projects for teaching dementia design. These were at UTS for interior design students, the University of Melbourne in the Architecture School, and the University of Tasmania for its architecture students, together with the Wicking Dementia Research and Education Centre, which is at the forefront of translational research. These education programmes will be evaluated in 2013 and recommendations for further dementia design training at university level will follow.

Figure 5: Glenside in Adelaide, designed by Medical Architecture and Swanbury Penglase, responds to new models of care in mental health

Hospital design evaluation

Post-occupancy evaluation (POE) is regarded as a means of developing research results and was carried out by consultants for NSW Health at various times prior to and after 2000. The technique was taught as a part of the UNSW physical planning subject and is currently covered in the health sciences course at the University of Western Sydney. A POE guideline was produced for national use by CHAA. However, while some of this POE information had been used to update the HFGs, the final outcomes were never released or published. The concern was that many criticisms in these reports were subjective and not evidence-based, which suggests the work was poorly carried out.

The learning benefit was therefore denied to the firms of architects and planners that are responsible for the major health facilities in Australia and New Zealand. The POEs would have constituted valuable research in the form of cases studies, but people were not able to learn what had occurred in earlier solutions to improve future outcomes. Despite the stated requirement for conducting POEs in the process of planning structure of many states, this is not well funded and feedback is infrequent.

Hospital design

Recognising that little original research is being undertaken in Australian hospital design, it is important to acknowledge that many of the architectural and engineering firms that design these major health infrastructure projects do contribute to knowledge through new and innovative ways of solving design problems. A questionnaire-based survey was sent out soliciting information from 15 major national firms about aspects covering any research in their practices. The major issues identified were as follows.

Approaches to health system reforms: While recognising that design firms have little impact on this issue, several firms identified approaches taken to meet national objectives. With the Queensland Children's Hospital (QCH), the design firms used workshops to increase the national objective of wider participation, involving 100 users in

a research-style information collection method for gathering and distilling diverse aspirations for the project and identifying the opportunities for achieving them in the built environment. At the Ingham Health Research Institute (IHRI) in Liverpool, NSW, attention was paid to engagement with the community by the use of overpasses linking the research buildings to the Liverpool hospital.

Technology: Based on the learned experiences from work reported in the US and UK, Australian design firms report that they have been able to create innovative approaches to changes in healthcare design caused by the introduction of new technology. This includes innovative ways to provide for new medical equipment, the provision of digital approaches to information distribution, integration of data and user applications for information and communications technology (ICT).

Although it is hard for design teams to have an influence on care policy, there were examples with psychosocial solutions in response to the use of this technology. An example of this was at Glenside in Adelaide where the old paradigm of the compressed physical adjacencies that led to the poor quality and inflexible internal environments were changed by fully embracing technology and allowing spatial disaggregation. Another was flexible engineering at IHRI, allowing the dry research floors to convert to wet research with minimum disruption, and innovative fire engineering allowed the circulation of the entrance lobby to perform as a fire stair.

At the QCH, the design has airport-style check-in facilities (connecting patient call and TV-based waiting data). This was developed after considerable research in order to streamline the arrivals process enough to empower patients and their carers to make informed decisions. In addition, waiting areas are colour-coded and arranged within view of the check-in terminal, thus making wayfinding clear and less stressful.

Concerns were expressed by engineering firms about communications and not being able to fully design the complete systems, due to equipment suppliers providing their own solutions, which hampered innovation.

Procurement: Although the issue of methods of facility procurement – and especially, since 2000, the public-private partnership (PPP) – this issue has dominated the discourse about health facility planning and building. However there has been little research on the Australian experience, and what has been done is often related to risk or modelling of management systems.[8] The topic has filled workshops and opinions from every aspect of the subject, but the only serious research has been from the private finance initiatives (PFIs) in the UK. This has been used to inform the debate – but no articles can be found that do more than review the UK literature. There are no US publications, since it is not an issue there.

Figure 6: At Glenside, there is direct access to gardens and outdoor activities

Models of care: There have been examples of innovative responses to models of care. Experimenting with specific design solutions has caused changes to care practices that have encouraged innovative workplace arrangements, improving qualities and efficiencies of care. An example was the use of a modular and 'open' planning system in the Glenside mental health facility, making it possible to expand or contract each of the functional components. At the QCH it was proposed to use a 'triage gate' in the emergency. This is a hypothetical layout of space to improve flows at the emergency department entry. The design implicated a change in clerking and nursing care models that had the potential to delete waiting from the triage process altogether.

Others were around planning the location and quantity of fixed computers as opposed to mobile computers, the integration of audio visual and video conferencing solutions for new teaching purposes and the implementation of nurse call, intercoms and mobile telephones throughout departments to improve communication between staff and patients.

Perhaps significant is the design solution at the new Royal Adelaide Hospital with the introduction of 100% single-bed rooms and the placing of flexible 'blue space'. The objective is to increase communication between clinical staff using informal and formal opportunities to engage. It is recognised that the whole nursing management system and clinical care models will have to change when this facility opens. This will provide an opportunity for evaluations and research concerning the outcomes in an Australian context.

Environmentally sustainable design: Many firms have been able to introduce innovations that help with the specific climate concerns in Australia, and in collaboration between architectural and engineering firms specialising in environmentally sustainable design (ESD), they have found ways to achieve high Green Star rating levels in built projects. Notable are ESD innovations at the major new tertiary hospitals across Australia. The Sunshine Coast University Hospital and the Gold Coast University Hospital (GCUH) in Queensland, the Fiona Stanley Hospital in Perth, The Royal Women's and The Royal Children's Hospitals in Melbourne and the Royal North Shore Hospital in Sydney are using innovative approaches through their own research efforts. These include allowing the use of 100%

fresh air, chilled beams, displacement air systems, recycled and retained rainwater systems, solar hot water and power, plus co- and tri-generator energy plants. These are now well integrated into health facility solutions, although reports of reluctance to absorb ESD costs are restricting considerable advancement. An example is the solar power at IHRI which produces 50 MWh per year.

Research has been carried out by the architectural and engineering firms into cost-effective facade systems on all the major hospital developments across the country. Innovative solutions have been achieved and the knowledge learned given wide dispersal.

Salutogenic design: All the major Australian firms say they now engage in research into ways they can commit to achieving healthcare design solutions that enhance the progress of salutogenic (health-supporting) design, so that spaces are more manageable, comprehensible and provide meaning for each individual who uses them. The objective is to reduce the level of stress on users. An example is in mental health at Glenside where the designed layout is characterised by embedded gardens, narrow planning and single-loaded corridors, which have impacted favourably on the microclimate of the individual inpatient units. Another example at Glenside is where almost all the primary and secondary circulation provided has views, window seats and direct access to gardens and the wider landscape to assist orientation, wayfinding and access to daylight and sunlight.

Research into the use of the biophilia hypothesis to make outside spaces available for intensive care unit (ICU) patients in beds with medical systems applied is seen at the new Royal North Shore Hospital and at the Westmead Hospital in Sydney. Similarly, the ability to move palliative care patients out into gardens in beds is seen at the Robina Hospital in Queensland and at the Queen Elizabeth Hospital in Adelaide. These all constitute research work conducted to ensure people-focused environments.

At the QCH and Glenside, the circulation systems are organised to offer a range of informal settings that allow the individual to choose between privacy and more public social interactions, be they with other service users, staff or family/carers.

Figure 7: Dementia design is moving up the agenda, with specialist courses introduced at degree level

Conclusion

While Australia has not been able to generate substantial output in original research, it has had a tradition of seeking information from major research centres internationally to apply in health facility design. There are small areas of specialist research occurring at university centres across Australia. Teaching and learning depends on a tradition of using conferences to engage with the stakeholders about health facility developments and this continues to distribute facility design knowledge. It is often overlooked that considerable research goes into creating technical solutions by design teams during the design process and this contributes to new knowledge.

In future, the potential for the proliferation of health facility-related websites will allow the hosting of discussions, so giving access to this knowledge and already expanding rapidly will soon create more opportunity for innovation in design practice.

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Generational design

The turn of the century saw a shift from a medico-centric to a patient-centric model of design, resulting in increasingly humanist health facilities. In the 21st-century, salutogenic and evidence-based approaches will enlighten us further

Corbett Lyon
Lyons

The 2000-2015 period has seen an unprecedented period of activity in Australia's healthcare sector, and a profound philosophical shift in thinking in terms of models of care and the way in which health facilities are designed and planned. This new thinking is represented in a range of new and innovative hospital types that are emerging in cities across the Australian continent. Earlier hospital models – with impersonal, institutional edifices, labyrinthine corridors and clinically designed spaces – are being replaced with facilities that offer human-scale spaces, views to the outside, green roofs and service models which put patients at the centre. These changes are not superficial or merely aesthetic. They are deeply rooted, a manifestation of a generational change in thinking across all areas of Australian healthcare.

Modern hospitals in an Australian context

In the early and middle part of the last century, Australia enjoyed a special status as one of the world's most progressive countries for innovative hospital planning and design. Architects such as Sir Arthur Stephenson and Leighton Irwin introduced many new clinical and technological concepts into the Australian hospital planning design field.[1] Examples in Melbourne, such as the Royal Melbourne Hospital, completed in 1936-42 by architects Stephenson & Turner (Figure 1), the Freemason's Hospital, completed in 1936 by Stephenson & Meldrum (Figure 2), and Prince Henry's Hospital, completed in 1940 by Leighton Irwin but now demolished, synthesised the latest in European medical practices and care models with the emergent language of architectural modernism.

Natural light and fresh air were central to these therapeutic models, many based on European sanatoria, and their smooth-finished, white-tiled environments conveyed a sense of efficiency and cleanliness. Streamlined balconies, strip fenestration and minimalist white stuccoed and cream brick facades expressed the optimism of the time: the idea of a modern and healthy society.

These early hospitals also introduced many new medical technologies and engineering concepts to Australia, including radiography and steam sterilisation. They also recognised the important civic role that hospitals played in the country's rapidly growing cities. Their civic presence and design conveyed a generosity of spirit and gave testament to a collective public good.

The later 20th century

The 1970s and 80s saw rapid advances in medical technologies, including new developments in anaesthetics and day surgery, which allowed procedures previously undertaken in acute hospitals to be delivered in ambulatory settings. Diagnostic spaces grew bigger, and advances in mechanical air conditioning and lighting meant that hospitals could be planned across vast floorplates. Mega-hospital complexes were developed in many of Australia's capital cities and regional communities to accommodate this new world of high-efficiency, high-technology medicine. Fitted out with

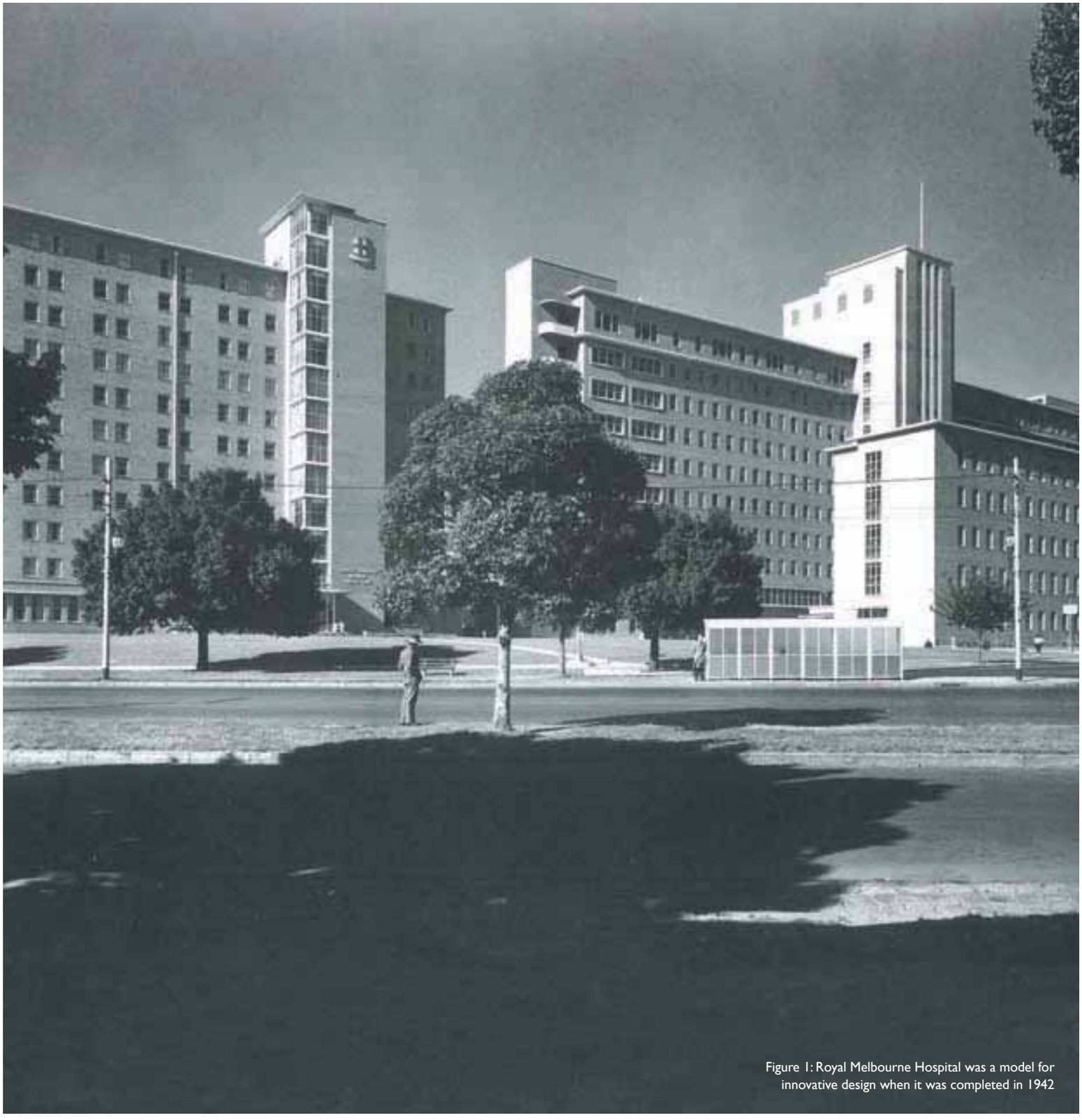

Figure 1: Royal Melbourne Hospital was a model for innovative design when it was completed in 1942

the latest electronic medical and diagnostic equipment, these mega-structures were uncompromisingly functional and were generally planned around the territorial model of the hospital department. Space standards and functional briefs – many of them highly prescriptive – were developed by many of Australia's public health authorities and these had the effect of further reinforcing a functionalist paradigm.

It was during this period that 'health planning' began to develop as a separate, specialist area of expertise, and it became increasingly divorced from mainstream architectural design. The new niche super-speciality located itself on the periphery of the profession and drew its authority from the latest technical knowledge of clinical functions and medical procedures. As a result, many hospital designs in these decades became physical manifestations of health planning and functional paradigms, reinforcing and ultimately codifying the public hospital as an impersonal, institutionalised type.

There were notable exceptions, and Lawrence Neild's Mt Druitt Hospital of 1982, located in Sydney, is an exemplar project from this period (Figure 3). The hospital won the New South Wales Australian Institute of Architects' Merit Award for Outstanding Architecture in 1983. It not only contested many of the functional principles of the time but also developed an architecture that reinvested the hospital with a sense of civitas.

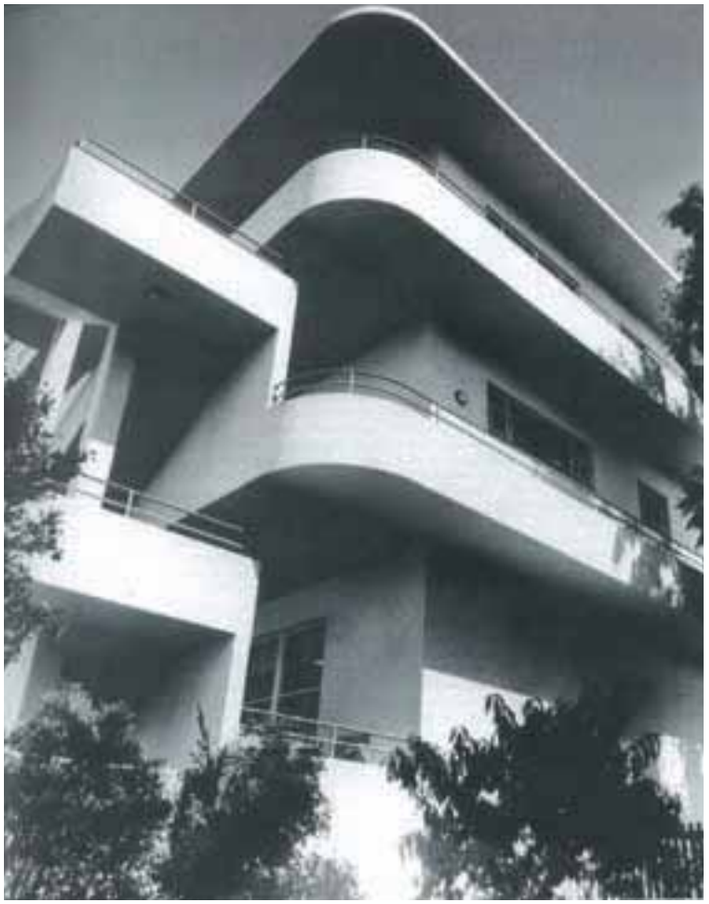

Figure 2: Freemason's Hospital's smooth lines gave off a sense of modern efficiency and cleanliness in 1936

By the turn of the new century, healthcare providers began to reclaim the customer, and patient-focused care emerged as the new paradigm for hospital planning. The high-rise ward block was challenged and medium-rise hospitals were developed in centres of high population growth. During this period, architects and health planners utilised a range of strategies to challenge the increasingly institutionalised models. 'De-institutionalisation' in many parts of Australia became synonymous with domestication and many regional healthcare facilities of the 1990s employed a residential architectural language – pitched roofs, banded brickwork, timber pergolas, 'residential' windows and domestic detailing – as an aesthetic strategy to subvert the prevailing language of the public institutional type. In the private healthcare sector, architects followed the lead of the US and developed hospitals that utilised the signs and symbols, and decor, of the luxury private hotel.

These were genuine attempts to reconnect the patient and the community with the hospital within the life of the city. But the institutionalised practices, public hospital codes, and the architecture attached to them, proved highly resistant to change and these projects effected only modest changes to the prevailing functionalist models.

Into the new century: 2000 to 2015

The last 15 years have seen Australia make a significant capital investment in new healthcare facilities and infrastructure. Community, regional and specialist tertiary hospitals have been developed in almost every Australian capital city and others have been established in Australia's fast-growing regional communities.

The designs of these new hospitals have followed a new worldwide trend where the needs of patients and families have been put at the centre of the healthcare model. Australia's new and soon-to-be-completed hospitals are also playing a more direct role in supporting health and wellness by opening out and re-engaging with the communities they serve.

The emergence and adoption of evidence-based design (EBD) into Australian design practice represents one of the defining characteristics of this recent period of hospital planning and design. By applying evidence-based research, architects and planners are able to deliver designs that are underpinned by empirical research; to deliver stress-free environments for patients, improve work practices and workplace amenity for staff and to optimise patient health.

EBD had its beginnings in early research studies in Europe and America in the 1970s but made its first appearance as a defined area of research in the US in 1999. Its adoption into Australian hospital design practice would not become evident until the first decade of the 21st century. Development of the worldwide web and search engines such as Google enabled Australian practitioners to readily access exemplar projects and evidence-based findings. Textbooks on the subject also became an integral part of the architect's library including seminal books such as *Improving Healthcare with Better Building Design*[2] and *A Visual Reference for Evidence-Based Design*.[3]

While Australia is yet to establish a central repository for Australian evidence-based research, healthcare providers and designers have continued to share and access resources from the international community. The US-based Center

for Health Design, established in 1993, and a pioneer in EBD, brings together participants from across the world to share and disseminate research knowledge in the hospital planning and design field.

A number of Australian architectural and health planning firms have made a commitment to EBD by establishing in-house research units, including Woods Bagot, Lyons, Billard Leece and Hames Sharley. Using a combination of intern programmes, in-house research staff, postgraduate academics and partnerships with Australian universities and academies, these practices are facilitating project-based and primary design research that will ultimately contribute to the local and international knowledge pool.

The emergence of patient-centred care

Australian hospitals developed in the 1980s and 1990s reflected a strong medico-centric model of care. Hospital departments were generally planned and located to deliver optimal operational efficiencies for clinicians and staff, often to the detriment of patients and families who were required to access multiple areas of the hospital to receive their care. In these environments, patients and families felt disempowered; on entering hospital, they relinquished control over their daily lives and had little or no control over their hospital care.

By the early 2000s, this model was beginning to change as Australian healthcare providers, prompted in part by new concepts in business thinking, began to reclaim the patient. Leaders in the healthcare industry began to talk about 'customers' rather than 'patients' and customers started to matter as much as efficiency throughputs.

Patient-centred care in design practice began to take hold in Australia in the mid-2000s and evidence of this new approach can be seen in many of the major new hospital projects recently or currently being completed in Australia. These include 2012's Royal Children's Hospital in Melbourne by Billard Leece and Bates Smart with HKS (Figure 4); the new Royal Adelaide Hospital by DesignInc and Silver Thomas Hanley, due to be completed in 2016 (Figure 5); The Fiona Stanley Hospital in Perth by Hames Sharley, Silver Thomas Hanley and Hassell, due to be completed in 2014; and Lyons' major redevelopment of the Royal Hobart Hospital in Tasmania, due to be finished in 2016 (Figure 7).

Considerations of operational efficiencies for staff and clinicians remain important, but in the new Australian century the pendulum has swung back firmly in favour of the patient. In contemporary practice, the concept of the 'patient journey' has also been embedded as a powerful planning and design tool to describe the dimensions and 'flows' of the patient journey within the patient centred care model.

Becker[4] and others have undertaken systematic studies of patient journeys in the modern American hospital.

Figure 3: Completed in 1982, Mt Druitt Hospital was an exception to the large, impersonal facilities of the period

Figure 4, above: The Royal Children's Hospital, Melbourne incorporates nature, animals and a sense of fun to reduce children's stress

Figure 5, below: The new Royal Adelaide Hospital will create a welcoming environment for patients and their visitors

They have found that patient visits often include long periods of waiting and delay combined with the need to access multiple sites within the hospital. Evidence shows that stress levels and anxiety for patients and families increase as a result of extended periods of waiting, particularly in areas involving urgent treatment. By re-engineering the service delivery processes and removing unproductive steps in the journey, the patient visit can be made more streamlined and convenient.

Improved wayfinding, provision of spaces for families and carers, facilities such as cafes, lounge areas and outdoor spaces and other design attributes that support the normalisation of the patient experience are key elements in this renewed focus on the patient.

The salutogenic perspective

The concept of salutogenesis was developed by medical sociologist Professor Aaron Antonovsky in the late 1970s.[5] It describes an alternative approach to healthcare whereby conventional pathogenic models, which focus on the treatment of disease, are subverted in favour of an approach that is focused on identifying those environmental factors that support health and wellbeing. Antonovsky proposed that a person's capacity to maintain a healthy life and sense of equilibrium were supported by what he termed a 'sense of coherence'. He described this sense of coherence as having three complementary attributes – comprehensibility, manageability and meaningfulness. His approach, translated into the world of health planning and design, suggests that hospitals may be designed to directly affect and support a person's sense of coherence, and in doing so reduce stress and promote wellbeing and health.

Salutogenic attributes, such as intuitive wayfinding, light and fresh air, access to views and to green space, the use of natural colours and materials and providing users with control over their environment are all elements that contribute to the creation of a restorative health environment. Opportunities for the application of salutogenic thinking to healthcare facility design have been well documented by researchers such as Dilani,[6] Golembiewski[7] and others, and promoted extensively by the International Academy for Design and Health. The approach is now being introduced into Australian design practice as a complementary approach to evidence-based and patient-centred design.

There is a need for systematic and empirical studies to investigate and verify the value of the salutogenic model, and to identify the specific design and environmental factors that contribute to the creation of a psychosocially supportive environment.

The soon-to-be-completed Queensland Children's Hospital in Brisbane (Figure 6) by Lyons and Conrad Gargett Riddel is one of Australia's first hospitals to be designed using the salutogenic approach. A research study to be undertaken by Lyons and the University of Melbourne in 2014-15 will identify the specific psychosocial attributes of its design and will undertake a comparative evaluation of the existing facilities at Royal Children's Hospital, Brisbane, and the new hospital.

The changing role of the architect and the client

The 2000-2015 period is also characterised by significant changes in the way design professionals undertake their role as designers and planners of healthcare facilities. Teams of specialist functional health planners are still present, as is the need to deliver ever more efficient facilities, but they and their specialist disciplines are being merged back into mainstream design thinking. Other disciplines, particularly from the social sciences (including public health, sociology, sustainability, workplace ecology, environmental psychology and the arts) have also been added to and integrated with the designer's expanded service capability. This has resulted in the emergence of truly integrated, multidisciplinary design teams that are now providing more holistic, and humanist, perspectives on hospital and healthcare design.

The interdisciplinary nature of contemporary health planning and design has also changed the way in which designers engage in the design process. Where many projects in previous eras were led, and often driven, by small teams of professional 'experts', designers are now offering a new form of enabling leadership, facilitated through design-led dialogue and interactive engagement.

Evidence of a renewed interest in hospital planning and design as a mainstream design activity can also be seen in the curricula of some of Australia's leading design academies. Design studios, research projects and investigation studies into new directions in healthcare planning and design are being undertaken in a number of Australian universities. Undergraduate and postgraduate design studios, research projects and investigation studies have been offered at

Figure 6: The Queensland Children's Hospital in Brisbane is one of the first Australian hospitals to be designed using a salutogenic approach

a number of Australian universities including the University of Melbourne, the University of New South Wales, the University of Technology, Sydney and the University of Western Australia. This suggests that hospital and healthcare facilities have returned as a design type considered worthy of serious intellectual investigation by a new generation of architects and designers.

Hospital clients too, have changed the way in which they participate in the design process. No longer the sole province of CEOs and hospital boards, today's client structures are designed to optimise innovation across all areas of the client's operational and strategic activities. User groups and project stakeholders are now important participants in the design process. Nursing staff, clinicians, management, government agencies and community representatives are all able to contribute local knowledge, expertise and corporate intelligence and to reflect community aspirations through user groups, design reviews and workshops.

This confluence of hospital clients seeking innovation, and structuring their client teams accordingly, and architects and designers able to bring a new and expanded form of creative thinking to healthcare design has been a particularly encouraging and defining feature of this recent period in Australian hospital design.

The future

With renewed interest in the health planning and design field, and Australia now making a highly visible and tangible contribution to world thinking, the future of health facility design in Australia looks bright.

Over the coming decades, models of care, healthcare practices and technologies will continue to evolve but it is likely that the new focus will be on promoting wellness, the design of supportive environments and ensuring long-term environmental sustainability. We can reliably expect to see a new generation of hospitals reflecting these humanist attributes, making engaging contributions to our future cities and actively supporting our society's health and wellbeing.

Figure 7: The design for the redevelopment of Royal Hobart Hospital in Tasmania puts the patient at the centre

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Blind spot

Mental health care has experienced pivotal changes since the turn of the millennium, but there remain issues that hold progressive facility design back. Research can point to how such spaces might look in the coming years

Jan Golembiewski
Schizophrenia Research Institute

In a brand-new, state-of-the art, high-dependency acute care mental health unit, the nurse beeps in a visitor and pulls on an anti-ligature door handle. The flash front counter sits in a foyer that looks like it could be the corporate headquarters for an international corporation. High, raked timber-clad ceilings and double-height glass windows looking on to untouched garden beds of artfully placed Australian wild grasses. The brief for the new unit was to build a 'state of the art and future-proof' facility to replace a 15-year-old 'deconstructionalist-style' building that was placed opposite the emergency department. The old unit had holes kicked into its plasterboard walls and was plagued by behavioural issues. These, I was told, were because it had a 'blind spot', a smoker's courtyard and dual-occupancy rooms. The new unit has very few blind spots (from the nurses' station), and these are supported by CCTV surveillance. It has no-smoking, single-occupancy rooms and plenty of parking. The high-dependency units live up to their name – not a door in the unit can be opened without staff assistance, even the bedrooms or courtyard.

Thirty years ago, the same hospital (on another site) had a locked psychiatric ward. If you peered in the window, past the safety-glass nurses' station you could see a Nightingale ward with 20 or so beds on either side: patients were sedated and confined to their beds.

Institutionalisation and deinstitutionalisation

A rise in global concern for psychiatric patients in the 1970s and 1980s had a rare confluence with conservative politics in the US and UK, resulting in policies of deinstitutionalisation.[1] In April 1992, the first National Mental Health Strategy was launched by the Australian federal government. Since then a lot has changed.

The problem was complex because psychiatric illness was a black hole that no one wanted to deal with. Mental health wasn't covered by the universal healthcare system, and as such, the burden of care was carried over many different state government and charity purses, with no one willing to take full responsibility. The result was (and still is to a lesser extent) that mental health was badly underfunded. It also allowed self-serving and hermetic fiefdoms to dominate the sector. At the time, almost 80% of patients in the public system were in long-term care, in stand-alone asylums that were typically located in 19th-century buildings situated within enormous grounds very close to metropolitan centres. There was no evidence that the model worked, and patients and their families did have concerns about their one-way doors, their stigmatising effect and horrific reputations. A typical example was Callan Park in Sydney, which occupied 43 hectares of waterfront parkland in an inner-city suburb.

All the states took different approaches to implementing the first, second and third National Mental Health Strategies – with mixed results. The money for reform largely came from the Labor Party (socialist) controlled Commonwealth (federal) government. But states with Labor administrations failed to implement changes for more than a decade largely due to opposition from nurses' unions, which feared that nursing jobs might be at risk and that patients might end up on the streets. The first state to fully embrace reform was Victoria, which had a Liberal Party

Figure 1: Ballarat Base Hospital Acute Mental Health Facility's open timber fence portrays a noninstitutional face to the wider community, helping to reduce stigma

Figure 2: The high-dependency unit courtyard of the Adult Mental Health Unit at Canberra Hospital. Inside the three-metre fence, there is only artificial grass

(conservative) administration. It welcomed the funding offered by the Commonwealth and, with bipartisan support, it was able to aggressively push past any opposition and set about replacing the asylums with community-based care.

Community-based care is a real improvement on institutional care, but it's not a magic panacea. How it is implemented varies hugely from state to state and country to country. A worldwide literature review concluded that 12% of homeless populations fit the criteria for a diagnosis of schizophrenia.[2] How this figure relates to deinstitutionalisation is unclear because the studies cited are scattered over the period of deinstitutionalisation.

In Brazil, for example, formerly institutionalised patients either live in homes with carers, or independently (sometimes homeless) with occasional psychiatric support from day centres. The former model has the disadvantage of replicating some patterns of institutionalisation, and the latter can be criticised for entrenching isolation and homelessness. Even so, despite these criticisms, patient consensus is that both alternatives are far better (and cheaper) than total institutionalisation, even as models of deinstitutionalised care still need improvement.[3]

The Victorian model of deinstitutionalisation also attracts criticism, but at least total institutionalisation in Victoria was eradicated by 2000: all chronic patients were transferred into 'villages', very much like nursing homes, where patients were given rooms in semi-independent cottages. Community-based carers, who occupy the gatekeeper houses, care for these patients. Patients who require acute attention are sent to acute mental health centres based within local hospitals. Patients who commit crimes are sent to forensic facilities. More and more, short-term specialist facilities are being constructed to suit local demographics.

The next few years saw other states gradually move toward implementing models based on the Victorian success. Most patients throughout Australia are now deinstitutionalised, although only Victoria has completed the process, along with the Australian Capital Territory (ACT) and Northern Territory (NT), which never had asylum-style care.

Guidelines inhibit progress

The first Australian attempt to codify the design of acute mental health facilities was in 2007, when CHAA (the Centre for Health Assets Australia – now defunct) released the first edition of the Health Facilities Guidelines (HFG). The guidelines included standards for acute mental facilities. These had very little empirical basis, other than

referring back to relevant statutes and replicating what other countries were doing to provide "solutions to satisfy the most commonly accepted design requirements". Nevertheless, they made architectural decision-making easier and provided a common basis for quoting on new project design and construction. The 2009 edition was officially adopted to varying degrees in all the states and became the Australasian Health Facilities Guidelines (AusHFG), expanded to provide guidelines for child and adolescent units, and psychiatric emergency care centres.

Guidelines are probably more suitable for areas of medicine other than psychiatry, where minor changes in the built environment can be amplified with disastrous results whenever task-oriented surgical procedures are not performed in highly predictable physical environments.[4] Except for a few specialised procedures (such as electroconvulsive treatment), current models of treatment for mental illness do not demand the same reliability and predictability as a surgical suite. Instead, the built environment is used as a tool to restrict and manage patient unpredictability and other aberrant behaviour. This is reflected in the AusHFG, which somewhat cynically mentions other statutes and guidelines (such as the NSW Department of Health's Restraint, Seclusion and Transport Guidelines for Patients with Behavioural Disturbance) without drawing any attention to the most salient points: that treatment is compromised by restriction and observation and "that these methods can never be considered a therapeutic intervention", for instance.

Coercive models of care and restrictive environments (including physical and chemical restraint and institutional conditioning) are known to cause emotional damage to patients, and shatter the trust and respect that should be fostered between patients and their carers. Such methods are currently used "at unacceptably high levels in mental health facilities, reflecting prevalence of poor clinical practice and culture".[5] Rather than address this, the AusHFG enshrines such models of care. In crystalising "the most commonly accepted design requirements" to improve the project management efficiencies, the AusHFG inadvertently draws attention to a bigger problem for all architects: at what point does the architect have a moral responsibility to challenge a flawed brief?

The high-dependency unit (HDU) is an environment where the 'grab and jab' mentality of the institutional wards still persists. It's also evident that 'safety' is a euphemism for an overuse of sedation and an absence of opportunities for suicide: locked doors, separation and the removal of furniture and of objects that may conceivably be used to harm. Yet inpatient suicide is rare, occurring in no more than 0.004% of admissions. Furthermore, there's no evidence that a restrictive environment alters this figure,[6] presumably because the loss of a locus of control increases actual risk while decreasing opportunity. What is alarming about emerging data (as yet unpublished) is the correlation between restrictive environments and a very significant increase in patient suicide numbers within a week of discharge.

Instead of focusing on what could go wrong, facilities should be declaratively positive, rewarding and empowering environments to allow recovery.[7] The garden in the new HDU I mentioned in my introduction has no plants. Artificial grass has been laid over rubberised asphalt. Even in the old asylums, the patients enjoyed better than this – real gardens to wander around. In both the gardens and the buildings, there should be variation. Mental illnesses are not all the same and patients may need different environments to recover, just as they may require different psychotropic medications to alleviate symptoms. Some need calming and others stimulation depending on their presentation and time of day.

The future

The future has always been hazy for mental health facilities, because there's always been a big question about how mental illnesses can be treated. From here, there are two ways forward. We might stick with the existing paradigms: this position is largely supported by the staff, who still hail from the bygone era of asylum-style models of care, by project managers who don't consider it their responsibility to interfere, and also by the members of the community who don't want to know about mental health except that potentially dangerous patients are locked away. Decisions are made on the basis of concerns such as staff convenience rather than best interests for patients.

Meanwhile, almost all the available evidence indicates that the current model for mental health facilities is unacceptable and not fit for purpose. There are now hundreds of empirical studies demonstrating that restrictive and coercive practices are part of a dangerous nexus of pathology, clinical practices and social/environmental factors that lead to poor mental health outcomes.

Only recently has evidence started to emerge that the environment is a causal factor in mental illness[8] and that perception is largely moderated by meso-frontal dopamine, the very same neurotransmitter that is implicated in all manic and psychotic illness.[9,10] This transmitter is particularly sensitive to perceptions that can be interpreted negatively or are ambiguous in how they should be interpreted.[11,12] A mistake that is often repeated is in programming legal facilities (such as magistrates' rooms in Australia or courts in the US) into mental health facilities. The primary role of these in a facility is to legally impose unwanted restrictions, and the presence of courts and the like makes a mental

Figure 3: Callan Park Mental Asylum, built over 43 hectares, was typical of the asylums of the 19th-century

Figure 4: Gold Coast University Hospital Mental Health Unit gives patients access to gardens and views over the parkland

health facility look and function as an adjunct to the legal system. These lend a negative tone and make mental facilities inappropriate places to recover. Even environments that are effectively ambiguous have been shown to trigger significant deterioration of a broad range of psychological tests within a period of 10 minutes of exposure.[13] Another mistake is to strip back environments to what is euphemistically referred to as 'low-stimulus' space in the belief that this will calm patients down. Even in healthy people, the perception of very low-stimulus environments will cause psychotic experience over a long enough period.[14]

Understanding this means challenging the guidelines and models of care. This has to be done collaboratively and in a balanced way, in a forum where mental health consumer advocates, facility managers and clinical staff can all balance their concerns. Problems, which inevitably cluster around issues of observation, control, staff and patient safety and models of care, should be tackled rigorously with up-to-date research and with mutual understanding. This should happen very early in the design process, ensuring that decisions aren't lost or watered down during the long design, detailing, construction and commissioning process.

An architect must take an active role here – and have enough integrity to resist passively gathering the working programme as a fait accompli. Architects must be informed and have the courage to advise stakeholders about what is possible and reassure them that passive architectural solutions are effective tools of treatment. There's a general a lack of knowledge about what is possible, what is legal and about the potential of architecture to trigger and reinforce cultural change. It's a little-known fact that designers drive almost all innovations in this specialist space and that the other professions tend to leave it to them. But it's everyone's responsibility to ensure that 'future-proof' doesn't mean unfit for tomorrow.

Modelling the solution

The task of designing a good therapeutic environment is made easier by understanding the principles of salutogenics, first developed by Aaron Antonovsky in 1987[15] and adapted as a method specifically for designing mental health facilities.[7,16] The theory asserts that a sense of coherence (SOC) is pivotal for improving health and that the SOC is the total of generalised resistance resources (GRRs) minus generalised resistance deficits (GRDs). Where GRDs are an entropic force made up of all adverse circumstances, GRRs are more specific and can be broken down into resources that contribute to any of three silos: comprehensibility, manageability and meaning.

Comprehensibility is a critical GRR for mental health patients, especially those who are prone to delusions. In the context of a mental health facility, this mostly means knowledge. Even when patients admit themselves to care, they do so because they recognise they are out of control and need to be admitted, not because they want to be admitted. So it would be fair to say that almost all patients will need to be fully oriented so they know how to ensure a quick discharge. Clinical staff should be completely frank about the diagnoses they are giving, the prognosis and the effects and side effects of any treatments that they are prescribing.

Comprehensibility is constructed out of narratives that are extracted from experience (ie our understanding that X happens as a result of Y). Because the acceptability of evidence can be very tenuous, entirely superstitious or even hallucinatory, delusions are easily fermented in the search for understanding about the world and a person's role in it. A lack of transparency about why things happen and how things are to happen may damage comprehensibility and exacerbate symptoms. Particular care should be taken that staff and carers are honest, inclusive and transparent about their decisions, and that they are genuinely 'on side' for patients, lest perceptions of unfairness feed paranoid delusions.

Manageability resources are the enablers that help a person manage their daily lives. In an acute care facility, staff tend to take over this role, but maintaining the skills needed to prepare wholesome food, to clean, to shop and negotiate 'bill-paying reality' should be made a priority. Useful resources that patients are expected to use outside should be available inside, so skills don't atrophy and can even be developed. Computers, laundry facilities, 'normal' bathrooms, kitchens, provisions for exercise, productive gardens and even mediated shopping facilities should be available for patients, even in short-term stay or high-dependency units. Instructional activities of daily living (ADL) facilities are a start, but they are usually kept locked and nonoperational. ADL bathrooms seldom have plumbing, for

instance. The original asylums conceived by TS Kirkbride in the mid-19th century, had animals for patients to milk and care for, vegetable gardens to tend etc. The belief was that meaningful and positive activity was helpful for maintaining a sense of wellbeing. The same principle applies today, but caution should be taken that not all activities should be work-related. (The Kirkbride units had a lot going for them, but within a decade of design, they were universally already becoming overcrowded sweatshops of indentured labourers.) Apart from rewarding work, art, music, reading and writing are important. Some consideration should also be made for tobacco addiction, as taking away this crutch may make life less manageable at a time when that really matters.

Sometimes concerns for manageability for staff trump concerns for patients. How often is parking a priority over public transport accessibility? (Understanding that staff will drive cars but patients catch public transport and may get confused if they need to change buses.) Is it better for staff to be cloistered in nurses' stations or out among the patients? In a brave move, some units in the UK are abandoning nurses' stations altogether.

Meaning is perhaps the most important GRR for mental health patients, especially for affective disorders – those who are depressed, suicidal or violent. Meaning grows with concerns about the world beyond one's own self. Meaning also spurs action: it makes life worth living. Pets, work, family, friends, other people, religious beliefs, concerns for the environment, nature, politics, art, music and anything that helps to build a sense of identity are all very important for the creation of meaning. In the UK, Medical Architecture regularly designs mental health facilities with provisions for local fauna such as bird and bat houses. Patients appreciate these because they are distinctly positive features that demand an engagement in the world beyond one's own private concerns.

The building of meaning should take precedence over concerns for safety, because meaning is a foundation for sustained wellbeing and therefore safety. In New Zealand, even forensic mental health units such as Ko Awatea encourage Maori (the indigenous people of New Zealand) to carve sacred totems (known as *pou*). This involves giving forensic patients sharp tools and the space to use them. Reports are that this practice has not resulted in any notable problems.

The physical environment either allows meaning to be made or it restricts it. Every design brief must thoroughly consider patients' frameworks for meaning before they design anything. What is to happen to a patient's responsibilities to their pets, children and other important connections when they are admitted? Are pets and children encouraged to stay too? A place that has lots to do and is truly welcoming will encourage more visitors, and that builds a sense of self-worth. Is there amenity for patients to express themselves? Are there provisions for social interaction? Board games and sports can provide social integration. Art and music are also important ways that patients can meaningfully engage with wider society. And is that not ultimately the goal of psychiatric treatment?

Figure 5: Bird boxes at Roseberry Park Acute Care facility in the UK, designed by Medical Architecture

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Going the extra mile

Regional and remote health facilities are no longer simply smaller versions of their urban counterparts. They need to be highly community focused, embrace technological developments such as telemedicine, and be attractive for staff

David Peters
Conrad Gargett Riddel

Australia's vast size lends a unique perspective to the delivery of health services outside the capital cities and the major centres. Although regional and remote health facilities share many components with their equivalents in more populous areas, there are significant differences, which have become more marked over recent times. The clinical requirements on a case-by-case basis are similar, and the need for controlled processes and infection control is shared by all healthcare professionals. However, with the increased efficiency and effectiveness of medical and communications technology (relating to diagnostic and treatment regimes and the rise of telemedicine), differences between the two environments have emerged. This discussion, while considering the differences in service delivery between the environments, will focus on how the physical and social context might influence the design decision-making process.

Australia has been forced to be resourceful in dealing with remote area health services. For example, the service now known as the Royal Flying Doctor Service was inaugurated in central western Queensland in 1928. It brings the clinician to the remote patient and provides a link from regional health services to remote outposts.

Health service delivery

In the past, regional and remote hospitals have been conceived of as simply smaller versions of their metropolitan counterparts, largely built with the clinical processes and staff in mind, scaled down, often inadequately serviced and difficult to staff. Increasingly, there have been severe and chronic staff shortages in remote areas, meaning that the hospitals could not be efficiently run.

As medical diagnostic and intervention processes have become more sophisticated, the ability to provide such services in remote areas has become increasingly difficult and – with greater levels of expectation and an ageing population – unsustainable.

Current trends point to hospitals concentrating on services that can be effectively delivered and address needs that in many cases are specific to their particular community. For example, mining communities have a higher proportion of young and often transient people and will often require larger emergency departments, while farming communities are likely to have a wider spread of age groups and activities and may require the services of a small general hospital. Some regional areas have extremely large numbers of retirees and geriatric medicine, meaning aged care facilities are a priority.

In order to apply a philosophy of early intervention, the community health centres actually need to be nearer to the community. The result is a greater number of smaller facilities, supported by a regional, tertiary hospital – a 'hub and spoke' model such as that being developed for the new Children's Health Service in Queensland.

Although a particular region may impose special requirements on the design, certain elements will commonly influence the process, no matter the location. These items will inform the design language adopted, and influence built

Figure 1: Wilcannia Hospital in New South Wales, redesigned in the late 1990s, makes a strong connection with the river landscape

form in terms of overall design, details of colours, materials, wayfinding and landscaping.

Common elements that influence the design process in regional and remote areas will include the following. The order of importance will vary according the region, and is in no particular order here.

- The health facility will be one of the most important buildings in the town or region
- The health provider will be one of the major employers in the region
- The local community will have a strong social link to the facility. This link will surpass the social link to health facilities in large cities
- The links between the health facility and the local indigenous community will be stronger than in more urban environments
- The ability to attract and retain staff is more keenly felt in the remote areas
- There is usually a political background to be negotiated. The more remote areas will feel they have been neglected in the past
- As technology develops and becomes more available, regional health facilities place a greater reliance on telemedicine in all its forms
- As a regional facility also becomes more remote, the significance all of the considerations above is magnified.

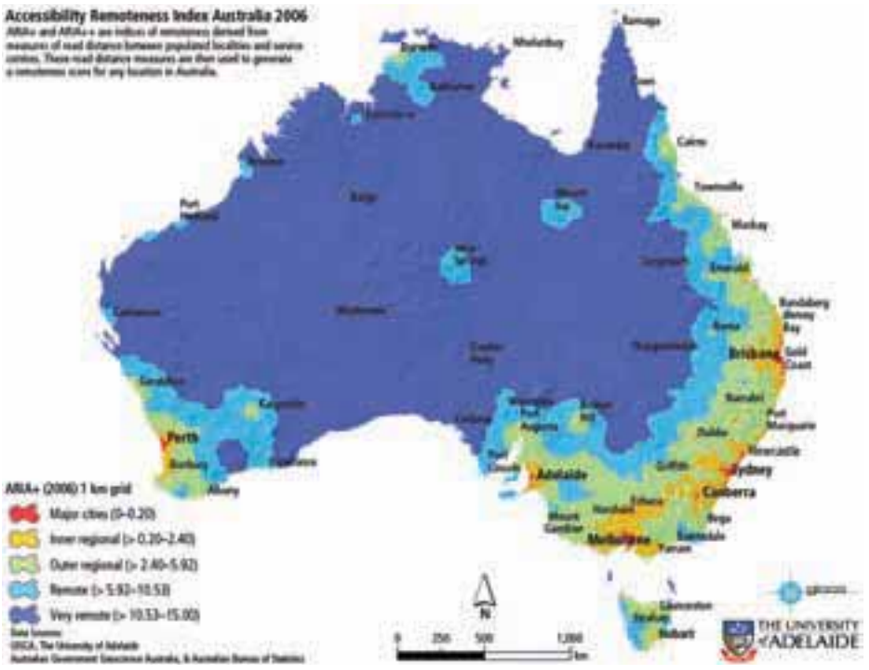
The importance of the facility

The relative importance of the facility to a particular city, town or region rather depends on the population of the area and the relative remoteness of the location. In a very remote region such as far western Queensland, even a small community health facility may become a major focus for the local community. In all regional areas the local hospital or community health facility will usually be a significant building in the town. It would normally be of similar importance to the town hall, courthouse or police station. The importance level emerges from the region's history, the level of influence of the building or service provided and also the level of employment generated.

The health provider, either private or public, will be a significant employer in the region. This source of stability and economic strength is important in the social fabric of a region. A related influence of the health facility is in the area of other support services. The health facilities, especially hospitals, are a common source of support to homeless people, meals on wheels and local charities. The facility often has to respond to requirements other than the core services of the building.

Commonly, the facility will include meeting rooms and gathering spaces for education or other general gathering. It will also act as a meeting place and refuge for locals and visitors in times of disaster.

Figure 2: ARIA map illustrating the road distances between populated areas – most of the country is classed as 'very remote'



Engagement with the community

The people who work in the facilities are 'locals'. This means they live and work in their own area, unlike their city counterparts. The more remote, the more this is so. What this means is that the facility is more than a place of work. It is a method of collaborating and with, and simply living in, the community. This is one of the ways in which the notion that regional and remote facilities are 'part of the community'.

Community engagement is crucial to the success of both establishing and maintaining the facility. Fear of change is real in these communities, and a great deal of care must be taken to allay any fears that the services in an area are to be downgraded. A recent initiative by the state government in

Whether correctly or incorrectly interpreted, there is a constant feeling by the regional users that they have been neglected for considerable time. It is normal for them to have been achieving significant medical and social outcomes with less than adequate resources for many years. The need to do more with less is pervasive in both clinical thinking and in facility briefing. The designer and the service provider need to overcome the users' belief that new projects are simply a 'fix' for old issues rather than a response to a new clinical environment. If the design responds only to the concept of fixing the old, they suffer the possibility of failing to provide for new models of care, and simply perpetuate the old systems.

Figure 3: The Royal Flying Doctor Service (RFDS) has been serving patients in remote outposts since 1928

Queensland has been the reinstatement of hospital boards; this may be seen as a move to engage more closely with communities in the provision of health services.

Because regional communities have a greater reliance on the health facility than their city counterparts, they will be more engaged with the design process, and more open to discussing wider issues surrounding the use of the building. People in these communities do not have the luxury of looking elsewhere for their health needs. It is particularly important that the design is one that engenders ownership by the community. One of the best ways to achieve this is to engage in meaningful dialogue with the community, and be open to allowing this to influence the design. It is also vital to explain to the community the design process, and the outcomes, throughout the process.

This will entail a number of meetings with a variety of community stakeholders. These may include interest groups representing the general community, indigenous community, pastoral workers, emergency services providers and community welfare groups. Although these groups are also common to urban facilities, the key difference is that in a regional setting these groups will usually be the actual users of the building, where in a more urban setting, the groups tend to represent more diverse interests and often are implementing policy rather than responding to an individual need.

Since the facility is often used for additional functions beyond the usual, such as external education, community meetings, social gatherings and social welfare groups, additional requirements need to be discussed and agreed.

The involvement of the indigenous community

The special needs of indigenous people were once ignored. We no longer do this. Indigenous groups are always consulted, and their belief systems considered along with their particular health needs. This may include external waiting areas, provision for ceremonies such as at births and deaths, or provision for culturally-required segregation at certain times between sexes or age groups.

In Australia, the indigenous population generally represents a higher proportion of the population in regional areas

Figure 4: Colours from the region, deep shade and the local river motif make visitors welcome at Queensland's Mount Isa Hospital

than in the highly urban environment. In addition, there is a higher level of health issues, resulting in a disproportionate level of presentation to the health facility. Both the service provision and the building need to address an historical distrust of hospitals in general terms, and ensure that the facility promotes a feeling of trust and wellness to the indigenous community.

In one community, this might mean recognition of the local traditional owners; in another it might mean recognition of multiple communities. It will always entail an understanding of when the locals feel most at ease in the world (often related to water) or how they view the journey from illness to wellness, or indeed the journey to death when this occurs. Building a feeling of trust around death can be of even greater significance than the trust required around making a person healthy. The pastoral care aspect of hospitals has always been considered important, but the belief systems of indigenous populations are all too often ignored.

The engagement of the local indigenous community can unearth many insights into the aspirations of the local people. The key to a successful outcome is the engagement of the key elders in the community. This can often only be achieved with the assistance of trusted external people to act as go-betweens.

How indigenous people will react to an institutional environment is of great importance to the health facility. To design a building that is welcoming, promotes trust and a sense of wellbeing is an obvious aspiration, but this will mean a shift in perception when designing for indigenous people. This will also mean different things to different groups, so needs to be addressed separately for each facility, as local issues will vary. There will also be a different range of issues for different building types. For example, a community health clinic will have quite different outcomes to an inpatient facility.

This process does not impose restraints on the design, but in fact opens up new and exciting options for designers. Schemes that incorporate design for indigenous people typically have good wayfinding strategies focused on external views, discreet and comfortable gathering areas, a respect for the transitions through life (including up to and beyond death), and respect for the privacy and dignity of the individual.

Staff facilities and accommodation

One of the constant sources of irritation within regional, and especially remote, facilities is the ability to attract and then retain suitably qualified staff. In order to do this, it is necessary to provide a good working environment. This means not only the clinical environment, but also sufficient administrative facilities. This may seem self-evident, but within regional facilities there has been a history of providing less than adequate facilities for staff. These need to be more carefully considered than in urban environments as an additional 'attractor' when competing for staff.

In addition, many regions suffer from a chronic shortage of live-in accommodation. There is little future in trying to attract staff to a region where there is little possibility for them to find accommodation that is both physically suitable and affordable. Hence, it is common for the provider of a health facility to also provide housing.

The provision of a private practice suite will also enhance a regional facility. There often needs to be some incentive to attract and retain doctors in remote areas, and there is also the benefit then of a seeming critical mass in the health service.

Figure 5: Tennant Creek renal clinic combines a hi-tech fit-out with a friendly external appearance, using scale, materials and landscaping

Reliance on technology

As technology becomes more advanced, and telemedicine likewise becomes increasingly sophisticated, regional and remote communities are becoming more dependent on these services.

Firstly, the use of technology can allow more timely interventions in emergency situations, meaning that situations may be dealt with quickly and on site, rather than needing to remove the patient to a higher-level facility. In remote areas, moving patients often requires air travel of a number of hours. With the use of telemedicine, this can often be averted.

One currently held view is that the best outcomes occur when those requiring ongoing treatment for chronic illness are treated within their own community. Relocating elsewhere for treatment, especially for indigenous people, can reduce the effectiveness of the treatment and result in less than satisfactory outcomes with longer recovery times. The use of the latest communication technology can often negate the requirement to relocate patients, with specialist advice being available via conferencing. In many cases this can even be at the bedside – especially valuable in emergency cases.

This means setting up an electronic infrastructure that will be robust and respond to demands of emerging technology. Current technologies, such as telemedicine and the use of smart tablet applications, is becoming standard, and future technologies are being embraced. These systems need to be embedded into the facility to allow a wide range of communication devices to be operated (and fully integrated) in all clinical spaces. All of this is likely to demand higher levels of training and some changes to current clinical tasks in order to achieve the desired health outcomes.

Conclusion

In delivering facilities and services, those responsible will juggle many demands, some of which will be in conflict, and many of which will be difficult to predict. However, when considering the design or operation of regional and remote facilities the people – both the staff and the wider community – are the keys to a successful outcome. The client, staff and community groups will all have key inputs into the design and operation, and unlike many urban projects, these groups will also be the end users of the project.

The facility will remain an important feature of the social and physical landscape of the region. It needs to respond to all of the physical needs, to be a building and a service of which the community can be proud, and which responds to its social obligations to the whole community. It needs to provide all the attributes of a safe haven, an education facility and a key element of the social infrastructure, all the while offering the medical care the entire community requires in a discreet and friendly way.

Compact care

Australia's super clinics aim to provide an alternative to traditional hospital beds, giving better local access to healthcare and improving efficiency – and Victoria's first such facilities can act as a model for future design developments

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Providing local access to health services is a challenge to any society. Communities and governments aim to balance the health needs and expectations of people with the demand for health building infrastructure, workforce expertise and financial resources. In the quest to (as far as possible) provide services locally, communities and governments have turned to new and innovative models of healthcare delivery. Such new models of service delivery provide new design challenges that have a symbiotic impact on the overall outcome of the new service delivery model. The design and establishment of 'super clinics' within the Australian state of Victoria between 2002 and 2008 demonstrates the influence of a new model of care and its impact on the design of healthcare facilities, as well as how building design opens up new possibilities for the delivery of services.

The story of super clinics within the Victorian context started with the Steve Bracks-fronted Labor Party's election campaign to hold a second term in office. Faced with mounting pressure to deliver healthcare services locally to communities that were rapidly growing or lacked access to 'hospital-like' services, the Victorian branch of the Australian Labor Party released its 2002 plan to build hospitals for the suburbs, including the establishment of super clinics in the Melbourne outer suburbs of Melton, Craigieburn and Lilydale.[1]

After winning office in a landslide victory in the same year, the Bracks Labor government released its Metropolitan Health Strategy in 2003; it provided a broad, but sketchy, outline of the role of super clinics within the broader healthcare system and the types of services that they would deliver.[2] The Metropolitan Health Strategy made it clear that the government's agenda was to establish services in areas of need, and that super clinics were aimed at being a substitute for hospitalisation, having the capacity to treat people with complex medical conditions requiring specialist intervention within a community setting. Super clinics were also intended to be the catalyst for the development of further health infrastructure, including future collocation of other services to form health precincts. The sites selected for super clinics were to have sufficient land to allow for expansion into the future.

The rise of the polyclinic

While the concept of super clinics was new to Australia in 2003, many countries within the northern hemisphere had already embarked on the use of polyclinics to make their healthcare systems more affordable and more available to local communities. Former Soviet republics such as Russia and Ukraine, as well as Germany, France and Switzerland already had well-established polyclinic networks, which focused on providing a wide range of healthcare diagnostics and services using multidisciplinary teams, without the need for overnight hospitalisation.[3] Cuba also has a network of over 470 polyclinics as the backbone to its healthcare system.[4] The UK is progressing with plans to extend its polyclinic programmes, although it met with some resistance from GPs as the clinics threaten the viability of standalone surgeries under 'businesses rules' associated with the National Health Service.[5]

Many of the guiding principles for Victoria's super clinics were based on New Zealand's model, such as the

Figure 1: Lyons incorporated a distinctive 'ribbon' on clinic exteriors to make them easily identifiable

Manukau SuperClinic, which provides specialist outpatient and day procedures in Manurewa, Auckland. A number of senior health planners in the Victorian Department of Human Services took the opportunity to review the super clinics within New Zealand to help shape the department's vision, which probably gave rise to the strong focus of the Victorian super clinics on outpatient-like services, although the New Zealand model did not offer primary injury-type services.

Figure 2: By scanning a barcode at check-in, patients at Melton Health are directed automatically to the right waiting area

There was strong emphasis on the fact that the Victorian Super Clinics needed to be completed towards the end of the second term of the Bracks Labor government to fulfil its election promise. The Government allocated AU$40m in capital funds toward the building of the Melton, Craigieburn and Lilydale super clinics. Consultants were appointed to undertake all three projects in order to prevent a duplication of effort and gain cost efficiencies; these include CMR Consultants as project managers and Lyons as principal consultants, architect and health facilities planners. Further consultants included AHW Engineering as building services engineers, Connell Mott MacDonald as structural and civil engineers, Gardner Group as building surveyors, Padgham and Partners as quantity surveyors and SKM for environmental design.

Local service planning

The new model of delivering hospital-like services within a community setting left some degree of ambiguity between the hospital and community health sectors about who should govern and operate these services. Victoria's health services are governed by local boards including, in some areas, separate boards for hospital and community health. On the service planning side, the Department of Human Services had an expectation that the boards would come to a consensus on who was in the best position to provide corporate governance of the local super clinic. It was decided that Djerriwarrh Health Services would provide corporate governance for the Melton Super Clinic (eventually named Melton Health); Northern Health, provider of hospital services to the Craigieburn area, was selected for the corporate governance of the Craigieburn Super Clinic (renamed Craigieburn Health Service); and Eastern Health was selected to provide corporate governance for the Lilydale Super Clinic (renamed Yarra Ranges Health).

The term super clinic was dropped by all three health services, which arguably stemmed from local communities' lack of understanding on exactly what it would offer. At the time, the idea of a super clinic was much harder for government and departments to 'sell' to communities than a local hospital service. (Subsequent super clinics established in Victoria used the term 'day hospital' in their title to emphasise their role as a substitution of hospital services.)

The model of care and services provided by all three of the initial super clinics varied slightly based on individual community health need, which was determined though local service planning. Services now provided at super clinics include multidisciplinary outpatient clinics in a wide range of specialities, urgent care or primary injury clinics, renal dialysis, day oncology, day surgery, mental health services, audiology, rehabilitation, medical imaging, pathology collection and dental. The model of care is specific to the individual clinic and was generally influenced and integrated into the models of care offered more broadly by the governing organisation and service partners.

The design considerations for all three super clinics were complex. The design needed to be applicable to all three sites to prevent a duplication of effort and gain cost efficiencies, while still creating something that was relevant to each community's health needs. Objectives of the design brief included facilitation of the service plan and model of care, as well as grouping like services, providing good access, a compact and operationally efficient footprint, showcasing new and innovative technology, allowing for future growth, providing for extended hours of operation, and creating a strong image and community identity.

Good access was achieved through a number of design strategies at multiple levels. Firstly, a comprehensive review of possible sites was undertaken to ensure that the clinics were located in the most appropriate area within the target community. Proposed sites needed to provide high visibility within the community, be accessible by public transport, be large enough to accommodate the clinic with anticipated expansion, and be strategically located to stimulate the development of a health precinct within the area. It was deemed that a parcel of land of between three and five

hectares in size was required for each site. Within Melton, a site immediately adjacent to the main shopping mall was chosen, which was in close proximity to the main arterial highway running through the township. The Craigieburn site was selected for its close proximity to the proposed 're-centering' of the town centre, as planned by Hume City Council, which was envisaged to occur over the next five to 10 years as a result of urban growth. The Lilydale site was more unusual because it was built above an existing community health centre to perpetuate the development of a health precinct in an area that was already close to a shopping centre and a local arterial road.

Within the political climate of the day, the super clinic had to also be an icon of government investment into the health and wellbeing of the local community. The site selection and building design needed to let the community know that new health services were available and accessible. While the super clinics were designed in a modular format to accommodate the model of care that incorporated grouping of like-services, the architects designed a distinctive coloured 'ribbon' that surrounded the modules, unifying them and giving the super clinics distinguishing characteristics that made them easily identifiable by the community.

A test-bed for innovation

Super clinics were intended to be a trial site for innovation and new technology. In an attempt to improve access and wayfinding, as well as patient satisfaction, the project control group looked at systems being used within other industries to receive, register and direct clients to the appropriate waiting areas. The use of automated airport check-in systems had just become popular at the time, so the group also investigated how this technology might be applied to healthcare.

The uptake of this technology was somewhat dependent upon each health service provider. Working at its best, however, the automated queue management and check-in service allowed clients to scan a barcode on their appointment letter, which then notified the treating clinician of their arrival, automatically registered that the client had arrived in the health service's patient management system, directed the client to the appropriate waiting area, allowed the clinician to automatically call the client from the waiting area over the television and audio systems, and automatically recorded the length of the consultation.[6] This was achieved through the development of an HL7 messaging interface between the automated queue management system and patient management system, believed to be a world first integration of these two systems within a healthcare setting. The system installed within the Melton Super Clinic is well recognised as being highly innovative and successful, winning a Victorian Public Healthcare Award in 2009 and an Australian Business Award for innovation in 2010.

As part of the access and wayfinding, each module was colour coded using an internal 'ribbon' around the walls and distinctive coloured seating. For example, the module might have a green line around the wall and vivid green seats to allow clients to identify the area. Symbols relevant to the local community were matched with the colours, to assist people who better identified with symbols and shapes rather than colour. The design of the building allows clients to see all waiting areas from the automated check-in point. Once registered, the check-in kiosk displayed arrows, colours and symbols to assist clients in finding the correct waiting area.

The use of the automated check-in service and colour coding of the waiting areas significantly reduced the footprint of the staffed reception area, allowing more space to be devoted to direct clinical service delivery. The system has also lowered recurrent costs, as there was a reduction of approximately 50% in the number of reception staff required. Client satisfaction surveys later demonstrated that only one in 10 clients needed to access a 'staffed' reception service, and that satisfaction with the system was high.

Figure 3: Interior courtyards help light to penetrate into the interior and introduce some views of nature

Staff and sustainability

The security of staff was paramount in the design. Each super clinic was zoned into public access areas, service provision areas (where clients were always accompanied by a staff member) and staff-only areas. A swipe-card system was instigated to maintain the integrity of the zoning. One of the challenges for the design team was to create a reception area that was secure, but also gave the appearance of being open and inviting to the public. This area also had to allow reception staff to be able to view all waiting areas to get a good sense of client activity. This was achieved through the use of glass panelling, which offered a secure barrier between reception staff and the public; it means that staff have good visibility of the public areas, and equally, clients can observe the activities of reception staff.

With an anticipated high volume of activity, the clinical rooms needed to be highly flexible in the sort of services that could be delivered from them. Consulting rooms were designed and outfitted to accommodate a variety of health disciplines, ensuring that items such as sinks, examination couches and clinical lighting were available in all rooms, as well as adequate storage for resources and aids used by allied health staff. Integral to the service model was the philosophy that no one clinician 'owns' a room; instead, clinicians not providing direct service delivery at the time (such as writing up clinical reports or undertaking service planning) utilised open office space within the centre of the building.

The environmental impact of the building was also a significant consideration, with an allocation of at least 5% of the total project budget being spent on environmentally sustainable design. Energy usage was reduced through better harnessing of natural ventilation by strategically located automated louvres, controlled by an automated building management system, and through renewable energy sources such as solar hot water heating. The provision of renal dialysis services from the super clinic sites also provided a unique opportunity to recycle more than 1,500L of dialysis waste water each day, along with the roof run-off, through installing a large storage tank. The non-potable water is then used for flushing the toilets and watering the gardens. Swales were also installed and planted with vegetation for collecting and filtering drainage from car parks before it entered the stormwater system. To reduce costs associated with heating and cooling, computer modelling was used to determine the angle of the external window shades, so that the facilities collected the morning sun to help warm them up, but also sheltered them from the afternoon sun.

Figure 4: The renal dialysis area at the Yarra Ranges Health: local service planning identified the mix of services for each clinic

A number of internal courtyards were included in the design, allowing internal gardens to be planted and letting in natural light. Recycled timber was used in the frames for the internal courtyards, and surface coatings with low VOCs were selected. The level of recycled and recyclable materials were also included in the selection criteria of furniture and fittings – the rigid components in the office chairs selected were made out of recycled car tyres, for example. The floor covering selected was Marmoleum, which predominantly contains natural raw materials, of which 70% is renewable.

Evaluating the super clinic

The first super clinic to commence services was Melton Health in February 2007, shortly followed by Craigieburn Health Service two months later. Yarra Ranges Health commenced services in 2008. Since the construction of the three Victorian super clinics, a fourth – now called a day hospital – was constructed in Sunbury, and opened in 2011.

The clinics have clearly demonstrated that an investment in locally based same-day health facilities is a more cost-effective option compared to building hospital beds for diagnostic and low-complexity activity. The capital investment required to build a 2,500sqm super clinic to service a community of 100,000-150,000 people is likely to 'buy' the same community only 20 overnight inpatient beds with supporting hospital infrastructure. Super clinics offer a compelling business case as healthcare resources become scarce. The Victorian experience has also demonstrated that they can

Figure 5: Clinicians do not 'own' any one room at Yarra Ranges Health; they carry out their non-clinical work in a shared space

also stimulate the development of nearby complementary private health infrastructure, such as GP clinics, allied health clinics and youth services.

Further evaluation is required on the level of overnight-stay hospital substitution that can be achieved through the use of super clinics. Arguably, the inclusion of day surgery capability in all super clinics would significantly enhance the healthcare system's ability to provide services locally, given that over 60-70% of all hospital activity is now undertaken on a same-day basis. Careful consideration also needs to be given to the 'branding' of super clinics, in the Australian context, to ensure that the community clearly understands and values the nature of the service.

Since the inception of the Victorian super clinics, the Australian government has committed AU$650m to the building of 60 GP super clinics around the country. While the focus of the clinics has moved away from outpatient and day-hospital services to primary care services, many of the design concepts are transferable and are often considered by those responsible for designing, planning and delivering GP super clinic services. The Victorian super clinics continue to help service the healthcare needs of their communities, as part of the wider healthcare service system, as well as serve as a demonstration of an alternative model of care to overnight stay hospital services.

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Close to nature

The Royal Children's Hospital Melbourne is based on a design framework developed by the author that integrates the hospital with the adjacent park, and which could be used for other healthcare facilities set in natural environments

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Simply being exposed, even vicariously, to plants, animals and other elements of the natural world can provide patients, visitors and staff at hospitals and other types of healthcare facilities with a range of health benefits. This notion is supported by both clinical and epidemiological evidence suggesting people can derive a variety of positive health outcomes from merely having exposure to the natural world within the context of predominately built environments. The benefits associated with more structured therapeutic programmes using plants and animals to encourage healing, such as horticultural therapy and the use of companion animals, have been well documented.

However, a number of studies have also shown that various environmental design strategies for integrating nature into built environments can result in measurable health benefits for both individuals and the general public.[1,2] Documented benefits include a range of positive benefits, both physiologic (eg lower heart rate, reduced blood pressure, better muscle tension and brainwave patterns associated with relaxation) and psychological (eg a greater sense of wellbeing, decreased stress and increased mental alertness), due in large part to the relaxing influence that having contact with nature can engender. Even viewing representations of natural landscapes within the context of built environments has been found to result in measurable restorative effects. This understanding has wide-ranging implications for the design of healthcare facilities and particularly the fields of architecture, landscape architecture, interior design, urban planning and other professions involved with the design of these types of facilities.

Health and human evolution

The theoretical basis for the health-giving influence of exposure to nature and natural elements has been linked with preferences for particular types of landscapes, specifically those landscapes that resemble the natural settings that provided habitats for our ancient ancestors. The biologist EO Wilson has hypothesised that people possess an inherent love of nature – what he calls 'biophilia', defined as the "innately emotional affiliation of human beings to other living organisms".[3] In support of this hypothesis, Wilson suggests that: "It would…be quite extraordinary to find that all learning rules related to that world (natural) would have been erased in a few thousand years, even for the tiny minority of peoples who have existed for more than one or two generations in wholly urban environments."[3]

The restorative powers of natural landscapes and the benefits of integrating natural elements into the design of healthcare facilities are thought to stem, at least in part, from the notion of biophilia. Other speculations on the relationships between natural landscapes and the therapeutic milieu that are evolutionary in nature are touched on below. However, more comprehensive reviews of these theoretical models can be found in Ulrich,[4] Low et al[5] and Kellert.[6]

Numerous studies have found that people generally prefer natural over built environments. Various evolutionarily based theoretical models have been proposed to explain the link between landscape preferences and the types of natural landscape settings and associated attributes that, in the ancient past, would have helped or hindered early humans in their struggle to survive in often hostile environments. Those landscapes and natural features most

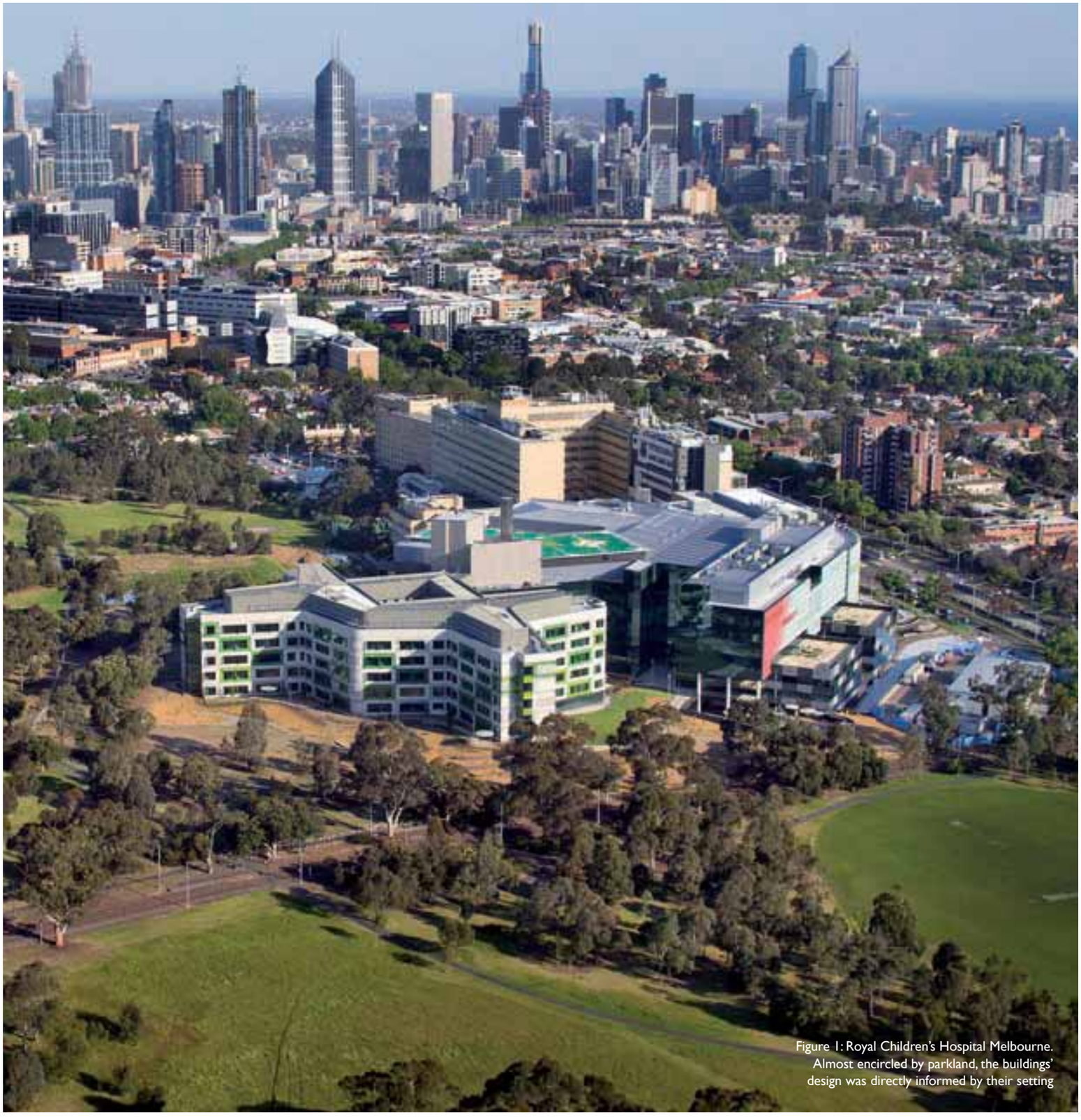

Figure 1: Royal Children's Hospital Melbourne. Almost encircled by parkland, the buildings' design was directly informed by their setting

beneficial to their survival would have been perceived as desirable places and inherently interesting compared to other places.[6] Extending this notion to contemporary landscape aesthetic appreciation, notions of beauty in the landscape would not have evolved if such emotions did not contribute to our species' survival in some way.[7]

Habitat selection theory predicts that savanna-type landscapes (relatively open, with scattered trees and/or small clumps of trees set in a matrix of grasses or other low-growing ground covers) will be particularly preferred because this is the type of environment that formed the habitat of early humans.[7] The findings of one ingenious study[8] confirm this preference for savanna-like landscapes – and for children in particular who seem to innately prefer savanna-type landscapes over other biomes. Many urban park settings have obvious associations with savanna-type landscapes; New York City's Central Park, which in parts is highly reminiscent of a savanna-type landscape, was created with the aim of providing city dwellers with greater contact with the natural world and its associated health-giving benefits.

Prospect-refuge theory[9] suggests that people possess an evolutionary predisposition to prefer places in the landscape that afford prospect, such as elevated locations that offer views over the land and places that offer opportunities for concealment or refuge, both of which would have given early humans survival advantages, particularly during hunting.

Seasonal changes visible in the landscape – such as the budding, flowering and fruiting of plants – would have provided perceptual cues to early humans about the changing availability of food sources. From this evolutionary perspective, the visible presence of flowers would be expected to be a highly valued component of the landscape and may underpin contemporary people's fondness for flowers.[10] It is well known that flowers are capable of signalling to non-human animals the availability of food and the prospect of successful food gathering. In plant communities that are species-diverse, flowers provide differentiation between plant species that may be difficult to determine from foliage alone. It seems that people do place great value on flowers, as witnessed by the money they spend on them as gifts and the desire to have them in and around their dwellings and parks. The custom of bringing flowers to people in hospital may represent an ingrained feeling that somehow their presence will speed recovery. Can the presence of flowers in hospital rooms increase recovery time and elevate people's mental attitudes? Some research seems to suggest that it can.

Figure 2: The inpatient unit, located deep in the park landscape. The facade was inspired by the textures, forms and colours of the park's natural features

It may be that positive emotional responses to flowers gave our ancient ancestors survival advantages in some way and that contact with them is healing to the human spirit, echoing primeval evolutionary connections with the natural world.[10]

Most people, and children in particular, find elements of the natural world to be fascinating, especially when encountered in the context of urban environments. Even subtle and non-dramatic natural processes, such as seasonal changes, the motion of leaves in the wind, bird songs or the patterns of shadows on the ground, can result in reflective states of mind and a strong aesthetic response. This interest in small, less complex natural environments, such as might be found in one's back garden or a nearby park, can result in a heightened mental focus or elicit what has been termed 'soft fascination'.[11]

A design framework

For the design of the Royal Children's Hospital Melbourne, the author developed a design framework to guide the integration of nature and natural elements with the hospital. The aim was to encourage optimal integration of the new hospital with the park landscape in order to create a total park/hospital system and to reap the associated health benefits. Both theoretical and empirical information gleaned from literature published in medical, health promotion/prevention, environmental psychology, landscape architecture, urban ecology and a range of other disciplines was reviewed.

Despite the paucity of research in this area, the scope and breadth of the available literature, coupled with the theoretical insights on relationships between contact with nature and human health, meant that a set of useful design principles could be formulated. These principles could be grouped under five broad categories: natural replacements; passive interaction with nature; nature as a facilitator of social interaction; nature as a facilitator of physical movement; and direct unstructured contact with nature.

Three basic assumptions underpinned the formulation of these principles: first, that there is a positive relationship between good health and contact with nature; second, that there is a positive relationship between aesthetically appealing landscapes, natural elements and human wellbeing and health; and third, the greater the biodiversity of natural settings, the greater the range of opportunities for having contact with nature.

Natural replacements

Natural replacements are elements used to evoke vicarious experiences of natural environments within predominately built settings. This includes the use of natural soundscapes, digital landscape simulations and other 'virtual' landscape elements that allow patients to have vicarious experiences of the natural world. The selection of local biological and geologic forms and materials as well as abstract representations of these forms are design strategies included in this category. A number of studies have linked these types of virtual natural replacements with positive health outcomes. One study found, for example, that watching videos of natural environments resulted in significantly lower heart rates (compared to the baseline) and better performance on various tasks when compared to watching videos of urban environments.[12]

One way the designers of the Children's Hospital responded to this principle was by studying the textures, forms and colours of the natural features found in the park's landscape, mimicking them in the design of the buildings. The facades, for example, incorporated references to natural forms found in the park, while the idea of the main lobby/entry 'street' (a space more than 100 metres long, 17 metres wide and 25 metres high) was to reflect a forest setting and be "deliberately soft, with resonance to birds, fish, leaves and clouds".[13] Seating in the emergency area was designed to resemble coral branches and scaled to fit a single family unit. A dramatic feature of the main entrance and emergency area is a 7.5-metre-high aquarium, strategically placed to provide visual distraction for people waiting for treatment and also function as a device to help in wayfinding.

Figure 3: A parrot on a flowering eucalyptus tree

Passive interaction with nature

Passive interaction with nature includes the use of windows, skylights, viewing platforms and other structures that allow people to view and sense in other ways nearby natural environments. The ability to directly experience natural environments while patients are sitting, lying or circulating through a healthcare facility building is central to this principle. It relates to natural elements and landscapes as an extension of the built environment made possible through capitalising on the 'borrowed landscape'. It is very important that the landscape-window interface be considered in terms of how it can facilitate views of surrounding natural landscapes while still providing a sense of privacy, as the aim is to be able to 'remove' patients psychologically from the hospital setting.[14] Planting trees and other forms of vegetation to provide a green outlook for people in upper-storey rooms is also important. This means considering how people looking down on the landscape from above will see the two-dimensional patterns created from this vantage point. Incorporating elements from the surrounding environment into the building design to create a sense of place identity is also important to bridge the transition from the general community and surrounding landscape settings with the medical facility.

Positive health outcomes related to these types of interventions include improved post-operative conditions of patients, shortened hospital stays, reduced blood pressure and self-reported measures of wellbeing. In one seminal study,[15] patients who had undergone gall bladder surgery who had views of a natural landscape from their hospital rooms had significantly shorter hospital stays, fewer complaints and a decreased need for pain killers post-operatively compared to those patients who only had views of brick walls from their rooms.

An overarching objective underpinning the architectural design for the Children's Hospital was to bring the park into the building and the building into the park. In doing this, the designers considered the views from various vantage points. One novel technique for allowing this passive experience of the landscape is found in how the tops of the window frames in the patient rooms were designed to reflect the park below, thereby allowing the children confined to beds to still be able to experience the park and its landscape.

Nature as facilitator of social interaction

Nature as the facilitator for social interaction refers to situations in which animals and/or plants are used within the context of constructed environments to foster people's contact with one another. Horticultural therapy has been used extensively to provide settings for increasing social contacts and fostering social support. Constructed environments can be designed to incorporate natural features that serve as focus points, such as water features, which have the ability to draw people together and thus facilitate person-to-person interaction. Areas for both group and solitary occupancy should be provided and user-group 'territories' should be carefully considered with areas designed to meet the specific requirements of different user groups.[16] Documented benefits associated with this principle include measures of increased social interaction and associated psychological wellbeing.

Nature as facilitator for physical movement

This involves the integration of natural elements that can facilitate patient ambulation and exercise. This includes location and design of pathways, provision of views of alluring destinations and use of multi-sensory stimuli such as natural sounds and tactile devices to encourage patient activity in, and movement through, spaces. Opportunities should be provided for different kinds of physical movement, ranging from physical exertion to gentle physical rehabilitation activities. Corridor sequences and strategically placed windows with views of nature can be used to let users take indoor walks – especially beneficial for patients who cannot physically go outside. Ease of access and wayfinding, both to and within designed spaces, are important and, here, design of inviting entrances to natural landscaped areas and clearly defined paths can be used. Enticing acoustical landscape stimuli, such as wind chimes and moving water, can also be used to help draw users' attention and lead them into the landscaped space.

Fostering a sense of independence for users also needs to be considered and can be achieved through attention to 'barrier-free design' strategies (both physical and psychological/emotional). Encouraging a sense of confidence in terms of user mobility is also important, which can be achieved through providing an appropriate range of ramps, steps, paths and ground surface treatments to accommodate wheelchairs, IV stands, etc.

Direct unstructured contact with nature

This includes the use of natural elements to foster a sense of fascination with natural phenomena, of adventure, play and educational interactions with plants and animals. This means providing opportunities for people to have direct contact with natural environments and natural elements within the context of the healthcare facility and its surrounds.

This can be accomplished by extending fingers of indoor elements into outdoor, natural spaces and likewise bringing outdoor spaces indoors to establish perceptual and functional connections between the healthcare buildings and the surrounding landscape. This includes the strategic location of vegetation, water features and other natural elements to provide sources of distraction for patients. This can be achieved, for example, by strategically locating indoor plants, aquariums and other animal enclosures, greenhouses, vertical gardens, planter boxes, roof gardens and terrariums to create micro-worlds filled with plants, rocks and animals integrated into healthcare facility buildings. In doing this, care should be taken to ensure that natural elements are accessible at a range of heights, levels and orientations to cater for all users, including those in beds and wheelchairs.

A diversity of indigenous wildlife, such as birds and butterflies, can provide both visual and auditory stimuli to engender experiences of soft fascination with the natural world. Birds are a particularly valued feature of healing landscapes. The feeding, breeding and nesting requirements of local species can be incorporated into the design of the surrounding landscape as a way of attracting them. Wetlands can be designed to provide a suitable habitat for a diversity of bird, insect and frog species, the calls of which would enrich the acoustic environment and provide a soothing and restful influence within a healing landscape.[17]

The inpatient unit (IPU) at the Children's Hospital was located deepest into the park landscape in an effort to bring attributes of the tree canopy and the park into the IPU rooms, where the sickest children would be. The designers also used decorative glass sunshades here, designed to provide visual interest in the natural shapes and colours associated with the park landscape, both when the light played on them and integrated into their design. Other facade elements were designed to abstractly reflect the bark, leaves and textures of the nearby eucalypt trees.

Figure 4: Constructed wetland set in savanna-like landscape in Melbourne's Royal Park

Conclusion

The winning design for the Royal Children's Hospital, developed by Billard Leece Partnership and Bates Smart Architects of Melbourne, in collaboration with HKS in the US and other consultants, responded to the design principles discussed here by integrating nature and natural elements into the design of the new hospital building in a myriad of ways. While the design response incorporated the design principles outlined above in a variety of innovative ways, more could have been done to fuse the park with the hospital buildings and their associated landscaped spaces, given additional space, particularly for landscape development. The final design and some of the key elements used to provide hospital users with opportunities to have greater contact with nature were not universally embraced. A headline in the 10 July 2009 issue of Melbourne's *The Age* newspaper proclaimed: "The new children's hospital has meerkats, frogs and sharks but not much room for patients."

But this project did break new ground by attempting to integrate a new hospital with adjacent parkland landscapes, with the overarching objective of reaping the health benefits that can be

Figure 5: The giant aquarium in the emergency area

gained through contact with nature within the context of a healthcare facility. Design professionals involved in the design of these types of healthcare facilities can learn from this example in their efforts to create a 'biophilic healthcare facility'. Only through long-term assessment of the health outcomes that this approach can provide will we know which design strategies work best.

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Inter-professional workplaces

As Australia moves to more integrated cross-disciplinary healthcare delivery, developments in non-clinical hospital workplace design are encouraging more open, inter-professional team working. But there are still challenges to overcome

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Healthcare systems globally are facing a crisis. The cost of delivering safe healthcare to a population with increasingly complex chronic diseases is absorbing a higher and higher percentage of GDP for most developed countries.[1] Australia has responded to this crisis by moving towards an integrated service that not only spreads the burden of care more evenly across the system but also seeks to support true inter-professional teams to deliver holistic care.[2] The Australian response has also been characterised by a recognition there is a need to update ageing infrastructure in order to adequately respond to these pressures and to effectively deliver a 'patient-centred' model of health.[3]

The design thinking associated with many recent projects has also begun to respond to and support inter-professional teams, significantly changing not only the ways departmental/specialist boundaries are conceived within institutions but also the kinds of spaces being provided in the clinical and non-clinical settings.[4] Of particular note has been the problematisation of non-clinical office space, applying new workplace models from the corporate and academic sectors seeking to improve communication within and across teams. Arguably, prior to 2009 the workplace model of new healthcare facilities was based predominately on the Australasian Health Facilities Guidelines, with little or no departure from them. However, more recently, new kinds of healthcare workplace models have emerged in a number of locations across Australia, seeking to deliver an organisational benefit beyond simply providing staff with a place to sit and work.

Rethinking healthcare delivery

To understand the need for a new workplace model, we have to look at how the healthcare system is changing and understand what this means functionally. There are several consistent themes, of which three are identified here. First is the need to move away from healthcare focused on acute episodes, generally requiring services delivered via a hospital, to a model that seeks to engage earlier in treatment paradigms via primary healthcare delivery such as GPs, wellness centres and the like. Second is a change away from funding models that tended to prioritise acute tertiary care and neglect early intervention models, the net effect of which is to create increased demand for tertiary care, thus creating a vicious cycle. Third, rather than delivering care in a way that reflects organisational (and frequently funding) structures, there is a move to deliver care via holistic models centred around the patient's needs. This last change also implies that care is delivered by inter-professional teams rather than through disciplinary specialists.

These three key changes imply other subsequent changes to the healthcare system. For the sake of simplicity, I suggest these changes can be grouped into infrastructure requirements and organisational cultural changes.

The infrastructure requirements, while perhaps complex to deliver, have been relatively straightforward to think about. New service delivery models imply new physical infrastructures. For example, as tertiary hospitals become the focus of acute treatments only, then facilities that are used to treat chronic illnesses are being relocated into non-

Figure 1: Royal Children's Hospital in Melbourne was an early project that sought to rethink 'workplace' from first principles

Figure 2: The cellular office configuration in Mackay Hospital in Queensland provides patient-free space that encourages inter-professional teams to engage with each other

tertiary settings. New service delivery models also imply a new level of information and data infrastructure. Many of the arguments behind eHealth records and the like recognise the greater demand that a distributed system places on the ready availability of information about care delivered across the many different locations.

Further, team-based care also requires different kinds of physical infrastructure than that which currently exists. These include facilities like larger consulting rooms that enable a team and a patient (and potentially their family) to simultaneously be part of the consultation, as well as facilities that support inter-professional teams, such as meeting rooms and handover spaces that support a team-based approach to care.

However, it is not be enough to simply deliver new built-environment infrastructure. As many have recognised, what is also necessary is a workforce "adept at working in multidisciplinary teams".[5] These teams are required to work within and across existing institutions. A regionally distributed model of specialist facilities also requires that the people who have the necessary skills to deliver the services associated with those facilities are also regionally distributed. In many cases, this presents a challenge as these people are sometimes in short supply. A solution to this is for these specialist individuals to become more mobile, working across a number of different facilities rather than being based in a single location.[6]

Working as a multidisciplinary team is not simple. It requires many adjustments, not least of which is culture. However, the inertia of existing organisational cultures is highly resistant to change, particularly if this change is being imposed.

Cultural barriers

Characteristic of many of the teams charged with delivering the new workplace model into healthcare has been the inclusion of a culture change manager. These teams have recognised that it is not enough to simply change how the healthcare system operates, rebalance the focus from tertiary to primary care or change the funding model and expect medical, nursing and technical staff will suddenly start working together as a true inter-professional team. All these changes need to be supported by a change in organisational culture.

One way of conceptualising the challenge of organisational cultural change is as a dual process of structural changes and socialisation. Structural processes are things that an institution is able to control. These include divisional/departmental arrangements, selection criteria, induction programmes, job (re)design and employee incentive programmes. Many transition teams working in healthcare today are able to effectively manage these structural changes.

Socialisation, on the other hand, is more difficult to articulate and more difficult to directly control. This is what some have called informal organisation or 'weak ties', and they include professional and collegiate networks (which frequently extend outside formal organisational boundaries). Importantly, change managers recognise that the weak ties that generally form the identity bond between individuals within an organisation can lead to the emergence of either strong professional identifications ("I'm a doctor" or "I'm a nurse", etc) or strong or organisational identification ("I work for XYZ hospital"). Research suggests that the best healthcare outcomes result when there is a balance between these two identifications.[7]

How design addresses this identification process is important. We know that identity, organisational or professional, is contextual – it matters where you are at the time. So while it is not possible for design to directly change how people think about themselves, it is possible to create the 'conditions of possibility' for an inter-professional culture to emerge through the design of spaces that makes certain identities more or less salient. Hospital settings provide a significant opportunity to create spaces that foster certain kinds of identification.

Design as identity

Design is able to shape which identities are most salient by making certain 'brands' such as departments or professions more or less visible. Branded spaces convey very clear messages about both purpose and hierarchy. For example, the renal ward is obviously where renal treatments take place and where the head of renal is generally a powerful figure. In such branded spaces, it becomes difficult to challenge those who are powerful. In practice, this means that when

there is a discussion, there tends to be fewer options considered, fewer ideas proffered and, generally speaking, less true collaboration. Rather, the team, even if it's multidisciplinary, tends to simply follow the programme set forth by the disciplinary lead of that area. So if we want to have multidisciplinary/inter-professional collaboration and innovation, then we need to create 'neutral' spaces that are not 'owned' by any single discipline or profession.

However, such neutral spaces are something of a challenge to how we think about healthcare facilities and hospitals in particularly. Many of the existing facilities are structured (and briefed from a design perspective) as standalone departments or units, frequently with locked doors separating them from each other. Historically, within each standalone area, these departments or units strove to be as self-contained as possible with office space, education space, meeting space and clinical spaces all collocated. While this potentially creates the conditions for good inter-professional collaboration within the department, because individual employees could develop a strong departmental identification that enables them to overcome professional barriers, it does also suggest that cross-departmental collaborations are not as well supported.

One response that potentially manages this conflicting requirement is to blur the boundaries around departmental and professional identities away from patient-focused clinical areas. Clinically eroding these boundaries poses problems in terms of ensuring a skilled workforce able to provide specialist care, but in the associated 'non-clinical' support spaces, no such safety issue exists. It becomes possible then to create non-clinical spaces that enable different departments and professions to mix. One approach that is increasingly popular, emerging first in Royal Children's Melbourne but also in the new Royal Adelaide Hospital, has been to create neutral spaces such as staff hubs, located centrally, that provide at least the possibility of collaboration on an equal footing.

Creating true inter-professional teams, however, requires more than just changing where the doors are (and what departmental title is emblazoned in gold letters on that door). It also requires a change to the kinds of spaces within departments. The creation of a range of work settings that provide a continuum of 'owned' to 'communal' spaces (with the balance distinctly towards communal space) to diffuse the clear identification of professions is important, in order to create the right conditions for true inter-professional collaborative teams to emerge. Here lessons can be learnt from the kind of thinking that corporate organisations have been doing about how they organise and manage work.

Corporate organisations have been engaged in thinking about their workplaces, because they also face similar challenges. In many respects they are further along the path. However, simply transferring design solutions from the corporate workplace to the healthcare workplace is a recipe ripe for failure – one size does not fit all. What we need

Figure 3: Lend Lease's 30 The Bond office in Sydney features a range of pods and open-plan spaces designed to encourage collaboration and a greater sense of connection

to borrow from corporate organisations is the realisation that work is comprised of distinctly different types of tasks.

Corporates realised that sometimes individuals needed to connect to others in order to collaborate and that sometimes they needed to work alone in order to concentrate. The corporate workplace model recognises that these antithetical functions of collaboration versus concentration[8] did not have to occur in exactly the same physical space within the workplace, rather people could move about within the workplace to find spaces that suited the task at hand as well as any individual preferences for the kinds of spaces they liked to work in.

This model has over time been called different names; the early relatively clunky name of 'new ways of working' is now a more brand friendly 'activity-based working'. However, the underlying principle of designing spaces to meet specific functional needs persists.

Healthcare workplace

Applying this functional perspective to the design of hospital workspace has focused on understanding the differences in the nature of teams and the multiplicity of roles that many health professionals juggle on a daily, if not hourly, basis and translating those functional needs into an effective kit of parts for a workplace solution. It is important to fully understand the nature of work in hospitals, and in particular, the informal practices that are essential for the formal processes to function effectively.

In order to do this, design teams have spent significant time developing a nuanced work pattern profile, using a variety of methods, ranging from interviews to 'following' the healthcare professional around. Perhaps the most significant finding of that research was that in the healthcare sector many employees, particularly senior employees, juggle multiple roles – clinician, administrator, educator, researcher, to name the most common. What this means in practice is that these individuals have to connect with many different teams or groups over the course of a single day. In terms of workplace solutions, this has translated into a focus on what team-based spaces are required.

Additional to these team-based functions, most healthcare employees also have professional identifications that need to be preserved and nurtured, not least for reasons of continuing professional development, but also because this professional identification is an important part of many of these employees' work identities.

This thinking translates into design as four key spatial features. First, the wards are being separated from some of the non-clinically focused support spaces, breaking down the previous model of completely collocating everything a departments needs into one demarcated area. Second, even some clinically focused spaces are being conceived as shared spaces – for example, many outpatient consulting rooms are now designed to support multiple specialties rather than being owned by any one group. Importantly, these first two key features enable a patient- and visitor-free zone within the hospital to be created. Within this zone it then becomes possible to blur the departmental boundaries between teams. Non-clinically focused support spaces such as office workspace, meeting rooms, education spaces and informal meeting spaces such as kitchenettes and hubs are carefully considered in terms of the functionality of the teams who will likely use those spaces. Office spaces, which include cellular offices as well as workstations in more open settings, are carefully rethought along functional grounds.

Figure 4: Kinghorn Cancer Centre uses staircases, open-plan office space, natural materials and light to create a collaborative, human-friendly workplace for staff

There is significant focus on how these teams will come together to collaborate, with increased emphasis on the transfer of information. What this means is that workspace is being conceptualised as clusters, supporting groups coming together. Design elements include ensuring offices face into team areas rather than creating long corridors with blank office doors on each side, using glass to create visual connections within teams as well as ensuring that each group still feels like they have a space they can call home.

Finally, the need to create professional identity spaces has seen the rise of 'community of practice hubs', spaces that are explicitly designed to foster a sense of professional identity and provide a place where individuals of the same profession can go and have profession-specific conversations that support the professional development and ongoing workplace learning. These spaces are necessary to provide a salient counterpoint to the specialist/departmental facilities above. They provide a place where the professional identity is foregrounded and, in the process, emphasise the inter-professional characteristics of the other spaces in the hospital.

The workplace benefits

All the design elements above have been borrowed from the corporate workplace but applied to different effect within the health sector. The most significant difference

is perhaps that of scale. Creating the right size cluster is critical. Too large and there is a risk of strong professional identities emerging that will limit inter-professional collaboration. Too small and the team becomes the predominate identification, which can lead to negative consequences as well.

So whereas in the corporate sector workspaces might support some 300-plus individuals, including up to 300 workstations in a single open contiguous area, within health the clusters need to be smaller, frequently supporting groups of up to 60 people. This creates the right level of connection within teams, aiding the development of a workplace identity that balances the team against the whole of organisation.

The benefits of changing the workspace model still need to be evaluated. In many instances, the kinds of spaces outlined above have only recently been occupied or are still under construction. However, again borrowing from the corporate sector, there are numerous studies that have shown that getting the balance between professional, team and organisational identifications right leads to higher productivity, higher levels of job satisfaction and better staff retention.

In health the productivity benefit, as mentioned previously, of getting the identification balance right is that we also create better health outcomes for patients. Further, once an institution becomes known as a good place to work, it attracts others to it thus creating a virtuous cycle of attraction and retention.

Figure 5: The staff terrace at Mackay Hospital encourages collaboration and communication

There are other benefits from this new workplace model. The design principles of clusters, connection and transparency also tend to result in spaces that are better to be in – healthier spaces. The move away from long corridors with offices on each side tends to result in designs that access natural light more effectively, which has been shown to have a positive health benefit. The smaller clusters also result in acoustics that are better because the team spaces are more intimate and people are intuitively more aware of what is going on around them.

Conclusion

The impact of this changed workspace model is still being evaluated, but given the other significant, and enabling, changes within the healthcare system as a whole – from funding to education to service delivery models – it will be difficult to isolate the impact of this change fully. However, it is interesting to compare international precedent examples developed within different healthcare systems. There we see the same trends of more open, connected and transparent workplaces – clinicians in those settings find it hard to imagine going back to enclosed, bounded and opaque workplaces.

Despite developing the thinking about the Australian healthcare workplace from ideas borrowed from the corporate sector and guided by careful functional analysis, we have arrived in a similar place to many overseas institutions. The common driver is the need to function effectively as teams, across organisational boundaries. It is difficult to see this trend reversing anytime soon – it seems then that this modern workplace will accompany us into the future as well.

References

1. A simple examination of the spend on healthcare across the OECD countries reveals year-on-year growth that in most cases outstrips total economic growth. See for example *OECD Health Data 2012* at http://www.oecd.org/els/health-systems [Accessed 18 April 2013].

2. See for example the recent Australian government discussion paper *Building a 21st Century Primary Healthcare System 2009* for one version of this rationale.

3. Perhaps one of the most fully articulated examples is the South Australia's Healthcare Plan 2007-2016 but most other states are moving in a similar direction.

4. The split between clinical and non-clinical is perhaps artificial, but by 'clinical' I mean spaces where patients are seen or treated and for 'non-clinical' I simply mean those spaces that support clinical activities but where the patient is not physically present.

5. Department of Health and Ageing. *Building a 21st Century Primary Healthcare System*. Commonwealth of Australia; 2010. p15.

6. This of course is not new. Many specialists do this now, but the current model tends to be a specialist who operates relatively autonomously, visiting facilities and delivering service independently.

7. Tataw D. Toward human resource management in inter-professional health practice: linking organizational culture, group identity and individual autonomy. *International Journal of Health Planning and Management* 2012; 27(2):130-49.

8. The antithetical nature of these two functions will not be lost on anyone who has tried to concentrate on anything in the middle of an open plan environment. There are even TV programmes devoted to this problem – for example, the UK's Channel 4 documentary *The Secret Life of Buildings* measures the EEG response to gossip in open plan environments.

Designing for wellness

Creating a healthy work environment – whether for a specialist healthcare building, or a more traditional workplace – is about designing for the needs of humans, and trying to recreate the sense of security we feel at home

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Healthcare environments are a complex network of services and communications uniting patients, carers, clinicians and the broader community. They function as centres for patients to heal, but they are also a workplace for the clinical and administration staff, many of whom work in extraordinarily stressful situations. Health projects are increasingly informed by the imperative to place the wellness of the individual at the forefront and to not discriminate between patient and clinical staff. Traditionally, Australian hospitals and health facilities have been planned as places of process and function. But with a growing body of evidence-based design imperatives among health professionals and 'curious' architects, Australian health projects are transforming into people-focused, civic-centred 'places' with an aspiration to become places of wellness.

Designing for wellness takes a holistic approach, integrating the physical and the psychological. The emphasis is on positive intervention to make our lives more rewarding, rather than designing ways to fend off illness. Wellness is culture, community and lifestyle, and architecture can inform the culture of society – the places that people spend their lives. Wellness in design is caring for and about people. The central tenet is to create spaces for humans; spaces that make people feel respected and feel as though they have been worth creating a respectful environment for. This is pursued through 'translational design' wherein the role of the architect is to translate the issues and aspects of how humans relate to their primary places of comfort, intimacy and interiority, which is the house, into the design of workplaces, and then develop this in the design of health workplaces.

Translating the home environment

Over time, the notion of 'self' in relation to the world has undergone tremendous change: from the primal world view where man was engaged with nature as an integral part of survival through to the late modern world view where the self is quite separate and almost meaningless to the world, which functions as a holistically owned system. Translational design takes the aspects of place where people feel most secure and integral (the home), representing the primal world view, and considers how to translate these aspects into a world that is counter to the idea of that. The basis of this change in world views is that there are three guiding principles that underpin the idea of being integral with nature, or being part of society or a whole, as opposed to being a component. These include the 'I' or 'the beautiful' which is the artistic idea that an individual is part of a whole system; the 'it' or 'the true' which is the scientific idea of what we are; and 'we' or 'the good' which is the community or society.[1] Architecture fits neatly into these kinds of considerations.

The idea that modern architecture has created a city that is transactional, as opposed to a city of 'living', as in older cities of antiquity, is articulated by Peter Buchanan: "Modern architecture and urbanism created the city of doing as opposed to the city of being, where different roles are played out in different places."[1] In simpler terms, this is summarised by Juhani Pallasmaa: "Why do so few modern buildings appeal to our feelings, when almost any

Figure 1: Plenty of open, communal spaces help to foster transparent collaborative behaviour at Sovereign's office in Auckland, New Zealand

Figure 2: Alinghi House beach retreat incorporates materials that reflect the sand and rocks of the surrounding environment, helping to turn the 'house' into a 'home'

anonymous house in an old town or the most unpretentious farm outbuilding gives us a sense of familiarity and pleasure?"[2]

To restore the sense of belonging into modern workplaces, therefore, it is essential to first understand the aspects of the house or home. Architects generally use the term 'house' rather than 'home' as the house is perceived as an abstract object. However, it is the symbols of familiarity that turn a house into a home. Thus, a home can be synonymous with intimacy, self, family, respect, security, refreshment, tactility and the way that love is central to how human beings develop. If these aspects are important to life, then it follows that home is a representation of the world, or: "To dwell in a house therefore means to inhabit the world."[3] It is these emotional attributes of a house – a place of nurture, wellbeing, belonging or a habitat – that can be translated into physical form. The building as an abstracted form from a basic shed or farmhouse can ultimately become a romantic home through the way it engages with nature or what architects refer to as its place. The use of materials that exude warmth and tactility, qualities of light and air assist in creating places that people want to inhabit.

Alinghi House, a contemporary beach retreat in Rocky Point, Queensland, is an example of the power of 'place' in design. Alinghi is a house of the landscape rather than on the landscape. It engages with its place, not just in terms of the physicality but also with the culture and the broad topography of the area. Alinghi House refers to the rocks and sand of its surrounding landscape, so that being inside the building is like being among and inside the rocks. The house also incorporates materials that are derived from rocks to create a sense of place. This notion of making 'place' is something that has preoccupied architects for a long time. However, the issue of making place inside a rigorously controlled health building environment is particularly difficult due to the code requirements for health facilities and infection controls. Therefore making place, or better still, 'belonging' becomes the key expression in designing for wellness – belonging not just to the physical landscape, but also to the spirit of the place.

A sense of human complexity

People enjoy being in places of great antiquity, such as Venice, and the city plan provides an insight into its amenity. There is a random complexity to the city that is surprising and delightful to engage with. There is no clear way to walk through it and the enjoyment lies in the discovery of the space. This complexity brings a sense of humanity to it, because it is not bland and predictable. In workplace design, specifically creating this type of complexity in social spaces is a key pursuit. Workplace projects, such as the National@Docklands in Melbourne, take the essence of the human activity in a space of antiquity – incorporating plazas, bridges and different gathering spaces which people can inhabit in groups or individually – into a contemporary corporate environment. Underlying this design aspiration is creating community and belonging. Part of the consequence of Buchanan's 'city of doing' is the disintegration of community, with people transacting separately rather than being connected to a whole.[1] Creating community in the workplace is not a difficult proposition; it can simply develop from two individuals interacting.

Yet, at the centre of a community is 'spirit' and an architect cannot create this spirit that makes a community occur. Architects can, however, make the places where community and goodwill occur. In the workplace context, this often involves being part of bureaucratic or corporate cultural change from hierarchical power structures to more organic structures that respond to contemporaneous change. At Campus MLC, for example, designing meeting rooms with tables that people can stand at or sit on immediately removes the conventions of power. Producing places that are like home, with different kinds of communal gathering spaces and central kitchens, creates spaces of community without affecting the privacy of individuals. These are key examples of the way architects can facilitate an idea about community through design.

In the past, workplaces essentially placed a container around the workforce that was air-conditioned and cut off from the outside world. The best workplaces today are still contained, but their edges are looser and they are designed around the needs of humans, to enrich their working lives, rather than the needs of the corporation and containing the corporation's values. A humanised workplace can effectively transform an organisation's culture and its ability to attract and retain staff. Improving the health of workers is also ultimately beneficial for the organisation; it improves productivity while at work and prevents illness, which results in abenteeism or presenteeism.

Promoting physical activity

Examining the chronic medical conditions that contribute to productivity loss, cardiovascular disease (including heart disease, hypertension and diabetes) contributes to 29% of the loss, while back, neck and spinal problems contribute to 7%. Depression alone contributes to a substantial (21%) productivity loss.[4] Together these conditions represent half of all chronic medical conditions that cause people to take time off work, and these conditions are effected by the workplace itself. Businesses have a vested interest in ensuring their staff is healthy as, overall, it costs them a lot more in productivity loss than it costs healthcare.[5] An estimated 3.5 million Australians have long-term cardiovascular disease,[6] yet cardiovascular disease risk factors such as lack of exercise, being overweight and a poor diet can all be changed. Regular physical activity has a beneficial effect on symptoms of depression and anxiety, which helps to reduce mental health disorders. The average office worker is sedentary more than 75% of the time. During waking hours on a workday, they are sedentary for almost 11 hours. More than six of these hours are in the office.[7] Despite the known benefits of physical activity, research indicates that long periods of sedentary behaviour in between exercise can negate the benefits of physical activity: "There is an association between sitting time and mortality from all causes and cardiovascular disease, independent of leisure time activity."[8]

Professor James Levine of the Mayo Clinic states: "What you need to do is to create an overall environment of health." Creating a healthy work environment is about designing for the needs of humans, rather than providing housing for computers, or predictability. As Alvar Aalto suggested in the 1930s as part of his 'extended rationalism,' human beings are by their very nature, uncertain beings requiring different conditions. The key is to determine the elements that are common to people, to create social spaces that encourage community, to place things in projects that aren't necessarily asked for, but contribute to the creation of place. Human beings have different needs during the day, and if you place the human at the centre of the decision-making processes – rather than the corporation or the business process – then you will make places for humans rather than places for machines. These needs extend beyond being sedentary at a workstation and can include cafes, collaboration zones, social plazas, gardens and project spaces.

Figure 3: In financial services firm MLC's workplace, the interiors try to break down traditional hierarchies – for example, with tables that can be sat on

In rhythm with the body

Preventing a sedentary work life and enabling people to regulate their circadian rhythms can provide real opportunities to dramatically improve worker health and can be facilitated in building and office design. Light, including artificial light, has a range of effects on human physiology and behaviour and can therefore alter human physiology when inappropriately timed. Light disruption affects circadian organisation, including the production of several hormone rhythms. The human body responds to light to create its ideal rhythm, and this contributes to determining mood and health. Interior lifestyles such as working in an enclosed office environment prevent us from following the sun's diurnal cycle. In workplace design, providing a variety of light contributes to wellbeing more than a single spectrum. Staff can decide to move from bright, naturally lit areas of floorplates to more shaded areas with warmer task lighting. Artificial lighting levels and temperatures should include high colour temperatures but also vary across the work floor. Outdoor space at the workplace is integrated with the interior and located to assist people benefitting from direct sun at different times of the day.

There are also several strategies that can be employed in the design of floorplate planning. The workplace design can encourage incidental exercise by providing dramatic stairs that encourage vertical movement; the use of a single bathroom and tea point to encourage horizontal movement and work settings that activate different parts of the body, such as standing at tables, electronic sit-to-stand tables, benches, inclined surfaces and chaises longues.

The built environment is acknowledged as shaping physical activity at an urban level. Using the urban analogy as part of the overall office or healthcare design is part of designing for individual wellness. Pedestrian pathways, nodes and landmarks are used to encourage movement within a space. The 'officescape' is not orthogonal or rigid, but instead follows principles of pedestrian cities that encourage walking as users investigate their surrounds in nondeterministic ways. The interior office design can be just as instrumental in health as well-designed cities. Positioning stairs centrally and visibly means they get used. Considerations such as gyms, bike lockers, changing rooms, parents' rooms and healthy food in the workplace are important within the overall workplace strategy.

Figure 4: With spectacular atriums and multi-level bridges, the National@Docklands office building aims to emulate the complexity of spaces that have evolved over centuries

Active and agile workplaces provide a great starting point for the future healthy workplace. The power of planning for people leads to wellbeing and business success. Greater levels of staff health and wellbeing also lead to better corporate health. By using the methodology of evidence-based design, healthcare facilities are now benefiting from this approach, already found quite commonly in workplace design.

Creating community

The making of 'place' – be it a workplace, library or healthcare facility – is founded on four basic principles: community, collaboration, innovation and wellness. Collaboration can connect people through stairs, and bridges across floors, with people travelling through a building rather than residing in it. The design by Lawrence Nield and Partners Australia (later BVN Donovan Hill) for the Children's Hospital at Westmead was based around a central street which gave civic presence to the hospital, and introduced into hospital design an impetus to create an urban 'place' specifically for children and their parents to feel nurtured rather than processed. The collection also included the most significant installation of art in a hospital in Australia of its time. The collection, curated by Joanna Capon, wife of former Art Gallery of NSW director Edmund Capon, was the initiative of then hospital director Dr John Yu who believed that art could help to humanise a hospital.

Buildings used to be disconnected from the outside world, but design features such as a glass wall can provide instant connection. Glass walls on meeting rooms can project the rooms into other spaces, so that even if people are not part of the meeting, they are aware of other activities happening within the culture of the organisation. Making community involves building village and town squares, cafes, atriums, gardens, places to celebrate birthdays and gather informally, and places to work by daylight. In a workplace, there are different models of creating place, such as active edge or active centre network workplace models, but all ultimately lead to creating a sense of community.

Aalto understood our experience of the environment to be empathetic rather than the way things look, or the way they exist compositionally. At the heart of his theory is the pursuit of making a building that is empathetic, one that engages the wholeness of humans and human

experience. Within the context of health, there is often a preconception that healthcare facilities are a 'closed shop'. Understanding that what people really want is to be at home makes the task of healthcare to provide the counter to this exclusion. A health building combines the different aspects of healthcare, such as patient-centric models, innovative research, continuum of care, excellence, ecologically sustainable development (ESD), collaboration and multiple disciplines into an integrated vision of place. The Kinghorn Cancer Centre in Sydney is a prime example of this integrated vision through the use of landscape, a central atrium as a social space, the incorporation of artwork and the depth of materiality.

Evidence suggests that people heal more quickly in home environments and proximity to nature and views have further measurable benefits. Hospitals can often be sterile spaces, but just adding a layer of materiality can make them feel quite different. Creating an environment of natural materials, tactile surfaces, colour, natural light and views to nature promotes a nurturing environment in stark contrast to the grim medical institutions to which patients are often referred. Mt Druitt Hospital in Sydney's western suburbs (designed by Lawrence Nield and Partners, now BVN Donovan Hill) adopts the language of contemporary Australian domestic architecture and creates a strong sense of place in its bush setting.

This approach takes heathcare as an entrenched part of the community that fosters an atmosphere of health and wellbeing for carers, patients and relatives alike. The traditional shroud of medical institutional mystique is also lifted, as spaces are broken open, and new atriums and circulation facilitate new ways for patients, clinicians and researchers to interact. Even in the area of mental health, with its rigid security framework, a feeling of domesticity, comfort and assurance can be created. The Brain and Mind Research Institute has the look and feel of a house rather than an institution. Incorporating courtyards, natural light and timber in as many places as possible makes patients and staff feel more comfortable, and also provides a reassuring environment for people who come to visit. The design for the Royal Children's Hospital in Parkville, Melbourne, completed in 2011, is an excellent development in creating people-centric hospitals. Its sense of scale and tactility is designed to make children, as much as possible, relate hospital to home.

Figure 5: Courtyards and communal spaces such as those at Queensland's Robina Hospital can help encourage patients and staff to walk and promote healthier lifestyles

Engaging in this work can also improve residential design, as architects can better understand how the needs for community and place migrate through all human activities. The design of house, workplace, health, community and place exists in a continuum, as Moore states: "People make architecture – architecture is incomplete, or merely 'building' without them."[9] Within the Australian context, the wellness of people has become a design imperative across a range of project types. The quality of wellness, along with design and functionality, underpins the whole philosophy of a building. The way a building responds to wellness is the same across all building types. It is breaking down a space into environments for people to occupy and providing different levels of interest and intrigue across those different environments to create places that are enlightening, facilitate community and enrich the human experience.

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Sustaining health

Despite a once-in-a-generation hospital building programme, healthcare facilities lag behind the commercial sector when it comes to sustainability. The industry must galvanise to overcome such complacency and strive for improvement

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Sustainability is the topic of our age. There is now a realisation that, in every aspect of modern day life, sustainability has to be a guiding principle in everything we do. However, this hasn't always been the case. The embracing of sustainability in Australia has been something of a slow train journey over the last 15 years, and while there is now momentum, the journey ahead is a steep one in light of the issues we are facing.

This is particularly so in the design and construction of our healthcare facilities. The last 15 years have seen a fundamental renewal of Australia's major health assets, particularly its acute facilities. This has been a once-in-a-generation event. The majority of its acute, trauma and referral hospitals have been renewed or totally reconstructed on greenfield sites, replacing existing assets that in the main were almost 100 years old.

Despite this massive rebuilding programme, however, the extent to which they have embraced true sustainability is questionable. These new facilities will take the place of the assets they replaced for the next 50, 60 or 70 years or more, and while there can be no doubting that they will perform better than their predecessors in respect of sustainability, the question of "will it be enough?" is a pertinent one.

Equally indeterminate is whether we have acknowledged the irrefutable connection between sustainability and human health in the philosophical design of these facilities. The construction of a healthcare facility is a subset of the wider construction industry and any review of our journey toward embracing sustainability in healthcare buildings has to first start with a review of the uptake of sustainability in the construction industry as a whole.

A journey of a thousand miles…

In the late 1990s, the topic of sustainability in Australia could best be described as one of passing casual interest – a fad reserved for environmentalists with little knowledge of economic and business drivers. There was virtually no market demand for a sustainable product, and certainly no definition of what a sustainable product would look like. There was no Green Star environmental rating system, no National Australian Built Environment Rating System (NABERS), and no requirements for energy performance or carbon performance in the Building Code of Australia. The science was still in the realm of controversial predictions of "what if's" from a limited empirical base.

While the amount of carbon in the atmosphere could be readily measured, predicting its implications was where the scientific community itself varied on agreement, thus creating doubt for those who wanted to doubt. However, despite the balance of opinion being with the sceptics at the time, there still was something afoot that was gaining interest, and a growing cadre of supporters.

The sustainable movement beyond Australia

Beyond Australia, the global scientific community was awakening to something of potentially enormous proportions. Perhaps some of its earliest recognitions were under a different guise, such as Marion King Hubbert's theories in 1956

Figure 1: Flinders Medical Centre was the first hospital in Australia to receive a Green Star rating for sustainability under the official rating tool

Figure 2: HASSELL's ANZ Centre in Melbourne is the largest, single-tenanted building in Australia to have received a six-star Green Star rating

of 'peak oil', or the energy crisis in the 1970s. While these events noted the finite characteristics of fossil fuels, the recognition of an impact to our global environment only started to emerge much later.

In 1983 the United States Environmental Protection Agency released a report that the build-up of carbon dioxide and other greenhouse gases in the Earth's atmosphere would likely lead to global warming. This was followed quickly by a meeting in 1985 in Villach, Austria, called by the World Meteorological Organization, the United Nations Environment Programme (UNEP) and the International Council of Scientific Unions (ICSU), which reported on the increases of carbon dioxide and other greenhouse gases in the atmosphere. They too predicted global warming.

In 1988 the Intergovernmental Panel on Climate Change (IPCC) was established by the UN as a joint initiative of the UNEP and the World Meteorological Organization, where the work of literally thousands of scientists is reviewed and assessed to improve an understanding of climate change. The IPCC's first report in 1990 acknowledged the importance of climate change as a challenge requiring international cooperation to address its consequences. The IPCC's second report in 1995 produced important material that was used by negotiators in the run-up to the Kyoto Protocol that was adopted on 11 December 1997, setting international binding emission reduction targets.

While the commitments were not endorsed by all, and while there have been subsequent revisions to the targets, the journey had fundamentally started; a ground swell, on a global level, had commenced. It was the start of international commitments and actions, by some, to reduce carbon emissions.

Among other things, it meant that as designers we needed to improve what we did. We needed to get educated, to become informed and to start doing better than we had ever done in the past.

The early days in Australia

The initial response in our market could be best described as a sense of confusion, a lack of direction and, as a result, lethargy. We knew that we needed to reduce carbon emissions and we knew that we had to improve – but by how much? What did improvement look like, and what features needed to be adopted? Surely this was going to cost. Was the community ready to pay for it?

Direction was needed so that this nebulous abstract of sustainability could be defined and measured. Rating systems started to emerge elsewhere around the world, with the BREEAM system being established in the UK in 1990. The US Green Building Council was formed in 1993 and LEED was launched in 2000. The movement was gaining traction and the topic of sustainability in the construction industry was starting to take hold.

In October 2002 the Green Building Council of Australia was established and by April 2004 we had our first rating tool for commercial office buildings. In October 2004, an office building in Canberra, 8 Brindabella Circuit, became the first Green Star-rated building, achieving a five-star design rating.

By the time that Council House 2 in Melbourne, another office building, received its six-star rating – the first in Australia – the topic was hot. It was now on the agenda of almost every project, and while it was still expensive and difficult to obtain products, it was nonetheless being adopted and building projects were signing up to join the ranks of the environmentally rated.

Once there was traction, the rate of pace increased dramatically. From that single building in Canberra in 2004, the number of certified buildings grew to more than 570 in 2013, representing some 7m sqm of built area. And while the system has been criticised in some sectors of the community as being a restrictive formula-based approach to sustainability, there can be no denying the benefits it has achieved.

Our supply chain is becoming greener. Sustainably manufactured products are now more widely available. Technologies and systems once ridiculed for use in buildings as being uneconomic, such as photoelectric generation, micro wind generation and trigeneration, are now being implemented. Sustainability is a topic on the agenda of practically every project and our buildings are the better for it.

Figure 3: DesignInc's Council House 2, which is owned and occupied by the City of Melbourne, was the first office building in Australia to receive a six-star rating

But what about health?

Understandably the commercial market was the vanguard of sustainable building. The commercial sector represented the largest volume of non-residential buildings and there was a clear economic rationale. Tenants and their workforces were looking for, and demanding, sustainable buildings.

In economics, demand will drive behaviours and the market responded accordingly. New buildings came on line with even higher ratings. The supply chain responded with improved availability of sustainable products. The construction industry responded with building practices that used waste-reduction methods, and more sophisticated building techniques.

By April 2005 the bar needed to be raised, and an updated version of the Commercial rating tool was released. By 2008 a further increase was needed, with Version 3 released in February of that year. With each tool, higher goals and targets were set; the market continued to respond, with ever more buildings being registered and certified. The Building Code of Australia (BCA) also responded, with the incorporation in May 2006 of Section J, the energy provisions of the BCA.

Perhaps one of the most significant events in our journey towards a sustainable society was the controversial introduction of the carbon pricing scheme, introduced by the federal government on 1 July 2012. While not impacting buildings directly per se, its consequential flow-on effect to energy and utility costs is likely to drive even greater sustainable behaviour and continue our march towards low-energy buildings.

But what about our health stock? A tool dedicated for healthcare buildings was released by the Green Building Council of Australia in June 2009, with a pilot being in place for a number of years beforehand, and one project, the Weipa Integrated Health Service in Queensland, being certified to four stars under the pilot tool in 2008. The first Green Star rated hospital under the official rating tool was Flinders Medical Centre, in March 2011. As of today it remains our only officially rated hospital. Why is this the case, despite the volume of construction being undertaken in our health system over the same period?

Have we missed the boat, or, more probably, has sustainability as we know and define it in the commercial sector missed the mark for healthcare facilities?

Sustainability and health

The market drivers that exist in the commercial sector – that is, the need to satisfy tenants and workforces – do not exist for a healthcare building. The undeniable relationship between the marketability of a sustainable building and reduced vacancy rates, improved leasing yields and enhanced property returns to owners does not exist for a healthcare building. The Healthcare rating tool was released using the commercial tool as the basis. But without the commercial driver, the stimulus to develop a green hospital was more subdued.

The corollary of sustainability in the commercial sector being for purely financial reasons alone, as opposed to the greater environmental good, can also be questioned. If it is that our efforts in sustainability thus far have been stimulated to a greater extent by financial benefit than by a true environmental compass, perhaps the pricing of carbon will be the catalyst we need to move further, because move further we must.

Many of the new hospital projects that are under construction have adopted 'self-rated' approaches. Improvements

in technology and materials available in the market have flowed in to the construction of hospitals, and the gravitation toward public-private partnership delivery models for health in Australia has also placed targets on consortia for performance over an extended concession period. And yet, despite these initiatives, there is still a nagging sense that the true mark has been missed as compared to the same insatiable appetite that exists in the commercial sector.

Figure 4, above: The Platinum LEED-rated Kohinoor Hospital in Mumbai, which has a solar hot water system and is landscaped with drought-friendly local plants

Figure 5, below: The new Royal Adelaide Hospital, where ecologically sustainable development initiatives are expected to result in a 40% reduction in CO_2 emissions

We cannot deny the need to be sustainable. We cannot deny that any building, irrespective of market sector, must, for the sake of us all, be designed and operated in a sustainable way. We know that healthcare facilities, with their 24-hour operation and their high equipment loads and ventilation rates, are one of the largest consumers of energy of any building type. And yet health is still lagging despite the innate and intrinsic connection that exists between sustainability and human health.

The impact of climate change to humanity is beyond doubt, and the potential consequences of a warming planet are truly frightening. The greater intensity of severe weather events that we are now seeing is just the tip of the iceberg. Impacts to human health through increased heat stress, increases in tropical diseases, drought and pollution-related respiratory illness are now all being reported. At the extreme end of the prediction scale, issues such as population displacement and instability in the food chain invoke images that, if they ever became reality, are beyond comprehension. If climate change affects our health, then our populations will ultimately turn to our health systems for help.

Sustaining the health of a patient represents the core purpose of our healthcare facilities and our healthcare providers. Sustaining the health and wellbeing of our environment represents the core purpose of an environmentally responsive design which, by doing so, improves the health of our communities. There is therefore a symbiotic relationship between the purpose of our healthcare facilities and the purpose of environmentally sustainable design that transcends any commercial driver.

Perhaps a greater body of evidence between the costs of treating a population whose health is being adversely affected by climate change may be the stimulus that we need. Nineteenth-century physicist Lord Kelvin is famously quoted as saying: "If you cannot measure it, you cannot improve it" and the famous American statistician William Edwards Deming is quoted as saying: "In God we trust; all others must bring data". Perhaps, learning from these great minds, a different set of metrics for sustainability in a healthcare facility is an essential element in driving the change that we need.

There is potentially some resonance in the notion of measuring the primary output of a health facility, being the volume of patients treated, as a ratio to environmental input or usage of carbon or energy or water.

Taking this proposition further, a hospital that consumed even more energy but did so justifiably by treating a greater number of patients would, ironically, be a better sustainable outcome than having to build an additional healthcare facility. Perhaps it is this sort of left-field thinking that we need and would be the type of result we could attain if we looked at the problem differently. Perhaps a debate about a radical recalibration of how we measure sustainability in healthcare facilities is an essential next step.

These linkages need to be explored and opened up to debate and recognition. Education, and its bedfellow awareness, must be heightened. Irrespective, a call to action by the design profession, to improve the adoption of sustainability in our healthcare facilities is essential.

The journey ahead

And so it is a journey, but a never-ending one. It must be life as we know it, and it must be the way in which we learn to live on a daily basis. There can be no deviation from this course. Learning to live with what we have, in the knowledge

Figure 6: AECOM's Gundersen Lutheran Hospital in La Crosse, Wisconsin, to be completed in 2014. Built to LEED standards, it incorporates many sustainable principles, including a geothermal heat pump

that our resources are finite and hence there is no more, must become the way of life.

In healthcare, the gravitation toward principles of salutogenics is widely acknowledged as the shift in thinking that must be embraced to address the healthcare crisis that we face. Salutogensis, a philosophy that focuses on the causes of wellness must, by definition, therefore embrace a study of sustainability, as sustainability causes wellness; these principles and design philosophies are inexorably entwined.

The creation of spaces that improve wellbeing – spaces that are salutogenic, through greater access to natural light and air, and buildings that reduce reliance on man-made artificial environments – must intrinsically be developed in concert with a detailed and scientific assessment of sustainability.

Sir Isaac Newton's third law of motion is that to every action there is an equal and opposite reaction. The time for acting, without thinking of the consequences to our environment and our wellness, is behind us. The time for creating new environments that support wellness and support human health, with these environments being informed from a rigorous scientific basis about the dynamic relationship that exists between a building and the environment in which it is placed is the journey ahead. This informing of decisions through energy modelling and simulation, through a highly engineered solution, is the journey we are on and one that all design professionals that practice in the field of healthcare design must embrace.

We must be the agitators and the advocates, for we are the ones who are trained and educated in the sciences and mathematics of building design and building performance. It is our responsibility to take the informed argument and debate to our clients and find the new set of metrics and the new language that convinces them to embrace true principles of salutogenics and sustainability in the design and operation of all our healthcare facilities. This is the road ahead.

The last 15 years have seen an incredible renewal of our health facilities in Australia and an incredible shift in the adoption of sustainability. However, we are far from finished, and the future of the design of our health facilities – and the future of human health and wellbeing, in this capacity at least – rests with us.

Innovation transformation

Innovations in technology and medical devices have not only transformed the way healthcare is delivered in Australia, they have also changed the way architects and engineers need to approach the design of healthcare facilities

Keith Joe
Australian Centre for Health Innovation

Healthcare has a long history of innovation. Aspiring to relieve suffering and improve quality of life, research and technology have partnered to create new investigative modalities, pharmaceuticals, devices and therapies. To this end, technology is increasingly being used to optimise limited health resources.

Some of the major challenges in healthcare delivery include rising healthcare costs, the ageing population and the inability of the healthcare workforce to keep up with demand in service. In addition, there is an emerging shift from medical and hospital-centred care to a broader information and provider base, leading to more effective patient-centred care. As a result, the built environment has required significant modification to accommodate the changes.

Adoption of health technology

In 2009-10, health expenditure in Australia was AU$121.4bn (9.4% of GDP) with hospitals accounting for 40% of the total. Of the admitted patient costs, 52% was spent on salaries for medical and nursing staff. Healthcare technologies comprised only 5% of total health expenditure.

Reducing this amount only has a limited effect in containing total healthcare expenditure. Conversely, well-directed small increases in spending have the potential to greatly increase the efficiency and productivity of the workforce – for example, on key areas of hospital technology such as computers and mobile devices, imaging technologies or medical advances, devices and equipment.

Computers and mobile devices: The success of computers in clinical care has been variable. Over the last 15 years, IT expenditure has transitioned from infrastructure to applications to a focus on integration and user interfaces. But the adoption of computing in healthcare by clinicians has had varied success. This is due to a number of factors including applications that lack user friendliness, requiring clinical practice to be translated for electronic capture; applications that lack integration; and limited resources for change management.

However, clinical engagement is now increasing with the development of applications that capture clinical processes using meaningful end-user interfaces – as clinicians develop expertise in IT, they are taking an increasingly active leadership role in implementation programmes.[1]

Current trends include increased use of bedside computing with either fixed or mobile devices. There is also growing use of rapid secure computer authentication through methodologies such as single sign-on and biometric recognition, as well as cloud hosting/virtualisation of computer desktops. There are increasingly intelligent communication systems, some with location awareness, and greater electronic linkages between home, community, and hospital-based care.

These developments have a wide-ranging impact on design – the need to accommodate the transition from paper processes to electronic solutions (for medical record storage etc) to provide good accessibility to electronic resources in the clinical space and to take into account infection control issues pertaining to electronic devices.

Imaging technology: Imaging technology rates as one of the top 10 medical advances over the last 50 years.

Figure 1: Sky Factory's daylight-mimicking ceiling, installed above an MRI scanner at Melbourne Olympic Park's imaging centre

Figure 2, above: Accessing electronic medical records at Royal Melbourne Hospital

Figure 3, above right: Cabrini Hospital emergency department's PACS (picture archival and communications system)

Australians developed the first ultrasound scanner in 1961 and they are now commonly used across the world in antenatal scanning and for condition diagnosis. Computerised tomography (CT), first introduced in 1971, has advanced to the point where scanners produce 1024 x 1024 matrix images, can acquire a slice in less than 0.3 seconds and offer up to 320 slices from dual-energy x-ray sources with iterative reconstruction techniques. MRI, introduced in the late 1980s, provides imaging without the use of radiation. And during the past decade, there has been rapid growth in the use and availability of CT, MRI and positron emission tomography (PET).

In Australia, the availability of picture archival and communication systems (PACS) has had a profound impact on clinical practice. The number of Medicare-reimbursed MRIs increased from 0.6 per million population in 1990 to 4.9 in 2006, and images are now available on demand, anytime, anywhere. Sustained clinical benefits include improved clinical satisfaction with imaging workflow, increased clinical image viewing, decreased search time for films/images and improved reporting times.[2]

Among the trends we see in this area are the increasing use of all advanced imaging modalities; continued growth of interventional radiology and minimally invasive investigation/treatment facilities; the blurring of traditional medical specialists' roles in the investigation and treatment of conditions (eg stenting by vascular surgeons, cardiologists, neurologists and radiologists); and the growing use of combinations of imaging and treatment such as hybrid theatres or the cyber knife.

For designers, this means taking into account the safe and appropriate housing of equipment architecture, structure, magnetic fields and shielding, electrical, plumbing, HVAC, energy, waste management, infection control, associated equipment and communications. In addition, the technologies need to be incorporated into the clinical workflow and facility, and account taken of the floor space needed for the storage of images as film printing and clerical filing is reduced and eliminated.

Medical advances, devices and equipment: Australians have pioneered significant medical advances through the development of devices and equipment. This includes the cochlear implant in 1978, the artificial heart valve in 1980, discovering *Heliobacter pylori* as a cause for stomach ulcers in 1982, and developing the first anti-influenza drug, Relenza, in 2000 and spray-on skin in 2005.

Australia has only a 2.6% share of the global medical technology market (valued at over US$300bn per annum) but our involvement is rapidly growing. Currently, most technology is imported, at a cost of AU$3.3bn per annum.

Service delivery continues to change as a result of new clinical technologies such as renal denervation for refractory hypertension; pharmaceuticals such as the new generation of antidepressants; new approaches to the management of conditions, including the use of minimally invasive interventions (eg cardiac stents versus coronary artery bypass surgery); and surgical techniques such as laparoscopic and robotic procedures.

We have seen increasing use of technology in operating theatres, along with a rising number of interventional suites. In addition, there has been a fall in the number of hospital beds per capita (this coincides with a reduction of average length of stays in hospitals and an increase in the number of surgical procedures performed on a same-day or ambulatory basis), as well as a growing number of conditions manageable in home care – as an alternative to hospital

admission or to support early discharge from inpatient care (eg dialysis, cellulitis and deep vein thrombosis).

These continually evolving treatment modalities, models of care and the settings in which healthcare services are provided, as well as an increase in same day facilities, are factors that have impacted on healthcare design.

Creating efficiency and capacity

Of major concern to healthcare planners in Australia is the interplay between rising healthcare costs, the ageing population and the inability of the healthcare workforce to keep up with the demand in service. While the current supply of nurses is adequate, by 2025 there will be a significant shortfall of more than 109,000 nurses.[3] This limited resource must be utilised efficiently through coordinated delivery of care, excellent communication and avoiding duplication, delays and workarounds.

Other industries, such as aviation and online shopping, have also experienced significant growth in patronage. Studying innovation in these areas reveals a toolkit for creating efficiency and capacity in health – particularly given that not all those who use the service will be adept at technology (particularly the very young or very elderly and those with severe physical or mental disability).

For example, in the airline industry strategies to address passenger increases include self-ticketing and e-tickets, online check-in and extended travel information. In health, current initiatives include better patient information portals, patient registration from home, self check-in at clinics and real-time location of patients in hospitals.

The growth of parcel traffic related to online shopping has been met with improved supply chain logistics using barcoding, RFID, automated sorting and GPS tracking. In the healthcare sector, supply chain solutions include standardising physical environment and processes, actively tracking equipment, and the use of automated guided vehicles (AGVs) – the first hospital to implement AGVs in Australia was the Royal North Shore Hospital in New South Wales in 2012.

Other current trends in this area include real time-patient flow and reporting as a standard of measurement of care efficiency and patient flow; the growing use of the web for online healthcare education, simulation and assessing credentials; and the use of event simulation that takes into account flow, models of care and staff mix to inform planning and physical design elements.

Design is increasingly integrating electrical and technological infrastructure in key areas to support contemporary technologies such as electronic wayfinding, and patient self-registration kiosks at outpatients allowing the efficient flow of patients, staff and supplies. In addition, designers have had to rethink supply chain logistics and their potential for efficiency, including well-designed just-in-time/supply chain infrastructure and the use of AGVs.

Figure 4: Service delivery needs to adapt to changing technology, such as robotic surgery

Quality and safety

The intention of health professionals is to provide safe, timely, high-quality care to patients. Hospital care, however, has been organised around diseases, medical specialties and departments. Silos of care have developed with the expansion of medical knowledge, sub-specialisation of care and the technological expertise required specific to treatments.

In the late 1990s, reports of unintentional harm in US hospitals and elsewhere in their health system estimated that preventable deaths due to adverse events were equivalent to one major airline crash per day. This led to a serious examination of policies, processes and practices across each health service to reduce the risk of unintended harm. Some of the significant areas that are the focus of improvement include clinical documentation, medication management, the use of data/communication and infection control.

There has also been much attention given to electronic medical records. Australia maintains a high rate (92%) of general practitioners keeping electronic medical records. However, in terms of electronic exchange of patient information with doctors in other practices, specialists and hospitals, Australia rated third to last (at 27%) in a Commonwealth Fund survey of 10 countries (Australia, Canada, France, Germany, the Netherlands, New Zealand, Norway, Switzerland, the UK and the US).

The European EHR IMPACT study objectively defines the benefits in pursuing electronic health records and

Figure 5: Minimally invasive surgery means shorter stays in hospital, and a drop in bed numbers

ePrescribing initiatives.[4] In the US, the federal government has legislated Medicare penalties in 2015 for those hospitals not using an EMR – to date only 1.8% of US hospitals have operational systems to HIMSS Analytics EMR Adoption Model (EMRAM) Stage 7 level, with a further 20% in the final stages of implementation. In Australia, no hospitals have reached HIMSS EMRAM Stage 7. However, with a number of new hospitals currently due for completion in the next five years, it is envisaged that higher levels will be achieved.

With respect to medication management, a few hospitals, such as St Vincent's Hospital in Sydney, have achieved electronic prescribing, with many more in the process of implementation. At the same time, there have been decreases (by more than 50%) in the number of prescribing errors and pharmacist interventions to adjust medication regimes, thus resulting in significant safety and efficiency gains. The use of electronic storage and dispensing systems is also becoming normative with many health services reviewing medication management at both the pharmacy and ward level as part of a redevelopment or new hospital builds.

Infection control has always been a quality and safety key performance indicator. Hospital-acquired infections (HAIs) affect around 10% of admitted patients in Australia (180,000 patients occupying almost 3 million bed days in 2008), lower than in the UK and US but significantly greater than the 1% encountered in Norway. An analysis of the strategies deployed by Scandinavian hospitals (eg the separation of patient and facilities management, the use of a single staff entrance, daily on-site uniform change, single-patient bedrooms and controlled antibiotic prescribing) would yield useful information as to whether these initiatives are important factors in HAI reduction.

With the growth of technology, the amount of electronic data captured has grown exponentially leading to the term 'big data'. In addition to bed management and statutory reporting, significant opportunities exist to interrogate data for the purposes of operational modelling and predictive analysis, an excellent example being the capture of patients' vital signs. These can be taken and recorded electronically without a need for transcription to paper. Vitals, therefore, are accessible on a number of devices remotely, and trend analysis may be used as an automated early warning system, pre-empting significant patient deterioration. This, coupled with pathology results, may enable prediction of impending deterioration before it clinically manifests. Applications that take multiple clinical data inputs, analyse their significance through complex algorithms and then output true positive alerts to the appropriate user's communication device are the emerging technology champions of safety.

Therefore, in future we are likely to continue to see higher levels of EMR adoption; replacement of manual processes in medications management with decision support, automation and end-to-end electronic solutions; the electronic capture of patient vitals at every bedside; and wider adoption of predictive analytics in patient care.

For health design this has meant accommodating the transition from paper process to electronic solutions such as medical record storage, printed resources and libraries; providing accessibility to electronic resources in the clinical space; making accommodation for electronic medication management; and the need for in-depth reviews of the effectiveness of current infection control measures.

How health is delivered

The current average life expectancy in Australia is 79 years for males and 84 years for females and it is forecast that twice the number of aged care places will be needed by 2030. By 2050, the number of people aged 65-84 years is expected to double, while the number of people aged over 85 will be four times greater. As a result, it is estimated that sector spending will need to double to meet demand.

With the rapid growth of diabetes, mental illness, cardiovascular disease, cancer and joint disorders, more than two-thirds of all health expenditure is associated with chronic disease management. Not all chronic disease requires hospitalisation: through the effective timely provision of non-hospital care, 9.3% of potentially preventable hospitalisations due to chronic ailments could be avoided. Therefore, a number of significant technology initiatives are currently being implemented around the management of chronic disease.

It is envisaged the national broadband network (NBN) will provide a number of benefits to the healthcare system – enabling expansive real-time in-home monitoring and the rapid delivery of test results and medical data between care provider organisations. The first release of a personally controlled electronic health record (PCeHR) will promote the sharing of summary health information.

Medicare rebates for online telehealth consultations across a range of specialties have resulted in a rise in remote access to health and equity of care. There is also a shift towards the provision of medical services in the home, using devices with remote monitoring capabilities. An emerging trend is monitoring and diagnosis at 'the speed of life'. Also growing is the use of telehealth from hospitals as part of the outpatient services and the increasing use of technologies such as home monitoring to assist elderly patients to remain in community-based care.

From a design perspective, this means a growing need for bariatric capability in health facilities; a need to factor in telehealth as part of outpatient services; increased emphasis on real-time data capture, storage, analysis and retrieval; more technology-enabled accommodation; and an increased need for aged-care facilities and community-based care.

Figure 6: Demonstrating a remote eye exam. Technology makes remote consultation and the rise of telehealth a reality

Consumer use of technology

Thirty percent of Australia's total burden of death, disability and disease can be accounted for by risk factors such as smoking and obesity. But the development of innovations such as Google, Skype, YouTube, smartphones, tablet technology and interactive gaming platforms, difficult to envisage 15 years ago, has brought about new options for transacting preventative healthcare. Health professionals have more ways to engage consumers – and consumers are better equipped to be proactive in their health.

There will be a freer exchange between healthcare providers and consumers. Patients will be empowered through active participation in their care. There will be increased accessibility to information, enabling better coordination of various facets of care, with devices more widely used in the active monitoring of disease, and greater choice for the consumer in how and when they interact with their healthcare providers. In addition, new resources and methodologies will enable the public to engage in preventative health and assume self-responsibility for the management of disease conditions.

While designers find ways to accommodate consumer devices in the healthcare setting, the innovative technologies that are pervasive in the community will have the potential to assist patients in health facilities to avoid social isolation, as well as being tools to reinforce care.

Conclusion

The last 15 years have seen great innovation in healthcare, technology and building design. Evidence-based medicine and evidence-based building design are providing rationality to treatment and care delivery, and the facilities that accommodate it. What is needed is rational use of technology to achieve its potential to enable new models of care provision. In addition, it must be leveraged to address health workforce shortages into the future. In other words: work smarter, not harder.

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The digital evolution

The use of information and communication technology in Australian healthcare has advanced in three distinct phases since 2000; the latest developments will move patients and clinicians into an era of fluid information and 'distributed care'

Brendan Lovelock
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The impact of information and communication technology (ICT) on Australia's healthcare industry has escalated remarkably since the turn of the century. ICT has evolved from simple patient administration to being an integral component of patient care.

Today we recognise the power of ICT to transform our whole health system. This progression has been driven by the interplay of three factors: new hardware, innovations in clinical software and government policy.

New ICT hardware has produced spectacular advances in the way we access, store and communicate our information. This has enabled rapid developments in the clinical software applications that process and manage healthcare information. These recent changes have been accelerated by targeted government policies, incentives and direct infrastructure investments.

As a result, ICT in healthcare has advanced in three distinct phases over the past 13 years. The early 2000s were a time of 'information islands'; the emphasis was on largely independent information systems. These systems often concentrated on the individual needs of specialised departments or clinicians. From 2005 to 2010, the healthcare industry expanded its focus to improving connectivity between systems and the smarter use of integrated information.

In 2013 we are at the beginning of an exciting new phase – the era of 'distributed care'. This is a vision of 'fluid' information, where data and skills flow between healthcare facilities so that clinical resources are accessed and delivered where they are required, not where they are located.

2000–2005: The rise of information silos

Technology overview: In Australia, hospital communication in the early 2000s was dominated by paper, telephones and face-to-face conversations. Pagers were the primary form of remote notification. Most computers were hardwired into hospital networks, as wireless capabilities were slow and patchy in their coverage. Telephones were largely analogue and not integrated with information systems.

Radiology and pathology – two data-intensive specialties – were more advanced than other specialty areas in their transition to digital technology. However, communications between these key diagnostic functions and clinicians largely remained paper-based. Automated notification of patient results was virtually non-existent, with most results turning up as a pile of documents at a nursing station, supplemented by a page or phone call if the result was extremely urgent.

During this time, hospitals were flooded with software applications. A majority of these applications focused on the needs of individual departments. Applications ranged from commercially developed programs to software created by clinicians in their spare time using consumer-oriented platforms such as Microsoft Office Access or Excel.

As a consequence, large hospitals sometimes had more than 200 to 300 standalone clinical applications of variable quality running on their ICT facilities. Interoperability between these systems, if it occurred at all, was chiefly via paper documents, which would be retyped into supporting programs.

Figure 1: 'Distributed care' is ICT's new phase: it will see clinicians and patients connected to the people and information they require

Policy development: In the early 2000s, the Australian healthcare industry became more aware of the quality and safety challenges it faced. The release of two US reports, *To Err is Human*[1] and its follow-up *Crossing the Quality Chasm*,[2] highlighted hospital error rates and the subsequent toll on human life. These reports estimated that approximately 44,000 to 98,000 people died annually from medical errors in US hospitals. *Crossing the Quality Chasm* emphasised the important role ICT could play in avoiding these tragedies. These reports, which were supported by equivalent studies conducted by Australia's clinical community, provided critical support for the introduction of ICT in Australian hospitals to improve patient safety.

Outside the hospital, the Australian government sought to drive innovation in primary care. A key initiative in this area was the introduction in 1998 of the Practice Incentives Program component, providing direct funding for the purchase of desktop computer infrastructure for GPs' offices.

Combined with the availability of GP practice management software that was subsidised by pharmaceutical companies, the Practice Incentives Program resulted in a dramatic increase in computer use in GP offices. By 2004, approximately 95% of GP offices in Australia used computers, but there were large variations in how GPs used computer hardware and software. Just like the situation in hospitals, there was little connectivity between individual systems, which created a sea of more than 20,000 information islands across Australia's GP practices.

The HealthConnect programme was the Australian government's first nationwide attempt to rectify interoperability. Introduced in 2000, HealthConnect was a partnership between the Australian, state and territory governments to leverage eHealth systems in different parts of the health sector through a common set of standards.

The programme delivered a number of pilot activities, but failed due to problems of complexity and cost. The Northern Territory was a notable exception; by 2005 its HealthConnect pilot programme had evolved into a highly successful electronic health record system.

Key outcomes: The lessons from this period were clear. Australia's healthcare industry and governments recognised that ICT was an important tool to help build a safer healthcare system. However, creating a multitude of individual, unconnected solutions was costly and inefficient. The real opportunity lay in connecting healthcare ICT systems so information could flow between care providers and between care providers and their patients. This became the focus of Phase 2 of Australia's eHealth journey.

`Figure 2: Technologies such as telehealth carts and dermal cameras improve how doctors communicate information to patients

2005–2010: The era of connectivity

Technology overview: This era saw two major trends emerge in healthcare ICT in Australia. The first involved interconnecting the myriad information systems that sprang up in the first half of the decade. The second focused on improving clinicians' ability to access and use this information.

These trends were fuelled by a number of technology developments, particularly the increased availability of high-capacity wired and WiFi networks; access to interoperability platforms and the standards that support them; and the shift to standards-based IP systems (such as phones, nurse-call systems, monitors and diagnostic equipment) within hospitals. The increased speed of wired and wireless networks saw voice over IP (VoIP) start to dominate new telephone installations, creating the opportunity to link messaging with phone systems and diminish reliance on pagers. This trend was accelerated by the increased use of WiFi phones to displace analogue Digital Enhanced Cordless Telecommunications (DECT) systems.

High-quality wireless networks also supported new mobile computing technologies such as computers on wheels (COWs) and dedicated clinical tablets. This enabled the first applications of mobile bedside clinical data.

Nurse-call systems were also part of this transition to IP. WiFi phones were linked with nurse-call and hospital clinical systems to provide healthcare workers specific alerts and requests, directly to the individual's phone. These functions were available through messaging software systems, which enabled standardised workflows and ensured each message could be received by the appropriate clinician in a timely manner. These innovations demonstrated their potential to significantly increase the care provider's productivity.

Real-time location systems (RTLS) added further intelligence by enabling alerts to be automatically sent to the nearest skilled healthcare worker. RTLS also allowed staff to track the location and status of equipment and vulnerable patients. Tracking the location and state of use of equipment delivered productivity gains by freeing-up the significant amount of time normally spent searching for these items.

Policy development: During Phase 2, standards and standard-verification processes were central to the interconnection of clinical information systems. Health Level 7 (HL7) standards (see www.hl7.com.au) for interoperable healthcare information guided the designs of ICT systems that could safely share information. Integrating the Healthcare Enterprise (IHE – see www.ihe.net) guided the international interoperability validation process.

In 2005, after its limited success with HealthConnect, the federal government founded the National E-Health Transition Authority (NEHTA), a clear reaffirmation of its support for a national approach to eHealth. An independent organisation with a board formed from state and federal government representatives, NEHTA develops and progresses the national infrastructure and support required for the adoption of eHealth in Australia. The first few years following NEHTA's inception were dedicated to consultation and process development.

Meanwhile, state governments focused on interoperability and began to standardise hospital information systems. New South Wales (NSW) and Victoria selected Cerner as their common electronic medical record (EMR) system for acute care hospitals. More than 140 acute care hospitals in NSW and 30 Victorian facilities run Cerner, with more than 100m instances of Cerner electronic charts being opened in the past year. In 2011, Queensland announced it would also adopt Cerner as its common EMR. In 2010, South Australia adopted Allscripts as its EMR platform.

Policy-supported capital investment: In this period, the Australian government began to develop an AU$40bn national broadband network to provide high-speed connectivity across Australia. At the same time, state governments invested heavily in hospital infrastructure and the overhaul of acute care facilities. Between 2005 and 2010, more than 21 major hospital projects totalling more than $15bn were at various stages of design and delivery. Each new facility presented Australia's healthcare industry with the opportunity to apply ICT to better meet community requirements.

This period of major capital investment has resulted in outstanding facilities such as the Royal Children's Hospital in Melbourne, the Royal North Shore Hospital in Sydney and the Fiona Stanley Hospital in Western Australia.

Key outcomes: Governments and industry learnt four major lessons during this period. First, the healthcare industry realised the importance of interconnecting health information systems to increase their usefulness.

Second, governments and industry realised that data, on its own, does little to improve the performance of a hospital or a clinician. It is only when data is delivered in context, in a usable format and on an easily accessible device that is useful to the clinician.

Third, governments and industry recognised that health systems are not just complicated, but complex. Healthcare information systems are complicated because they involve many participants and processes, and they are complex because processes within the systems are not simple or linear. In other words, a small change to one part of a healthcare information system can have an impact on a seemingly unrelated or different part of the system. Policy

Figure 3: Searching for equipment can occupy a significant amount of nurses' time; real-time location systems (RTLS) ensure that key equipment can be rapidly located

Figure 4: By 2004, around 95% of Australian GP offices had computers, but with large variations in exactly how hardware and software was used

makers and programme managers realised that a silo-like approach to the management of healthcare information systems was likely to fail.

The fourth important lesson learnt during Phase 2 was recognising the need to embrace adaptability in ICT system design. Because healthcare is a highly individualised process, rigorously encoding uniform workflows and protocols is inappropriate for most healthcare environments. Governments and industry now understood that ICT systems need to deliver capabilities that assist in adherence to best practice. However, they must also allow clinicians and patients to adapt care processes to individual circumstances.

2010–2020: The era of distributed care

Technology overview: 'Distributed care' is a new vision of healthcare that takes the hospital and reorients its clinical services so they face outward to the community. These services are linked into the broader health ecosystem of primary, aged, community and home care. Data, voice and video technologies, combined with interoperable clinical data, decision support systems and intelligent process coordination create a 'fluid' care environment. Healthcare services can flow to where they are needed rather than being constrained to fixed locations.

The future of distributed care is built on a foundation of ICT infrastructure developed during the previous decade, overlaid by advances in technology that are evolving around us. It uses Australia's growing framework of connected clinical applications, high-speed wired and wireless networks, RTLS, IP telephony, video and smart messaging to create an environment where clinicians and patients are connected to the information they require and the people with whom they need to interact.

Building on this foundation are our emerging technologies to make these capabilities not only independent of location but also of end-user device. This is achieved through virtualising computing services, shifting computing power from the end-user device to the cloud. Using these systems, individual applications or entire computer desktops can reside in the network and appear on any device via secure end-user identification.

Initially focused in acute care facilities, these innovations were often driven by clinicians' simple requirement to use their own mobile devices in the hospital. But increasingly, these services are spreading as institutions become confident with the processes and solutions are developed to better present clinical systems on multiple non-PC devices.

Interaction of technology and information: The foundation of distributed care is a fully interoperable information

ecosystem, spanning all points of care. This information ecosystem is made available to clinicians and patients by access-layer technology, which enables them to retrieve relevant data on role-appropriate fixed and mobile devices that are equipped with applications tailored to the tasks they need to complete.

Once clinicians and patients possess the data they require, they can distribute and exchange this information via a layer of sharing technologies that include data, video and voice. For clinicians, the process of exchanging information during consultation is a key part of the clinical process; for patients, it is an essential foundation for their care. Finally, armed with this information, clinicians and patients can use a coordinating technology layer to mould clinical processes and tailor them to meet their needs.

This capability-layer model for distributed care comprises access, sharing and process-coordination tools. These tools build on each other to cumulatively enhance the value of the information contained in the clinical information ecosystem on which they are based.

Policy development: Technology is only part of the 'distributed care' vision. Government policy and investment is crucial to this phase of health system evolution. The Australian government's funding of NEHTA has created an important vehicle for change. Tasked with delivering the core structural elements of a national eHealth system, NEHTA has embarked on a series of programmes to deliver essential services for sharing healthcare information. These will form the building blocks of Australia's distributed-care future.

To date, NEHTA's major achievements are the:

- establishment of the Healthcare Identifiers Service
- completion of the first stage of the personally controlled eHealth record (PCEHR)
- National Authentication Service for Health
- creation of eDischarge summary specifications
- development of eReferrals specifications
- creation of eSpecialist referral letter specifications
- establishment of the National Product Catalogue
- founding of the National Clinical Terminology and Information Service.

Australia's vibrant software development community is using NEHTA's specifications and services to create applications to manage Australia's interconnected healthcare system.

State and federal governments continue to make significant investments in telehealth by providing funding for video consultations with specialists, GPs and other care providers. Each state and territory has a telehealth programme which is already heavily relied upon, particularly in sparsely populated areas of Queensland, Western Australia and the Northern Territory. The Australian government has also funded programmes to bring specialist clinical services to rural and aged care communities and deliver specialised infrastructure to create a more interoperable telehealth environment.

There is still much work to be done, but Australia's state and federal governments have been instrumental in creating the foundation of distributed care.

A glimpse of the future

What does the future hold for Australia's vision of distributed care for our 'fluid' healthcare system? The proliferation of sensors in sophisticated clinical systems and low-cost consumer devices gives us a hint. The future lies in improving connectivity between healthcare systems, devices, clinicians and patients. This is encapsulated by the concept of the 'Internet of Everything', which will connect patients' biological functions, genomic blueprint and environment with all aspects of healthcare processes. Sophisticated analytics will provide clinicians and patients with a holistic view of an individual's health, which will improve the management of all aspects of patient care.

The role of ICT in improving healthcare has taken the world on a breathtaking journey and the future looks equally exciting.

Figure 5: High-speed wireless networks and mobile computing have enabled bedside clinical data

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TERTIARY & ACUTE CARE

Connective spaces

Strongly underpinned by research, the innovative design of the Fiona Stanley Hospital in Perth is not only people-friendly and sustainable but it will also support its ambitions to become one of Australia's leading hospitals

The development of the Fiona Stanley Hospital in Perth is the centerpiece of a major healthcare reform programme currently being implemented in Western Australia (WA). Its brief was to facilitate the delivery of a patient-centric service, providing healthcare in the most user-friendly and cost effective manner.

The hospital will rank among the best in Australia – a leader in clinical care, research and education, supported by an innovative design that harnesses the latest in scientific, technological and medical developments, and a built environment that is founded on evidence-based design research and case studies.

The design solution is underpinned by national and international research and collaboration with Australasian and international specialists, which included collaboration with evidence-based design researcher Professor Roger Ulrich, who worked closely with the design team and key stakeholders during the masterplan and concept design phases of the project. Collaboration with more than 1,000 staff, key stakeholders, health consumers and community reference groups has contributed to the success of both the design brief and design solution.

The Fiona Stanley Hospital comprises a built area equivalent to more than four city blocks, set in over five hectares of natural bushland, landscaped parks, internal gardens and plazas. The facility will be at the centre of an integrated health, research and education precinct benefiting from planned links to the adjacent Murdoch University, the Western Australian Institute of Medical Research and St John of God Hospital Murdoch. It has 150,000sqm of functional floor space, and 6,300 rooms in the main hospital building. The hospital's 783 beds including 140 dedicated rehabilitation beds in a specialist building, with 83% of acute patient rooms as single occupancy. Built in conjunction with the Western Australian Institute for Medical Research and WA universities, it will be a world-class medical research facility.

The development of the hospital precinct will also be a catalyst for local and regional growth, representing the first stage in the development of the Murdoch Specialised Activity Centre – a transport-orientated ▶

Fiona Stanley Hospital, Murdoch, Perth, Western Australia

Type of healthcare facility: Acute health
Client/owner/commissioning authority: Government of Western Australia (WA) Department of Health
Architects: The Fiona Stanley Design Collaboration (Silver Thomas Hanley, HASSELL & Hames Sharley)
Services engineer: AECOM (mechanical) and Wood & Grieve (electrical)
Structural engineer: BG&E
Project manager: Government of Western Australia (WA) Department of Treasury – Strategic Projects
Quantity surveyor/cost manager: Ralph Beattie Bosworth (RBB)
Building contractor: Brookfield Multiplex
Form of procurement: Managing contractor
Cost: AU$2bn
Size: 150,000sqm
Construction start: September 2009
Construction completion: December 2013
Project in use: May 2014 (forecast)

mixed-use development that combines employment, residential and education in one locale. When completed, the Murdoch Specialised Activity Centre will accommodate 35,000 jobs, 25,000 students and 4,000 homes.

A key challenge for the architects working on the Fiona Stanley Hospital was ensuring that this greenfield development would engender a sense of place and a feeling of connectivity. The agreed design will significantly activate the precinct, providing a distinctive and engaging location for the community.

The facility capitalises on WA's favourable climate and spectacular natural environment by incorporating natural light, views and usable outdoor space. It will offer patients, staff, visitors and the wider community access to areas for exercise, relaxation and rehabilitation, with the positive distraction of direct contact with the natural environment, including flora, conserved wetland and fauna. There will be visually interesting and interactive environments, with 'safe places' that will foster social interaction, promote health and improve the overall wellbeing and comfort of users. The hospital will also be a vibrant and attractive workplace – one that will enhance staff performance and patient care, and in turn, aid in the attraction and retention of staff.

Pivotal to the hospital's success is the creation of an engaging, sustainable, health-promoting built environment that will foster participation, wellbeing and health activity through the integration of built form and landscape. These underlying ideas had a fundamental effect on the development of the architectural and healthcare model. Instead of spreading out to maximise the footprint of the building on the site, the main hospital block rises in height and wraps itself around a large external public park. This park reaches deep into the heart of the building, facilitating light and views, as well as offering external areas for activity. The lower podium floors of the building (which, through clinical necessity, are deeper planned) are penetrated by a network of landscaped courtyards and open-ended corridors, which fragment the building mass. These offer patient and staff access to external space immediately adjacent their accommodation or workspace, while also being excellent for wayfinding. The elevated inpatient accommodation capitalises on the rooftop landscaping and views on to the public and conservation parklands and beyond.

Movement patterns are another key feature. Detailed analysis of staff, patient and support service flows has resulted in the development of clear and direct pathways within and outside the facilities. This delivers highly effective wayfinding and efficient flows between all operational areas, while maintaining a high level of connectivity with the external environment.

Outside influence

Taking full advantage of southern Queensland's favourable climate and natural beauty, Gold Coast University Hospital seeks to engage patients in the positive benefits of the external environment as part of their treatment

Gold Coast University Hospital (GCUH) uses the region's good climate and natural beauty to its fullest advantage, drawing in nature and offering plenty of outdoor amenity space that becomes an integral part of the treatment process. The 175,000sqm tertiary hospital is one of the first fully integrated urban design, landscape and architecture health projects that incorporates a precinct strategy.

Serving the Gold Coast region of Queensland, the hospital's integrated facilities include: a pathology education building; a 72-bed mental health facility; a comprehensive cancer care centre; a 50-bed neonatal intensive care unit; paediatric ambulatory care and inpatient services; a birthing suite with women's ambulatory care services; and hot floors for intensive care and surgical services. The masterplan for the site promoted the creation of 'place' and a vision that would allow for future expansion. A parkland setting was created, incorporating connections with light rail infrastructure, enabling the public to reach the site via public transport.

The physical arrangement of departments and the connections between them was developed around the journey of a typical patient or visitor, with journeys between lifts, receptions and major journey decision points occurring within a 60m radius. Time-and-motion studies were also undertaken, to study the journey of different client groups across a three-minute period. This led to a design that provided signage every 60m and rest stops or places to linger along some of the major corridor areas.

The architects collaborated closely with Queensland Health and numerous stakeholders, instigating an interactive design process from the outset. Several studies were also undertaken during the design of GCUH, which involved benchmarking against both national and international precedents. The consequence of these studies was the generation of a compact design, augmented by a seven-storey atrium space that enabled visual connections from lifts and ▶

Gold Coast University Hospital, Southport, Queensland

Type of healthcare facility: Acute health
Client/owner/commissioning authority: Queensland Health and Gold Coast Hospital and Health Service
Architects: GCUH Architecture (pdt architects, Silver Thomas Hanley & HASSELL)
Services engineer: Sinclair Knight Merz & Aurecon
Structural engineer: Aurecon & Sinclair Knight Merz
Project manager: Capital Insight
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Bovis Lend Lease
Form of procurement: Guaranteed contract sum
Cost: AU$1.75bn
Size: 175,000sqm
Construction start: 2007
Construction completion: September 2013
Project in use: September 2013 (forecast)

entry points into the hospital. Intuitive wayfinding has led to the arrangement of hospital departments around this atrium space.

The number of single bedrooms increased to 75%, a state initiative in recognition of research that single rooms contribute to healthcare quality improvements, including the reduction of hospital-acquired infections. The reduction of pain relief and patient stays through the preservation of outlooks to natural landscapes, also became a key reference point.

Access to daylight and the outdoors was integral to the design, with some of these outdoor spaces also serving as clinical spaces, providing important breakout space from intense clinical environments such as day chemotherapy and neonatal intensive care. Major artwork commissions have been installed in the parkland and courtyard spaces. Lounge and dining areas open directly onto courtyard spaces via stack doors that could open up the entire lounge area to the courtyard.

Through benchmarking and design review, it was established that 10-12 operating theatres arranged in clusters were operationally more efficient than one large 24-theatre suite. This clustering enabled the decentralisation of set-up spaces and sterile stores; one wing of theatres could also be closed once the theatre list for the day was completed, enabling staff to be concentrated into one area.

GCUH has been designed to achieve the equivalent of a four-star Green Star rating. Some of the ecologically sustainable development initiatives included glare analysis (to maximise the use of natural daylight in internal spaces without causing patient discomfort), which was accompanied with facade prototyping, to analyse views out, and glazing efficiency. Other measures include rainwater harvesting and the use of solar photovoltaics for renewable energy. The air-conditioning system uses a refrigerant with low ozone-depletion potential.


Royal
Adelaide
Hospital

A cultural shift

Set on the edge of the parklands that circle the city, the new Royal Adelaide Hospital has a leafy setting that will promote healing, and 100% single-bed rooms – a first for a major public hospital in Australia

The new Royal Adelaide Hospital (new RAH) is being developed to lead cultural change throughout the health system in South Australia (SA), by creating an environment that encourages and supports staff in adopting new organisational values and systems of work. It is based on a patient-centric model of care, with an outcome-focused approach that is intended to support the state's broader healthcare plan.

The new RAH will be located at the west end of Adelaide's central business district, at the confluence of Adelaide's renowned Park Lands, which encircle the city, and its Riverbank precinct. Two large public plazas and links to the Park Lands will reinforce its greater community context; the hospital's leafy setting also influenced the incorporation of open green spaces and elevated sky gardens, which will make the new RAH literally one of the greenest hospitals in Australia. This in turn led to an overarching design theme – that of a park within a hospital, rather than a hospital within a park.

The new RAH, which is the second of three public-private partnership (PPP) projects designed by architects Silver Thomas Hanley and DesignInc in joint venture (STHDI), will provide more than 175,000sqm of purpose-built facilities supported by 76,000sqm of car parking space. Within the acute hospital will be 700 single beds and 100 same-day beds. The efficient and highly flexible layouts will enable SA Health to achieve a high level of patient throughput while providing staff with excellent conditions in which to work.

The design follows the state's Patient Centered Model of Care, which focuses on delivering a better, more efficient care outcome for all South Australians. The hospital is therefore envisioned as a centre of healing and learning, not only supporting advancement and efficiencies around the care of its patients, but also providing for staff and their future advancement. Quality healing environments will support patients and their carers, providing efficient and enjoyable spaces for clinicians and other staff to undertake their work and education. ▶

The new Royal Adelaide Hospital, Adelaide, South Australia

Type of healthcare facility: Acute health
Client/owner/commissioning authority: Hansen Yuncken Leighton Contractors (HYLC), SA Health Partnership and SA Health
Architects: Silver Thomas Hanley and DesignInc (STHDI)
Services engineer: Bestec & Lehr Consultants International
Structural engineer: Wallbridge & Gilbert and KBR
Project manager: SA Health
Quantity surveyor/cost manager: HYLC (Hansen Yuncken & Leighton Contractors) Joint Venture
Building contractor Hansen Yuncken Leighton Contractors (HYLC)
Form of procurement: PPP (public-private partnership)
Cost: AU$1.85bn
Size: 175,000sqm (+ 76,000sqm car parking)
Construction start: June 2011
Construction completion: 2016 (forecast)
Project in use: 2016 (forecast)

The provision of 100% single bedrooms is a first in a major public hospital in Australia; it means a lower risk of cross-infection while providing a light-filled private space with optimum views over parkland or the city centre. Bedrooms are grouped in pods of 16, arranged on three sides around a central island control and service centre.

STHDI re-engineered the 'conventional' hospital bedroom design in response to the project brief. Separate zones were incorporated into the bedroom to meet the different needs of patients, clinicians and visitors. For example, the en suite is located on the bed-head wall of the room, which is intended to optimise patient safety while maximising external views; this configuration also maximises opportunities for access and visibility from the corridor for staff and patients alike.

For the interiors, the design again responds to the hospital's parkland setting, with a theme that embraces nature. Organisational and wayfinding strategies have been developed to respond to the key elements of earth, water and flora as well as acknowledging cultural diversity and Australia's indigenous heritage.

The passive and advanced ecologically sustainable development initiatives that have been incorporated into the facility's design will result in a 40% reduction in CO_2 emissions. Features include glazing systems that provide high thermal qualities and exemplary acoustic performance; water and heat recovery systems; solar shielding and efficient engineering services systems; and equipment designed to minimise energy consumption.

The early success of the project can be attributed in part to the innovative use of building information modelling (BIM) software. The deployment of BIM on the new RAH has set new benchmarks for the design and construction of infrastructure projects in Australia.


RNSH

Calm amid complexity

A teaching hospital and a major trauma centre for New South Wales, the Royal North Shore Hospital has been designed and planned to improve operational efficiency and create an environment of wellness

The Royal North Shore Hospital (RNSH), one of the largest and most complex hospitals in New South Wales (NSW), is one of five major trauma centres in the state, and is also a teaching hospital of the University of Sydney and University of Technology, Sydney. As part of an AU$1.2bn redevelopment, BVN Donovan Hill created a new masterplan for the 11-hectare site and designed a new acute hospital building.

The new 100,000sqm acute hospital is the centrepiece of the RNSH upgrade. It incorporates one of Australia's largest operating suites, a 60-bed intensive care service, nine 30-bed inpatient units, a major radiation oncology centre, a 34-bed mental health unit and a major emergency department. The design focuses on safe and efficient delivery of services, flexibility for future expansion and the provision of a welcoming public building.

The innovative physical layout is based on the development of a clear circulation and services backbone. This is manifested in the 'high street' of the hospital, under a sunlit atrium. This layout minimises patient and staff travel by providing the shortest distances possible and supports team-based delivery of care.

The planning provides a physical framework to improve operational efficiency, the working environment of staff and services to the community. While colour is used as a clear internal wayfinding device, it is also used to enhance an environment of positivity, care and wellness.

Following the opening of the hospital at the end of 2012, management feedback confirmed that the impact of the design on staff collaboration had been profound, and had changed the way that people interacted, reflecting the important role played by the quality of the hospital's environment in providing a context for cultural change.

The project has also demonstrated how design has the capacity in such a large project to make significant changes to the way people work. The design process began by engageing a wide range of clinician groups in workshops to ensure all clinical requirements were taken into account, establishing a collaboration that enabled the architects to incorporate the highly complex mix of activities and design an improved work environment. For example all 40 outpatient clinics are now located on the ground floor level making access for visitors and clinicians easier and faster.

The key features of the Royal North Shore Hospital include: Over 5,000 rooms; 126 departments; a 60 bed intensive care unit; 14 inpatient wards; a 34 bed mental health unit; a cancer care centre; an emergency department; and an acute dialysis unit.

Royal North Shore Hospital, Sydney, New South Wales

Type of healthcare facility: Acute health
Client/owner/commissioning authority: NSW Government, Health Infrastructure
Architects: BVN Donovan Hill
Services engineer: Hastie International
Structural engineer: Hyder Consulting
Project manager/building contractor: Thiess
Quantity surveyor/cost manager: Thiess
Form of procurement: Full architectural services
Cost: AU$1.2bn
Size: 100,000sqm
Construction start: 2008
Construction completion: 2012
Project in use: December 2012

No corner wasted

Designed for excellent observation and communication, the ICU at Melbourne's Alfred Hospital has been carefully considered to the smallest detail. As a result, cross-infection rates are down, and staff retention is up

The redeveloped intensive care unit (ICU) at Melbourne's Alfred Hospital significantly expands the critical care floor area for this major trauma hospital, located in the city's inner suburbs.

With a scarcity of views to nature (the building is confined on three sides, with a masterplanned tall building on the fourth side) an innovative approach was adopted in the design. High-level roof lanterns let in natural light, allowing patients views to the sky and changing outside light conditions – crucial qualities of health design that aim to reduce depression, levels of medication, duration of stay and rates of readmission. This inversion of the traditional logic of perimeter windows means patients face the staff areas, but that they also see the sky, the changes in the weather and the passing of time, to assist in regulation of circadian rhythms. All patient bays have a view to the sky with carefully considered glare control, such as roof overhangs and switchable glass to roof lanterns. Meanwhile, the best view, through full-height glazing across to Fawkner Park, is reserved for occasional visits of long-stay patients.

The patient area is broken into three distinct pods, with central staff observation areas for each, but with the edges blurred to allow patients/staff to flex between pods depending on demand. Natural light was then sought from the centre of the pod rather than windows on the perimeter.

Patient cubicle design was carefully standardised and became the model for ICU cubicles in Australasia. The bed position enables staff to have the best view of the patient and supporting life-saving equipment. Central staff stations were designed as low sculptural pieces, with multiple pass-throughs (for rapid staff back-up) and bays for writing up while maintaining a peripheral view of patients, as well as alcoves for plug-in storage out of the corridors. Spatial guidelines were innovatively reinterpreted to avoid collections of little box rooms, but rather find the right home for every role, and every piece of at-call equipment.

The patient care pods are supported by a family waiting and interview area likened to an airport lounge, a generous staff area for breaks and an education centre that can flex to large teaching groups.

The unit is designed around a number of key criteria for healing environments, including highly absorptive sound attenuation (in the ceiling finishes and spatial geometry) to encourage patient rest/sleep. Most of the building maintenance can be performed from outside the unit to avoid noise, potential contamination and disruption to patient care, and noisy equipment is removed from the patient care area for cleaning and maintenance.

Post-occupancy evaluation indicates the unit has exceeded all expectations, particularly in the way that a calming environment has been achieved; staff turnover has also reduced significantly. The unit was tested shortly after it opened – in 2009 it was the main response unit for the burns victims from the Victoria's Black Saturday bushfires in which 173 people died and many were severely burnt. Users noted a significant reduction in cross-infection rates compared to the previous unit.

Alfred Hospital Intensive Care Unit Redevelopment, Prahran, Melbourne, Victoria

Type of facility: Acute health
Client: Department of Health and Department of State Development, Business and Innovation (Victoria) / Alfred Health
Architects: Billard Leece Partnership
Services engineer: Arup
Structural engineer: Connell Wagner (Aurecon)
Project manager: Johnstaff
Building contractor: John Holland
Quantity surveyor/cost manager: Padghams (Sweett Group)
Form of procurement: Construction management
Cost: AU$20.2m
Size: 4,000sqm
Construction start / completion: 2007 / 2008
Project in use: September 2008

New birth

More than 500 extra beds and cots have been created on the site of Austin Hospital, thanks to a new acute facility and the addition of a state-of-the-art women's hospital

This project provides two new hospitals on the Austin hospital campus, located in Heidelberg, an outer suburb of Melbourne. An existing facility, Austin Hospital, was redeveloped and newly co-located with the Mercy Hospital for Women. Known as the AR/M project, it was commissioned by the Victorian state government and designed by Silver Thomas Hanley in association with Jackson Architecture.

The AR/M project added a new tower to Austin Hospital, containing 400 acute beds, specialising in cardiac, neurosurgery and paediatrics, with state-wide specialities in liver and renal transplant, spinal injury and respiratory support. A quarter of rooms are single-bedded, with en-suite facilities in each room. The hospital also incorporates a unique teaching, training and research precinct.

The Mercy Hospital for Women provides 128 beds of obstetric, maternity and gynaecological services with 62 neonatal cots in the special care nursery and neonatal intensive care unit. Its 13 birthing suites and four family birth centre suites all have en suites. There are also four operating theatres, plus teaching and training facilities.

The Austin service included a dedicated paediatric emergency department, with separate entry and amenity from the main emergency department. It also included a paediatric ward, with an adjacent 'secure' outdoor playground area. The ward area also incorporated a waiting space associated with paediatric day surgery. Child-friendly decor – in terms of its finishes and choice of materials – features across the department.

The result was a fully integrated campus with a fresh, contemporary image for each of the facilities and entities occupying the site. Its design provides a patient and visitor friendly facility that facilitates patient-focused care, maximises external views, ensures good wayfinding and provides access to gardens. Aluminium-clad facades and the use of an enduring yet simple palette of materials – stone, timber, glass, terrazzo and stainless steel – create a unified aesthetic.

Austin Hospital and Repatriation Medical Centre Redevelopment/ Mercy Hospital for Women Relocation, Heidelberg, Melbourne, Victoria

Type of facility: Acute health
Client: Department of Health Victoria/Austin Health/Mercy Health & Aged Care
Architects: Silver Thomas Hanley & Jackson Architecture
Services engineer: Bassett Kuttner Collins & Co Joint Venture
Structural engineer: John Mullen Partners McWilliam Joint Venture
Building contractor: Baulderstone
Project manager: Atkinson Project Management (now Aurecon)
Quantity surveyor/cost manager: Davis Langdon (now an AECOM company)
Form of procurement: Managing contractor
Cost: AU$400m
Size: 97,000sqm
Construction start: May 2001
Construction completion: April 2005
Project in use: May 2005 (Mercy); June 2005 (Austin)

Star performer

A mixture of active and passive design strategies – from a solar energy to a heat-recovery system and efficient glazing – helped Flinders Medical Centre to become Australia's first Green Star-rated hospital

Flinders Medical Centre (FMC) is the major tertiary referral centre for acute care and emergency services in the southern region of Adelaide and has recently undergone the largest and most complex single redevelopment the South Australian Department of Health has undertaken. Staged construction was completed in 2012 with all services maintaining full operational levels throughout the five year redevelopment program.

Delivering excellence in environmentally sustainable design was defined as a key objective for the redevelopment and the New South Wing at FMC was the first Australian healthcare facility to achieve the Green Building Council of Australia's five-star Green Star 'As Designed' and 'As Built' rating. The four-storey New South Wing which links to all levels of the existing hospital represents a significant new-build component of the centre's redevelopment.

The New South Wing was constructed as the first stage of the redevelopment and provided the opportunity to collocate Women's Health Services and to exploit the views of the natural creek setting to the south to provide a restorative environment separate from the busy acute ward environment of a major tertiary hospital.

The new South Wing accommodates the women's assessment and birthing services, obstetrics and gynaecology wards, outpatient clinics and administrative areas. The second stage of the redevelopment included the redevelopment and upgrade of ageing hot-floor departments including operating theatres, recovery, ICU, emergency and intensive care departments.

The design philosophy was to minimise the environmental footprint of the project and create a healthy environment for patients, visitors and staff. To this end, extensive evidence-based design connecting good indoor environment quality (IEQ) to faster recovery rates and improved staff and patient health made IEQ a natural focus for the project. The target for the New South Wing was to improve energy efficiency by up to 45%, as well as a greater than 15% reduction in water consumption.

The heating and cooling strategy includes an innovative displacement ventilation system, high-efficiency chilling plant and air handling systems, and heat recovery from exhaust air paths. The automated BMS enables the use of energy reduction techniques, such as using 'free cooling', when outside temperatures permit.

A 230-panel solar hot water system is calculated to reduce recurrent energy costs by approximately AU$400,000 per year, and annual CO_2 emissions by approximately 380 tonnes.

The building's design maximises access to natural light and includes effective passive design features. These include purpose-designed external fixed shading devices, to maximise light penetration while minimising solar heat gain; high efficiency glazing throughout; and a building envelope with high thermal performance and suitable insulation levels.

Flinders Medical Centre New South Wing, Bedford Park, Adelaide, South Australia

Type of facility: Acute health
Client: SA Health
Architects: Woodhead
Services engineer: AECOM
Structural engineer: Aurecon
Quantity surveyor/cost manager: Rider Levett Bucknall
Building contractor: Baulderstone
Form of procurement: Managing contractor
Cost: AU$34m
Size: 4,700sqm
Construction start: February 2008
Construction completion: September 2009
Project in use: September 2009

Independent living

Clinical services have been cleverly placed out of sight at this sub acute residential facility for older people. The building is domestic in scale, patient and family-focused, with an emphasis on communal living and recreation space

The Mornington Centre is a purpose-built 60-bed geriatric evaluation and management facility, providing extended residential accommodation for older people who require specialist geriatric evaluation, management and rehabilitation. These services are delivered in a new purpose-built building located in the clients' own community – in a residential street near the sea.

The building contests the conventional paradigm of a nursing home. Through its spatial arrangements and normalising environment it shifts from a medico-centric model of care to one where family and carers work with staff to deliver care to residents. It feels more like a big house or coastal hotel instead of a hospital, with its architects needing to develop a different language to describe this new type of building.

A large-scale, folded pitched roof encompasses the whole building, tying together the spaces within, while a repeating rhythm created by the folded bedroom walls formally articulates the building along its length and controls the hot summer sun. The rooms in which people stay over were designed as bedrooms, not wards, and each contains a bay window in which people can sit and enjoy the view. The rooms have generous openable windows for admitting daylight and fresh air.

Inside, the clinical and clinical support spaces are suppressed or hidden to highlight spaces for clients and their families – the spaces that form the clients' experience of the building. Internal timber cladding, directional timber vinyl flooring, warm colours and domestic lighting contribute to this spatial reading. The reception area presents like a hotel concierge desk – friendly and helpful – with materials, fittings and other visual cues designed to reduce people's anxieties. The entry space leads into the dining room, which acts as the social heart and family focus for the building. Here family members, guests and staff can come together to eat, chat and have a cup of tea.

Like the bedrooms, the lounge rooms are similarly arranged to how they might be at home. They have been positioned for light and view, and offer flexibility of use, for group settings, watching TV, quiet sitting or family gatherings.

Collaboration within the interdisciplinary clinical teams was also a key objective for the project. Staff workspaces are designed for optimum interactivity and amenity. Staff rooms are generously sized with views to the outside, and are complemented by external garden areas.

The building is clad in a brick render, figured with a combination of smooth and rough grain, the latter constructed out of conventional house bricks embossed with a contoured digital design. From a distance it gives the impression of oversized timber planks, lending the building a domestic feel while meeting maintenance requirements.

This building supports a new way of thinking about how services are delivered to older people in our communities – through buildings that put people and families at the centre, and which draw on evidence-based research into the special clinical and psychological needs of these clients.

The Mornington Centre, Mornington, Victoria

Type of facility: Sub-acute
Client: Department of Health Victoria and Peninsula Health
Architects: Lyons
Services engineer: Umow Lai & Associates
Project manager: Atkinson Project Management
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Abigroup
Form of procurement: Construction management
Cost: AU$20m
Size: 4,500sqm
Construction start: 2006
Construction completion / project in use: 2007
Project in use: August 2007

Crisp and clean

The Oral Health Centre of Western Australia, the state's major dental teaching, research and clinical facility, was designed to provide a non-threatening environment for dental patients with views out to the adjacent nature reserve

The Oral Health Centre of Western Australia is the major dental teaching, research and clinical facility for dentists, dental hygienists and dental technicians in Western Australia (WA). The development, jointly funded by University of Western Australia (UWA) and the Government of Western Australia, is located at the southern end of the Queen Elizabeth II Medical Centre campus in Perth. The 10,000sqm includes 108 chairs with corresponding utility support areas, a lecture theatre, academic study spaces and child care facilities. It treats in excess of 7,500 public dental patients per annum.

The Oral Health Centre formed one new integrated organisational and physical unit for five organisations previously delivering teaching, research and clinical services in WA – the UWA School of Dentistry, the UWA Medical Library, Curtin University's Department of Dental Hygiene and Therapy, the Central College of TAFE facilities for the training of dental technicians and the public dental facilities of the existing Perth Dental Hospital.

The design aesthetic aimed to present an image that was confident and progressive technological as well as non-threatening and non-institutional, recognised as a place of wellbeing. The materials and the language of the built form were developed from the recognised aesthetics of the nearby UWA campus, in a contemporary form without literal reference and the addition of modern materials which simultaneously deliver human scale and familiarity with an aesthetic that reinforces crispness, cleanliness and the vision of the Oral Health Centre.

The massing of the Oral Health Centre took into account the adjacent hospital helipad to ensure that flight paths were not obstructed. The project team also wished to respond to the nature reserve adjoining the site by ensuring that the design of the building took advantage of views and access to this unique feature. In siting the building, consideration was given to retaining as many of the existing mature trees as possible.

The library was determined to be a separate but related building and the lecture theatre was to be separately identified with its own access. The need to separate student traffic from members of the public seeking direct access to public dental care was also a major consideration in the configuration of the building.

The decision to place the main entrance between the two dental buildings solved a number of circulation problems while enabling the functions in each building to have the capacity to independently expand. A courtyard off the main entrance was included to permit those waiting for appointments to enjoy the temperate climate WA has to offer, while the pedestrian route from the medical library back to the medical school was deliberately designed to traverse the nature reserve. The juxtaposition of the buildings created protected external courtyards and meeting points for each of the different users of the buildings.

Oral Health Centre of Western Australia, Perth WA

Type of healthcare facility: Public and research dental health facility
Client/owner/commissioning authority: University of Western Australia
Architects: Hames Sharley
Services engineer: Wood and Grieve Engineers
Structural engineer: Connell Wagner (now Aurecon)
Project manager: Clifton Coney Stevens
Quantity surveyor/cost manager: David Langdon Australia
Building contractor: BGC Constructions
Form of procurement: Traditional lump sum
Cost: AU$35m
Size: 10,000sqm
Construction start: September 1998
Construction completion: December 2001
Project in use: January 2002


Zouk Café

Civic renewal

The first stage of a masterplan to consolidate and update 150 years of incremental building, the redeveloped Royal Hobart Hospital's design is informed by the latest research, as well as the city's venerable history

The Royal Hobart Hospital is located in inner-city Hobart, on a site continuously occupied by the hospital since the mid-19th century. Having grown incrementally to occupy an entire city block in multiple buildings, the resultant campus is inefficient, difficult to navigate and outdated. The Redeveloped Royal Hobart Hospital (RRHH) project is the first stage of a multi-phase masterplan to redevelop the site into a contemporary hospital campus that complements care models developed from the latest research evidence, with a focus on salutogenic outcomes. Lyons' masterplan, developed in partnership with the client, replaces old buildings with new facilities that maximise operational efficiencies and provide capacity for future growth.

It introduces two major internal 'streets' to the site, connecting the hospital community to the city. Three new major buildings are accessed off these streets including a new inpatient and surgical services building (Stage 1), an outpatient and ambulatory care building and a centralised hospital services building. A heritage ward building is retained as the main hospital entrance and remodelled as a future family resource centre and clinical directorate.

During the planning phase of Stage 1, innovative accommodation was designed to support care models based on recent medical research. For example, in the women and children's precinct, the delivery unit is divided into two distinct zones differentiating 'clinical' deliveries from 'natural' births. In response to clinical evidence indicating that incorporating water immersion during natural births provides effective pain relief and a reduction in analgesics, all birthing rooms have labour pools, set in a home-like environment where medical services are concealed. Similarly, evidence finds that socialisation between children can improve recovery rates, but this is difficult to achieve in single bedrooms. Through the careful placement of openable acoustic doors, a 'single/double' room was conceived for RRHH, whereby two children can move freely between rooms when nursing arrangements allow.

Analysis of views from a typical inpatient bedroom identified that a T-shaped window profile would maximise vistas of the dramatic natural scenery. These windows are protected from the summer sun by a series of sunscreen boxes, the proportions of which are similar to the Georgian stonework characteristic of Hobart's architecture. In their pattern and colour, the boxes have a quilt-like quality, reminiscent of the Rajah quilt made by prisoners en route to Hobart in 1841, a significant historical artifact from colonial times. It grants the development a uniquely identifiable image within the city, giving it a civic presence not often associated with contemporary hospitals.

The RRHH is one of Australia's first hospital projects delivered using building information modelling (BIM). This has enabled project stakeholders to review all phases of design in three dimensions, leading to more informed decisions, such as better incorporation of services with architecture and more effective project documentation in support of on-site delivery. Information collected during the design and delivery phase can be used by the client post occupancy, to measure performance and identify improvement opportunities for subsequent stages.

Redeveloped Royal Hobart Hospital, Hobart, Tasmania

Type of facility: Acute health
Client: Department of Health and Human Services Tasmania and Royal Hobart Hospital
Architects: Lyons
Services/structual engineer: AECOM
Quantity surveyor/cost manager: Donald Cant Watts Corke
Building contractor: John Holland Fairbrother JV

Form of procurement: Two-stage managing contractor
Cost: AU$565m
Size: 40,000sqm
Construction start: 2016
Construction completion: 2017
Project in use: 2017 (forecast)

Continuous improvement

A complex expansion and refurbishment has seen Townsville Hospital's facilities come in line with current best practice – including the upgrading of the southern hemisphere's largest emergency department

The redevelopment of Townsville Hospital – a major far north Queensland referral and teaching hospital serving in excess of 670,000 residents – is an example of the need to expand and consolidate existing hospitals while maintaining all current functions. Work commenced in 2008 on the first component of six levels, with a new emergency facility, a relocated intensive care unit (ICU), medical imaging expansion and shell space for future growth. It was followed in 2009 by expansion of the neonatal ICU, and subsequently a pathology expansion, a new ward block, a central energy facility, a clinical support building and a cancer centre expansion including a PET suite, linear accelerator and chemotherapy facilities.

The most significant achievement of this project is the consolidation of a previously horizontally sprawled hospital into a unified, condensed whole, generating both enhanced operational efficiencies and a much-enhanced sense of vitality for both staff and patients. As a major regional referral and teaching/research facility, Townsville Hospital provides a flexible model of care that enhances a people-centred philosophy, ensuring services to patients and visitors are relevant to their needs. Continuous improvement underpins all the hospital's activities and practices.

In the redeveloped emergency department – the largest in the southern hemisphere – the brief included the integration of primary and secondary care emergency services, allowing for an increased volume of frail aged, aboriginal and paediatric patients, and meeting state-set key performance indicators (KPIs) for triage categories.

The pathology department serves regional hospitals as well as a significant expansion in high-complexity services at Townsville Hospital, such as chemical pathology, haematology and transfusion medicine. To meet this demand the facility is organised around six principle zones including specimen collection, central specimen receiving, specialised laboratories, administration and stores. Consideration was given to the establishment of a core lab area for services requiring minimum response times and high specimen throughput. The design provides for maximum future flexibility to expand or contract spaces and change equipment configurations.

The expanded and refurbished cancer centre, where the model of care is largely ambulatory, provides a welcoming non-threatening environment that is conducive to healing and improved wellbeing, as well as meeting the needs of carers and patients with acute and chronic care needs. Patients' attendance is also supported by family or friends, which is actively promoted by staff; thus, waiting areas and clinic rooms must facilitate their presence.

The South Block provides inpatient beds and facilities potentially for medical, surgical, rehabilitation and maternity patients. The primary focus for this service is the effective management, assessment and planning of the acute admission, considering patients' entire complex needs, and providing care in line with best practice and evidence-based principles. It is also an environment that enhances and promotes educational opportunities for medical, nursing and allied health staff.

Townsville Hospital, Douglas, Townsville, Queensland

Type of healthcare facility: Acute health
Client/owner/commissioning authority: Queensland Health
Architects: Cox Architecture & TAHPI
Services engineer: S2F and DMA
Structural engineer: Sinclair Knight Merz
Project manager: Tracey Brunstrom & Hammond
Building contractor: Thiess
Quantity surveyor/cost manager: Rider Levett Bucknall
Form of procurement: Design & construct
Cost: AU$460m
Size: 60,000sqm
Construction start: 2009
Construction completion / Project in use: 2011-2014 (four-stage delivery)

WOMEN & CHILDREN'S HEALTH

Tree of life

The new Queensland Children's Hospital has been designed as a 'living tree' to both facilitate the patient journey and provide a 'green' environment of wellness and health for the patients, staff and visitors who use the facility

Located at Southbank, Brisbane, the new Queensland Children's Hospital (QCH) brings together two existing children's hospitals – the Royal Children's and Mater Children's Hospitals – into a new purpose-designed facility to deliver state-of-the-art tertiary/quaternary paediatric care to the state-wide community, using a healthcare model that empowers patients and families and which uses the built environment to support health and wellness.

The building has been designed around the concept of a 'living tree'. This design concept was developed early in the planning phases in collaboration with the project's stakeholders. It provided an underlying design narrative to develop specific strategies for wayfinding and to develop the salutogenic objectives of the project – connecting inside and outside, and with nature to provide a 'green' working and care environment for patients and staff.

The design approach also focused on the patient journey, locating spaces and services where they are most convenient for patients and families, reducing unnecessary steps in the journey and making access to services direct and convenient. The building is designed as a medium-rise building with an emphasis on lateral circulation and walkable vertical links between departments – minimising the need for lift transportation. Short-stay, high-throughput departments and public activities (cafes, lounges, retail outlets etc) are located on the lower levels and are connected by escalators and stairs.

A network of generous public spaces/double height 'branches' radiate out from the atria/'trunks' at the centre of the plan and extend beyond the building line to form external balconies. Each branch points to, and visually connects with, a key landmark in the city – to central Brisbane, the adjacent parkland, distant mountains and the river. This network of branches and trunks forms the main public circulation system for the new building. The tree elements provide patients with a mind map of the building using local external landmarks as a means of orientation. ▶

Queensland Children's Hospital, Brisbane, Queensland

Type of healthcare facility:
Tertiary/quaternary acute paediatric hospital
Client/owner/commissioning authority: Queensland Health
Architects: Conrad Gargett Lyons (JV architects)
Services engineer: AECOM
Structural engineer: Cardno Alexander Brown
Project manager: Aurecon
Quantity surveyor/cost manager: Aquenta

Building contractor: Abigroup
Form of procurement : Two-stage managing contractor
Cost: AU$1.4bn
Size: 90,000sqm
Construction start: 2012
Construction completion: 2014 (forecast)
Project in use : 2014 (forecast)

The building's exterior is designed as an environmental response to Brisbane's subtropical climate. Vertical and horizontal sunshades provide shading from the sun while maintaining views out of the building. Colours used on the outside and inside of the building are derived from the colours of the Queensland landscape. These include muted neutral colours found in the Queensland outback and the more vibrant colours of Queensland's exotic birds, butterflies and flora. Access to green spaces and views to nature have been a key part of the design thinking. Rooftop gardens, green walls, enclosed courtyard gardens and views to the surrounding landscape are integrated elements of QCH's healing environment.

The design also focuses on optimising functionality and efficiency for clinicians and staff: delivering compact planning arrangements to minimise travel distances, co-locating like functional areas and providing collaborative workspace hubs throughout the building.

New models of care were tested and developed with the QCH stakeholder groups during the concept design phase. These include: a 'no-wait' emergency department where patients are triaged immediately on arrival and are streamed into one of five zones; a paediatric intensive care unit/high-dependency unit (PICU-HDU) developed around a pod design with centralised support services (conventional ICU cubicles have been replaced with 'roomicles' which have sliding door panels and operable side walls); clear separation of public and back-of-house flows; inpatient areas designed as interconnected pods which provide children with localised 'neighbourhoods' that offer QCH staff optimum flexibility in bed management through use of swing beds; separate medical admissions and surgical admissions lobbies to stream admissions into the new hospital; and a long-day lounge to support the needs of patients and families during extended day stays in the hospital.

The procurement of QCH has involved the input of many people committed to its successful implementation – government representatives, QCH staff and clinicians, contractors, subcontractors, arts curators, community representatives and the design team. Regular walk-through tours of the construction site are being conducted during the construction phase with those who will ultimately work in, operate and maintain the new building. This ensures that the ownership developed by the project stakeholders during the design phases is maintained as the facility nears completion.

In 2010 QCH established an arts curatorial committee to oversee the commissioning and installation of public and other artworks in the new building. Major artworks are now being commissioned for installation in the building before its scheduled opening in 2014.

Nature's healing hand

Melbourne's new Royal Children's Hospital integrates with the surrounding parkland both inside and out, to provide an enriching and healing environment for patients, staff and the public – and entertaining diversions for children

The Royal Children's Hospital (RCH) in Melbourne was designed using state-of-the-art ideas developed by the hospital around a family-centred care model that puts children and their parents at the centre of the facility. Using innovative and evidence-based design principles, the RCH reflects changing healthcare practices, workplace patterns, user expectations, community aspirations and environmental responsibility.

With evidence-based design showing the importance and value of nature in the healing process, the architectonic language was directly informed by the natural textures, forms and colours of surrounding Royal Park, a park with a character much like a typical slice of Victorian bushland. The built environment infused with the experience of nature creates an enriching and restorative environment for children, staff and the public. Considered detailing invites the human touch, respectfully acknowledges the child and provides a safe environment while deinstitutionalising the hospital genre.

The design responds to the uniquely Australian context, drawing on the colours of the flora and fauna found in the surrounding park – the approach to colour is intrinsically linked to the wayfinding strategy celebrating the landscapes which make up the state of Victoria. A sweep of coloured 'leaf' blades, fabricated in curved panels, provide protection from the sun while creating a shimmering organic structure. Further, the calming effects of nature are immediately apparent upon entry, with a collection of engaging distractions which allow patients, families and staff moments of wonder.

Positioning the new hospital adjacent to the old hospital enabled direct links to Royal Park and provided an opportunity for a new international benchmark for integration of park and building design. The old hospital is currently being demolished with much of the site to be reinstated as parkland, ensuring no net loss of parkland while creating a southern gateway to Royal Park and an optimal urban design solution. ▶

The Royal Children's Hospital, Parkville, Melbourne, Victoria

Type of healthcare facility:
Tertiary level paediatric hospital
Client/owner/commissioning authority: Department of Health Victoria and The Royal Children's Hospital
Architects: Billard Leece Partnership, Bates Smart with HKS
Services engineer: Norman Disney Young
Structural engineer: Irwinconsult
Project manager: Lend Lease
Quantity surveyor/cost manager: Donald Cant Watts Corke
Building contractor: Lend Lease
Form of procurement: PPP
Cost: AU$847.4m
Size: 165,000sqm
Construction start: November 2007
Construction completion: September 2011
Project in use: November 2011

The six-storey Main Street, a naturally lit public thoroughfare at the heart of the facility, links the elements of the hospital together and invites community through retail offerings, places to meet and eat, performance space, playgrounds, a meerkat enclosure and aquarium, large-scale artworks and interactive video screens. Partnerships with Melbourne Zoo, Scienceworks Museum and Hoyts cinema enabled these popular activities for children and families, which distract and engage the imagination of all age groups. The many features of the Main Street, including major installations by Australian artists, combine to make an otherwise stressful visit to the hospital something special. As a major wayfinding device, the Main Street allows for future organic growth or extra 'address points' to be added as needed.

As well as providing family-centred care for children and their families, the RCH is also a wonderful space for staff across the campus. By co-locating clinical, research and education functions, the design encourages a greater sense of community and allows for easier interaction across staff groups.

Split into a campus masterplan, with the central Main Street addressing major new public gardens to the north and southwest, the collection of north-oriented buildings have light-filled landscaped gardens around their full perimeter, avoiding a 'front and back' portrayal, and enhancing the connection between child and park. The clinical buildings' narrow footprints ensure abundant natural light to enter all corners of the hospital.

The natural slope of the site links the facilities to the park at three different levels, intertwining the hospital with its park setting. The Inpatient Building, designed in a star shape to the north, is woven into the fabric of Royal Park, allowing an intimate connection with nature. More than 80% of rooms have park views and others look into courtyards. Specially designed glass sunshades on the hospital's exterior allow activity in the grounds below to be viewed from the patient's bed.

The bedroom spaces have been designed to be calm and comforting, befitting a place of recovery and respite. Medical procedures are conducted away from the bedroom, leaving these spaces to be a haven for rest and family time.

Recognising the health of our environment and the health of people are inextricably linked, the hospital campus delivers a holistic approach to sustainability – environmental, emotional, physical and psychological. The integrated design solution separates support from clinical areas, enabling the shutdown of areas not required to run 24 hours per day. It also provides views to parkland wherever possible, optimises natural daylight and significantly reduces the carbon footprint through a combination of tri-generation, biomass heating, solar thermal panels and water conservation, including blackwater treatment and rainwater recovery, among other initiatives. Energy efficiency measures mean the hospital produces 45% fewer greenhouse gas emissions compared to a conventional hospital, and water saving measures achieve at least a 20% reduction in water use.

Breath of fresh air

The state-of-the-art Royal Women's Hospital features light-gathering spaces and high-quality care for women and newborns, and was one of the first acute hospitals in the world to provide 100% fresh conditioned air in patient wards

The new Royal Women's Hospital is a modern, world-class hospital designed to deliver accessible, high-quality patient services to women and newborn babies. It is characterised by a welcoming and reassuring atmosphere, family-friendly patient and visitor facilities, respect for privacy, religious and cultural needs, state-of-the-art technology and research facilities, and a supportive work environment that enhances the care provided by staff.

This 250-bed specialist women's and neonatal health service was designed as an iconic stand-alone facility with its own distinctive presence. It was designed to be efficient and non-threatening, contemporary yet fitting into its environs, innovative, sustainable and, most of all, planned with all women in mind.

Leading-edge technology incorporated into the design includes advanced new medical equipment, IT systems and functionality, such as nurse call and baby monitoring, improved training facilities and staff amenities, and a revolutionary fresh-air ventilation system, improving air quality. The new Royal Women's Hospital was one of the first acute hospitals worldwide to provide 100% fresh conditioned air to the inpatient wards using the energy-efficient displacement method that helps to minimise cross-infection and improve wellness. Infection control and occupational health and safety principles are also reflected within the design.

The design is flexible for meeting future needs, with provision for future expansion built in from the outset. Flexibility was further enabled by locating decentralised plant rooms in the corners of each floorplate, so that any given part of the hospital could be reconfigured in future without major disruption to surrounding areas.

Pedestrians access the hospital without crossing any vehicular traffic lanes at both the main entry off a forecourt plaza in Grattan Street and the secondary entry at lower ground floor level off Flemington Road. The latter 'hotel-style' entry is the vehicular access for drop-off and pick-up by private cars, taxis, as well as ambulances or police vehicles that access a specific bay next to the emergency admissions area. ▶

The Royal Women's Hospital and Francis Perry House, Parkville, Melbourne, Victoria

Type of healthcare facility:
Specialist women's hospital
Client/s: The Royal Women's Hospital and Ramsay Health
Owner: State Government of Victoria
Commissioning Authority: Department of Human Services (now Department of Health) Victoria
Architects DWI (DesignInc Melbourne & Woodhead International; Architects in Association)
Services engineer: Bassett Consulting Engineers
Structural engineer: Bonacci Group
Project manager:
Bilfinger Berger Project Investments
Quantity surveyor/cost manager: Rider Hunt
Building contractor: Baulderstone
Form of procurement: PPP (public-private partnership)
Cost: AU$300m
Size: 45,000sqm hospital + 40,000sqm car park
Construction start: April 2005
Construction completion: April 2008
Project in use: June 2008

The two reception desks for the public and private hospitals within the facility are clearly visible to all persons arriving at ground level from the main pedestrian entry. For persons arriving at the vehicular entry at lower ground, they arrive opposite a bank of lifts and an up escalator leading directly to the main reception areas at ground level. They can make a clear visual connection with the main reception lobby as the two spaces flow into one another through a void in the ground floor level of the four-storey high atrium space. The balustrades around the opening are glass.

The 960-space car park directly under the building is accessed off the main vehicular entry by staff, patients and visitors. Dedicated car park lifts service lower ground to level 2, including emergency, the main entrance and reception, administration, teaching, health information, ambulatory services, imaging, pharmacy, allied health, reproductive services and private consulting suites. One of the main lifts, accessible only to staff using swipe cards, services all hospital levels from the car park.

The facade is constructed of pre-cast concrete panels, with metal elements incorporating distinctive curves and articulation. The sunshading devices provide protection from the direct northern sun, as well as vertical side protection from low sun from the east and west.

The plan of the building, with two wings joined by links at lower levels, forms multi-level atriums in the centre of the space. These act as light-gathering spaces, which connect inside and outside, as well as orientation spaces for ease of wayfinding. Because of the nature of the linear wings, the building increases the availability of natural light into the depth of the plan, enhancing both energy efficiency and the sense of wellbeing. The central opening, connecting ground to lower-ground entries and extending through two further upper levels, has been provided with all-round access for patients and visitors and acts as an orientating reference point. It creates visual connection with floors above, and people's movement is visible on upper level floors to create interest.

A healing garden has been developed on the roof of the atrium, at the same level as the maternity inpatient wards, and the neo-natal intensive care unit and special care nurseries, but it is accessible to all patients, staff and visitors throughout the hospital. The private hospital on levels 6 and 7 also has a courtyard garden accessible to all.

The streetscape has been sensitively treated, with careful scaling of building elements and setbacks to relate to the adjacent built environment, with all major existing street trees preserved.

CANCER CARE

Holistic healing

The design of Sydney's Kinghorn Cancer Centre brings people, process and place together in a holistic, human-friendly vision of a translational research landscape where innovation and collaboration are key

The functional brief for the Kinghorn Cancer Centre had a clear vision to: "create a facility of international standing and world's best practice by recruiting the highest quality clinicians, clinical researchers and biomedical scientists. The outcome of the research is to improve patient outcomes in the diagnosis and treatment of cancer." The brief provided the designers with an opportunity to create a unique place in the 'translational' research landscape – a place in which the vision was not just articulated in the building, but in the way people experienced the building.

A translational landscape in the research and medical field is a landscape where, rather than working in isolation, laboratories and clinicians work collaboratively under the same roof by sharing and exchanging information to produce better and quicker results. In order to achieve innovative research and clinical workplaces, a process of integrated thinking, teamwork and socialised design is required.

The role of the architect in this process is to facilitate a design solution informed by these integration imperatives. These are deduced by understanding the research and cultural aspirations of the client, and by gaining an understanding not just of the functional fundamentals but also of the embedding of the client values and objectives.

While the usual domain of the architect can often be the design of just 'space', the designers' contention for the Kinghorn Cancer Centre was that the design of this new workplace would provide a synthesis of 'people, process and place', leading to a holistic design solution. In simple terms, this meant a building that was inclusive of all these factors and one that was derived from understanding, clarity, logic and function imbued with humanity which, ultimately, would become a joyful, respectful and memorable human experience.

Vertical movement and perambulation are essential components of buildings. Within the design solution created for Kinghorn, contiguous internal space and lifts, bridges and stairs were located to encourage an exchange of ▶

Kinghorn Cancer Centre, Darlinghurst, -Sydney, New South Wales

Type of healthcare facility:
Cancer care & medical research institute
Client/owner/commissioning authority: Garvan Institute, St Vincent's Hospital & Mater Health
Architects: BVN Donovan Hill
Services engineer: Arup
Structural engineer: SCP Consulting
Project manager: Capital Insight
Quantity surveyor/cost manager: WT Partnership
Building contractor: Richard Crookes Construction
Form of procurement: Managing contractor
Cost: AU$100m
Size: 10,800sqm
Construction start: January 2011
Completion: December 2012
Project in use: December 2012

culture and information across the diverse user groups.

The plan followed a simple functional analysis – laboratories need discrete servicing and, in a challenged site, were located to the south. The discrete core became the south end of the building.

People need sunlight in socialising and meeting spaces – hence the 'village' atrium was placed in the sun-drenched north.

Principles involving the human spirit and human comfort were deemed to be integral to the choice and expression of materials in order to enhance the patient experience. It was determined, for example, that timber is a material that makes people feel comforted and inclusive – in contrast to the typical health institution vinyl or ceiling tiles that make people feel they are in a functional process-oriented environment.

Equally, shape, volume and visual tactility were seen to contribute to a sense of wellbeing.

The design aspiration of the Kinghorn Cancer Centre is to encourage physical and intellectual interaction between research and clinical staff and, of most importance, patients to provide the opportunity for new ideas and thoughts to be exchanged and formulated.

That aspiration was carried through to the final design solution. In the Kinghorn Cancer Centre, interactions may come about through chance meetings on the way to shared meeting rooms, common tea stations and kitchenettes, or simply while crossing a bridge over the atrium on the way to the toilet – conversations and chance meetings leading to groundbreaking discoveries.

Font of wellness

The Olivia Newton-John Cancer and Wellness Centre uses natural materials, domestic-style design and light to create a patient- and family-focused facility that delivers an environment of wellness

A wellness philosophy has been embedded within the physical environment of the Olivia Newton-John Cancer and Wellness Centre (ONJC&WC) at the Austin Hospital in Melbourne. The centre delivers cutting-edge clinical care in a tranquil environment that reduces stress on patients, visitors and staff.

The ONJC&WC brings together the cancer services currently dispersed across the Austin Hospital and Heidelberg Repatriation Hospital sites, as well as a range of new and expanded services, including inpatient accommodation for acute and palliative care patients, a radiotherapy facility, ambulatory care services, clinical trials, clinical research centre and an education and resource centre.

The facility design is leading a fundamental change in the delivery of cancer treatment with a focus on treating the whole of the person and providing therapies which will work in tandem with the patient's clinical therapies. The centre incorporates a purpose-designed wellness centre, bringing together family spaces and a range of complementary therapies.

The building was designed to maximise energy efficiency and minimise environmental impacts. Building systems were selected to maximise comfort levels, such as the choice of passive chilled beams over air conditioning. Natural light has been harnessed and natural finishes, colours and textures used to create a sense of bringing the outdoors inside.

Pivotal to its design, the facility offers patients and staff continual access and visual connection to the central courtyard which is gently wrapped and nurtured by the building facade. The design of the courtyard promotes wellness through restorative offerings of light, air, distraction and sustainability to both staff and patients of the facility, seamlessly connecting therapeutic and treatment environments with nature.

Waiting areas are deliberately small, with patients encouraged to relax and enjoy the Wellness Centre and Info ▶

Olivia Newton-John Cancer & Wellness Centre, Heidelberg, Melbourne, Victoria

Type of healthcare facility: Cancer and wellness centre
Client/owner/commissioning authority:
Department of Health and Department of State Development, Business and Innovation (Victoria) / Austin Health
Architects Jackson Architecture and McConnel Smith & Johnson (MSJ)
Services engineer: WSP
Structural engineer: Bonacci Group
Project manager: Johnstaff Projects
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Leighton Contractors
Form of procurement: Traditional lump sum
Cost: AU$189m
Size: 24,000sqm
Construction start/completion:
May 2010 (Stage 1), June 2013 (Stage 2b)
Project in use: 2012 (Stage 1 & 2a); 2013 (Stage 2b)

Lounge or have a coffee while waiting for their appointment. In Day Oncology, the treatment areas have been designed so patients can choose to have privacy or mingle with fellow patients, looking out onto the calming leaves of the 'tree of life'.

The centre also incorporates two acute cancer wards, a palliative care ward, office space over four levels as well as a full fit-out of the laboratory and associated research support spaces.

The new building presents a clear and separate identity to the public and the entry and foyer space is where the image and identity of the building is conveyed. Large areas of space in the entry are devoted to providing for the patients' wellbeing, respect and dignity.

This patient focus continues throughout the centre, informing a humanistic design approach that emphasises elements such as natural light, external outlook, intimate public space and the patient experience. Double-height spaces have been designed into the main entry area to provide a sense of drama and presence at the heart of the centre.

The building is supported with intuitive wayfinding, organised around two strong circulation axes. The intersection of these axes organically culminates in the main entry space with direct links to Zeltner Hall, radiation and oncology services, and into the existing Lance Townsend building. The relationship between ONJC&WC and the Zeltner Hall Wellness Centre is clearly expressed in the central courtyard, onto which both buildings front. A dramatic stairway links the two buildings with disabled access discreetly provided.

The integrity of the historic Zeltner space is maintained with new forms inserted into the volume to provide new functional spaces.

The interior finishes provide a healthy, productive, safe and healing environment for patients, their families and staff, with materials that are sustainable, have low toxicity and low embodied energy. The maintenance and life cycle of all materials have been considered in conjunction with current Austin Hospital requirements to provide the appropriate selections for each area.

The public areas use more natural materials: terrazzo, carpet and bamboo flooring and feature walls of stone and timber panelling provide a welcoming, comfortable, non-institutional address to the hospital. In clinical areas, the use of natural style materials and colours is carried through with finishes that are robust and easy to clean. Timber-look resilient flooring and eco-resin decorative feature wall panels contribute to a non-clinical feel. The natural colour palette continues through to the clinical areas, although with brighter tones to complement the requisite higher lighting levels.

Hub of collaboration

When it opens in 2016, the Victorian Comprehensive Cancer Centre will be a centre of national and international importance, bringing research and clinical cancer care together in a state-of-the-art facility

The Victorian Comprehensive Cancer Centre (VCCC) Project is an AU$1bn facility purpose-built for cancer research, treatment, care and education in the Melbourne suburb of Parkville. When operational in 2016, the VCCC will enable improved cancer-related clinical and research linkages between building partners Peter MacCallum Cancer Centre (Peter Mac), Melbourne Health and the University of Melbourne.

It will also build a powerful alliance between the Peter MacCallum Cancer Centre, Melbourne Health, the University of Melbourne, the Walter and Eliza Hall Institute of Medical Research, the Royal Women's Hospital, the Royal Children's Hospital, Western Health and St Vincent's Hospital Melbourne.

Located in Australia's premier biomedical and research precinct, the facility combines a new 13-storey building, bordering Flemington Road, Grattan Street and Elizabeth Street, and the construction of four new floors on top of the existing Royal Melbourne Hospital (RMH). The new building and the extension to the RMH will be linked by enclosed bridges above Grattan Street.

The facility will be home to more than 1,200 cancer researchers and has been designed to provide the opportunity and environment for clinicians, researchers, educators, patients and their carers to interact and learn from each other.

This includes collaborative working environments: project partner administration areas, for example, have been given their individual spaces but have also been linked horizontally and vertically to promote interaction. Break-out spaces provide further opportunities for collaboration within the administration zones, as well as around the atrium and lift lobbies. In addition, an interactive welcome hall, corridors, beverage bays, lounges and cafes aim to promote impromptu communication, while meeting rooms, seminar rooms and lecture theatres facilitate more formal interaction through education and events. A roof garden on Level 7 and other staff gardens and terraces provide spaces for informal collaboration. ▶

Victorian Comprehensive Cancer Centre, Parkville, Melbourne, Victoria

Type of facility: Comprehensive cancer centre and research facility
Client: Peter MacCallum Cancer Centre, Melbourne Health & University of Melbourne
Owner/commissioning authority: Department of Health and Department of State Development, Business & Innovation (Victoria)
Architects: Silver Thomas Hanley & DesignInc in partnership with McBride Charles Ryan
Services engineer: Lehr Consultants International and Wood and Grieve
Structural engineer: Bonacci Group
Project manager: Plenary Health
Quantity surveyor/cost manager: Davis Langdon Australia (an AECOM Company)
Building contractor: Grocon Constructors (Vic) & PCL Constructors Pacific Rim joint venture
Form of procurement: PPP (public-private partnership)
Cost: AU$1bn
Size: 130,000sqm
Construction start/completion: December 2011 / 2015
Project in use: June 2016 (forecast)

Integrated technology throughout the facility enables the sharing of leading-edge ideas, high-cost equipment and the facilities required for advanced research and development and treatment.

Innovation is at the heart of the design, delivery and operation of the VCCC. Some examples include the use of evidence-based and best-practice design principles, including maximising the use of natural light and the flow of fresh air, where possible, to all clinical and research spaces. A central atrium acts as a key wayfinding tool within the building as well as providing more natural light to the centre of the building.

Another innovation is the inclusion of the staff collaborative floor on Level 7 of the facility where researchers and clinicians are encouraged to meet, exchange ideas, relax and create. There is also innovation in the facility's research and laboratory design including clustering of 'like' rooms to provide further flexibility for the future.

The building will also boast a number of sustainability initiatives, including onsite tri-generation of energy and thermal storage of chilled water to reduce peak energy demand; solar-assisted domestic hot water production; and natural daylight to most indoor spaces.

The environmentally friendly facade (with a 20%+ improvement on Building Code of Australia requirements) includes energy-efficient double glazing. In addition, a minimum 80% of all timber used in the construction of the VCCC will be sustainably sourced – and the use of recycled timber will be strongly encouraged. Low-volatility organic compounds (VOC) have been used wherever possible and a minimum 80% of all construction waste has been diverted from landfill.

Further, the project's PPP delivery model has enabled Plenary Health to deliver additional value to the state through privately funded provisions – for example, floor space on Levels 9 and 13, which provides commercial opportunity space at Plenary Health's risk but which is designated as future clinical and research expansion space for the state in the longer term. Country patient accommodation has been provided on Level 1 which also can provide future clinical expansion space. The facility will also house the first Maggie's Cancer Care Centre in Australia, providing a unique form of care and support to patients and carers living with cancer.

Construction commenced on the VCCC in late 2011 and is due for completion at the end of 2015. The project is jointly funded by the Australian and Victorian governments, contributing AU$854.6m, with remaining funds provided by member contributions, the sale of surplus land and philanthropic donations.

The spirit of hope

Drawing on the experiences of cancer survivors and their families who actively participated in the design process, the Ballarat Regional Integrated Cancer Centre connects to the life and spirit of the community

The Ballarat Regional Integrated Cancer Centre (BRICC) serves a city of approximately 100,000 people, 115 kilometres west of Melbourne, and a region extending five hours' drive to the west. It brings together facilities for care, therapy and treatment previously located disparately across the city, and combines them with office, research and education spaces, community facilities and a wellness centre – creating a one-stop shop for cancer care.

The centre links to the life and spirit of the community. It reinvigorates a historic building and creates a new five-storey glass tower which flanks a central waiting/meeting atrium space. All the functions of the centre can be viewed from this hub. Drawing elements from the streetscape of the city, including bluestone flooring, low-height walls for seating and public art, the atrium is a familiar place for gathering, casual discussion and informal knowledge exchange. Acoustically absorbent natural timbers line the walls and ceilings, providing a sense of peace to those in this space.

The Ballarat Base Hospital building has stood at the corner of Sturt and Drummond Streets for over 100 years. The historical building consists of a Wellness Centre at the ground floor and consulting space above, while the new building accommodates radiation therapy on the ground floor, and chemotherapy and satellite pharmacy on the first floor along with multidisciplinary meeting and education facilities (the knowledge centre). Offices/education and research occupy the floors above. This glazed tower changes character through the day and with the seasons. The profiled aluminium fins cast shadows across the glass surface facade, which reflects the clouds, sky, and trees around the facility.

The design draws from the experiences of cancer survivors and their families, active participants in the design process. A discreet entry location away from the main hospital entry and the distribution of spaces reflect the desire for a greater need for privacy. A generous skylight penetrates the radiation therapy wait area with natural light while the bunkers are lined in natural timbers with perforated patterns of local wildflowers on the walls and ceiling, aiding patient relaxation for treatment.

A key component of the design was to include interior finishes that minimise the contribution and levels of volatile organic compounds to promote indoor air quality enhancing the comfort and wellbeing of building occupants. A solar array on the roof provides year round heating for hot water in the building. This is linked to a display panel in the foyer which demonstrates the amount of energy being generated (and therefore diverted from fossil fuel consumption) in language easily understood by the public.

Ballarat Regional Integrated Cancer Centre (BRICC), Ballarat, Victoria

Type of healthcare facility: Integrated cancer centre
Client/owner/commissioning authority: Department of Health Victoria and Ballarat Health Services
Architects: Billard Leece Partnership
Services engineer: BRT Consulting
Structural engineer: John Mullen and Partners
Project manager: Johnstaff Projects
Quantity surveyor/cost manager: Slattery Australia
Building contractor: Leighton Contractors
Form of procurement: Construction management
Cost: AU$55m
Size: 7,200sqm
Construction start: January 2011
Construction completion: March 2013
Project in use: April 2013

Integrated informality

The design of the Flinders Centre for Innovation in Cancer not only opens up the interface between medical staff and the public but also creates an environment for collaboration between clinicians, researchers and academics

Located 20 minutes from the centre of Adelaide, Flinders Centre for Innovation in Cancer's (FCIC) four-storey, curved-glass and copper-coloured facade fronts an innovative facility and the fostering of something new in the fight against cancer. Ten years in the making, the FCIC's iconic building housed Australia's first integrated cancer care and research facility.

A decorative, two-metre high indigenous shield, built by local artist Karl Telfer, stands in front of the atrium. The atrium is the focal point of the interior space – a concentration of movement, activity and life. This space encourages informal communication and exchange between different departments – facilitating the rapid application of research findings into clinical practice. The atrium provides connectivity between the research and clinical floors.

The sole staircase, wide and timber, snakes up and around the four floors. A large glass meeting room features in the centre of the upper floors, and downstairs a T-bar franchise donates all profits to the FCIC. A lecture hall next door doubles as a yoga suite, with wellness facilities soon to be on offer.

Timber materials seep a healing effect, white walls are neutral but calming, subtle graphic design features throughout, and amalgams of spots dotted around represent cancer cells and the fight against cancer. In the Infusion Suite individual bays can be reshaped for need – or simply to provide a change of environment.

The helipad was moved from atop the car park across the road – the journey from landing to theatre previously involved a complex and long-winded shuttle across much of the hospital. Now, from the FCIC roof, patients travel down one level in a lift, along a corridor and arrive where they need to be, making it not only efficient but also almost unnoticed, with sound and vibration stabilisers creating a quiet place for the patient and the researcher.

Informality is everywhere, public places light and uncluttered, but the real intrigue is upstairs where a coterie of researchers, academics and more sit down daily across a coffee table to discuss and develop their research into finding a cure for cancer. "Where there's an informal space people can head to, they will do. It's where the best ideas come from," comments FCIC professor Ross McKinnon.

Transparency and visibility are integral – heading back to the desk post-coffee means a workbench within a vast open plan laboratory, all light and white, or a seat in an adjoining open work area where PhD students can hot-desk and collaborate with senior medical staff.

Hot-desking for all manner of consultants and clinicians amid an open-plan workplace was questioned at first, but the Flinders Medical Centre Foundation is now firmly wedded to contemporary approaches to business in both outlook and practice. "The new work area breaks down all the hierarchical barriers," McKinnon says.

Flinders Centre for Innovation in Cancer incorporating the LIVESTRONG Cancer Research Centre, Bedford Park, South Australia

Type of healthcare facility: Integrated cancer care and research facility
Client/owner/commissioning authority: Flinders Medical Centre Foundation
Architects: Woodhead
Services engineer: Aurecon
Structural and environmental engineer: Aurecon
Project manager: PM Connect
Building contractor: Hindmarsh
Quantity surveyor/cost manager: Rider Levett Bucknall
Form of procurement: Managing contractor
Cost: AU$29m
Size: 6,000sqm
Construction start: 2010
Construction completion: January 2012
Project in use: April 2012

Rays of hope

The Sunshine Radiation Therapy Centre uses simple wayfinding and the symbol of a rainbow to communicate a message of hope and reduce stress for the cancer patients who use its state-of-the-art services

The Sunshine Radiation Therapy Centre is part of the Sunshine Hospital redevelopment for Western Health, a major healthcare agency in metropolitan Melbourne. The design brief called for a standalone, greenfield radiotherapy centre located within the existing hospital site to provide state-of-the-art radiotherapy treatment to cancer patients. A key objective was to minimise the level of stress experienced by patients and visitors through simple wayfinding, drop-off and pick-up and the effective use of positive distractions throughout the facility.

The architecture expresses the vision as a curved rainbow form and forms a physically prominent sign of entry to the facility. The symbol of a rainbow also translates a connotation of hope and, as such, fuses together the architectural language with the patient journey. The curved external entry element wraps giant strips across the facade with graduated, bold use of colour. The centre is positioned against an architectural form which is encompassing, reassuring and welcoming on arrival to inspire hope and positivity.

The main health planning principle is the conceptual grouping of treatment zones and staff areas, strategically placed along axial corridors for clear wayfinding. Spatial configuration is further developed based on the patient's journey on a typical treatment visit, thus encouraging them to go straight to their treatment destination. The facility is divided into zones based upon tracking the patient care journey within the facility. The floor layout is defined by a spacious lobby and waiting area. The interior optimises access to daylight and views via a heavily punctuated facade, providing external glimpses of daylight which filters speckled internal daylighting while maintaining patient privacy.

The patient journey to the otherwise intimidating radiation bunkers is through small and intimate waiting areas with connection to nature via views to adjacent gardens. The patient journey is personalised, warm and calming to minimise anxiety. The bunkers are a heavy construction mass and patients are positively distracted from their circumstances with bright and expansive ceiling panels, termed 'visual therapy panels'. These panels provide relief in an otherwise claustrophobic space with back-illuminated photorealistic views of nature.

The Australian environment inspired the architectural design and internal environment. The facades are articulated by warm and earthy finishes such as polished concrete, terracotta wall tiles, zinc cladding and double grey glass. Six-metre-high concrete bunkers are visually broken up by an apron of terracotta tiles at ground level. Above the apron, the concrete walls are routed with an abstracted sunburst motif that showcases the stark Australian sunlight.

Continuing with the local theme, an Australian art collection is displayed in prominent locations throughout the centre. The interior colours were inspired by the Australian outback and further integrate and reinforce the positive effects of the artwork.

Sunshine Hospital Expansion and Redevelopment – Stage 2 Radiation Therapy Centre, St Albans, Victoria

Type of healthcare facility: Radiation therapy centre
Client/owner/commissioning authority: Department of Health Victoria/ Western Health
Architects: Silver Thomas Hanley
Services engineer: AECOM
Structural engineer: Irwin Consult
Project manager: Johnstaff
Building contractor: Cockram Construction
Quantity surveyor/cost manager: Donald Cant Watts Corke
Form of procurement: Construction management
Cost: AU$38.5m
Size: 2,650sqm
Construction start: September 2009
Construction completion: March 2011
Project in use: April 2011

MENTAL HEALTH

Brain box

The Brain and Mind Research Institute's Youth Mental Health Building uses a mix of natural and industrial materials to create a non-threatening environment for mentally disturbed youths that blends into its urban surroundings

The Youth Mental Health Building (YMBH) was designed to provide a place for the pursuit of research into youth mental health in a 'translational' environment, so that laboratory research is translated into clinical applications and procedures. It is part of the Brain and Mind Research Institute (BMRI) of the Faculty of Medicine at the University of Sydney in Camperdown, which focuses on research into mental health and clinical issues relating to the brain.

The YMHB consists of two floors of patient interaction and consultation and two floors of research laboratories. The building is organised so that the two lower levels provide experiential comfort for mentally disturbed youths who might be in a range of agitated states and therefore might need a range of responses. The language of the building is purposely crafted to provide a place in which they will feel non-threatened and will feel familiar, or 'at home', with the building. The selection of utilitarian materials in their raw states makes for such an environment – the materiality is unloaded so that it is more of the street and house than of the institution and care.

The building is part of a satellite campus of the university, located in a light industrial area formerly known for clothing trades. This gritty urban area is respected for its heritage streetscapes, and the specific site of the YMHB has a heritage-listed facade which required retention.

At the street edge, the materials reflect the light industrial context – steel, recycled timber and face concrete block. Internally, the floors are linked by an open stair and small atrium containing the social space of the centre. Meeting rooms and all facilities are accessible from this central space, with materials relating to the exterior – timber, steel and concrete. But here they are used on a more tactile scale, reflecting the need to participate in the daily theatre of human activity.

The organisation of the building places the two research floors above and the clinical floors below, allowing an ▶

Youth Mental Health Building, Brain and Mind Institute, Sydney, NSW

Type of healthcare facility:
Clinical and translational research building
Client/owner/commissioning authority:
University of Sydney
Architects: BVN Donovan Hill
Services engineer: Arup
Structural engineer: Connell Wagner
Project manager: AAP Corporation
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Buildcorp
Form of procurement: Lump sum contract
Cost: AU$14m
Size: 3,000sqm
Construction start: 2008
Construction completion: 2009
Project in use: 2009

upper-level bridge connection to further research laboratories in two adjoining buildings. This configuration fitted neatly with the requirement to retain the two-storey heritage facade – allowing the street composition to be expressed by the placement of the laboratories in a clearly articulated new glass box, effectively on top of the old facade, with the more tactile people spaces accommodated within the realm of the older component.

On reaching the first floor, there is a large open social area which uses the double-height space above the entry that is flooded by daylight from a full-height window that turns to form a glass ceiling. This allows views to the external street, as well as across the bridge to the clinic and back to the timber stair.

The vertical street created by the timber stair adds a further sense of being in an open and accessible space, making it easy for people needing to see clinicians on the first-floor level to find their own way without any confronting barriers. The timber stair traverses the full height of the building – the rise is broken on the first floor to another axis before rising onto levels two and three where it serves laboratories.

The further requirement to step the building toward the north to ensure sun penetration to neighbouring houses enabled the new glass box to 'slide' over the older building, creating a large-scale composition with smaller scale detailed elements at the conjunction of the forms. The 'sliding box' is clad with translucent glass planks, ensuring diffuse daylight to the laboratories throughout the day and resulting in very low energy consumption.

Externally, the building subliminally communicates that you can use the building – that the building doesn't own you. On approach, the building has a social expression as opposed to an architectural expression. The architecture comes from inside, revealing what it means to inhabit the space.

Community concept

The redevelopment of Glenside Hospital aims to destigmatise mental health by integrating the centre with the local community, and creating gardens and other spaces that can be used by both patients and the public

South Australia (SA) is currently undertaking a major reform of its mental healthcare to modernise and improve mental health and drug and alcohol services across the state. At the heart of the reforms is a stepped model of care with community services at its centre, focusing on prevention and early intervention and redeveloping Glenside Hospital as a centre of specialist mental health services – made in the light of emerging practices in the US and UK to build new stand-alone specialist psychiatric hospitals.

The vision of the Glenside Campus was that modern specialist health services should be integrated within the wider community. In 2008 the Glenside Campus Redevelopment Master Plan identified a coordinated strategy for redevelopment of the campus. The masterplan located new health facilities adjacent to new retail, commercial, film centre and residential precincts to provide the integration with the local community not afforded by the current historic asylum context and public perception. The facilities will be part of an active and varied new health precinct with increasing opportunities for normalisation through managed permeability.

The aim of the South Australia Specialist Health Services brief was to bring a number of key mental health and drug and alcohol services together on one site in order to enable a coordinated stepped pathway of care. They included acute, rehabilitation, drug/alcohol withdrawal and perinatal inpatient and outpatient services for consumers and clients from South Australian country regions and the eastern metropolitan Adelaide region. An opportunity was taken to create a new benchmark facility in Australia with international credentials, through the implementation of a new and innovative model.

The principle design objectives were to provide modern health facilities for Glenside as a place of refuge, safety and security, creating facilities that would support healing through demystification, destigmatisation and autonomy, via an interactive and integrated relationship with the community in an adaptable and sustainable development. ▶

Glenside Campus Redevelopment, Eastwood, Adelaide, South Australia

Type of healthcare facility: Mental health campus
Client/owner/commissioning authority:
SA Health – Major Projects
Architects: Swanbury Penglase & Medical Architecture
Services engineer: BESTEC Consulting Engineers
Structural engineer: Kellogg Brown Root
Project manager: Swanbury Penglase
Quantity surveyor/cost manager:
Rider Levett Bucknall

Building contractor: Hansen Yunken
Form of procurement: Managing contractor
Cost: AU$130m
Size: 14,800sqm
Construction start: June 2010
Construction completion: December 2012 (Stage 1),
June 2013 (Stage 2)
Project in use: December 2012 (Stage 1)

Designed jointly by Swanbury Penglase Architects and Medical Architecture, the new 129-bed health facility adopts a 'village' urban design model. Delivered to a high quality in a park-like setting, the facilities are arranged around a shared central 'healing garden' which is accessible to both patients and the public in an aim to destigmatise the old asylum site. Functioning as focal space for clients and consumers, health professionals and the general public, this central garden represents a key step in the consumer's recovery along a graduated series or spaces from private to public.

Many of the existing inpatient buildings were deep plan, with gardens located around the building perimeter, enclosed by fences. A courtyard model was adopted for the new facilities, with the building creating a protective edge in place of secure fences. By locating gardens at the heart of the building, secure open space is both integral and accessible, fostering consumer autonomy. With the absence of fences and, therefore, less conspicuous measures of security, these inherently more private courtyard gardens support a recovery-focused model of healthcare. An approach successfully adopted by Medical Architecture in the UK, this produces a more flexible layout, while introducing greater levels of natural light into the building and increasing views outwards. Developed with clear zoning, inpatient buildings are designed using a consistent concept: a series of pods containing the private on-ward activities linked by a mall off which shared spaces are accommodated, with the public face of the building providing flexible generic accommodation.

Since the launch of the Glenside Campus concept plan, SA Health and the design team have undertaken a comprehensive community engagement process. This process has included public meetings and workshops – from detailed user group workshops on the design of the inpatient facilities, through to presentations by local school children to the design team on their open-space designs – as well as a community feedback line and newsletters with an information website.

The new model of care was tested through an enablement programme of temporarily relocating inpatient services to refurbished buildings that also allowed the release of land to build the new health facilities. The design's evolution is influenced by the project evaluation of the enablement programme. A post-occupancy evaluation process will be conducted within the first 12 months of handover to provide an objective measure of the outcome.

Home-like haven

Ballarat Base Hospital's Acute Mental Health Facility portrays a welcoming aspect to the wider community, while using timber, brick and light-filled spaces to create a safe, home-like environment for patients

The renovation and expansion of Ballarat Base Hospital's Acute Mental Health Facility challenges the preconceptions of a mental health facility through the creation of an urban streetscape language, inserting courtyards for natural light amenity and using warm hotel-like interiors.

Located on Ballarat's main street, the existing facility was hidden away from the community behind a high, solid fence and was described as cold, dark and unwelcoming. Shared bathrooms allowed little privacy and activity/leisure spaces were virtually non-existent. Reusing this facility ensured that the optimum location and connections to the main hospital and wider community were maintained.

Maintaining the existing number of beds, a warm, light-filled and welcoming facility was created with large open spaces for activity and leisure, while a new entrance to Ballarat's main street with an open timber fence portrays an engaging presence to the wider community. A double skin of timber battens allows glimpses from the street into the entry courtyard and, for the clients, a view out while maintaining their security and safety. The facility maintains an open front gate during the day and a welcoming, accessible front yard provides an outdoor recreation space for lower risk patients, away from the more secure backyard areas.

Within the entrance courtyard sits a low-slung pavilion to house the Children and Adolescent Mental Health Unit, linked to the main wing by support areas – the architectural articulation creates inviting, domestic-scaled spaces. Red glazed bricks complement the existing building fabric. And a private secure 'backyard' was re-imagined with a new glazed brick facade of soft colours, and a cloud pattern and landscaping injecting some whimsy and humour.

The existing facility was renovated to create central lounge and activity areas with direct observation from a large central workstation. Removing internal partitions and introducing skylights and larger windows created uninterrupted open areas and enabled light penetration into the deep building footprint. These large-scale open activity areas can be furnished into separate zones to allow for changes in treatment practices. The activity areas were complemented by extended and refurbished bedrooms provided with fixed desks and bench seating for individual retreat. Patient security and amenity was further enhanced through private bathrooms, large windows with views into courtyards and individual swipe card entry. Two additional pods were created with independent lounge areas and courtyard access. The child and adolescent pod provides additional family facilities and minimises the risks associated with mixing children within and acute adult facility. A second pod can be created by closing doors depending on patient acuity profiles. The planning of the unit into pods helps reduce the scale of the facility into a more home-like environment. The zoning of lounge spaces aims to reduce agitation while the interiors reflect a culture of a quiet, positive, healing and safe environment. Warm, natural materials promote feelings of comfort and retreat. The facility won the Design & Health Best International Mental Health Project Award in 2011.

Acute Mental Health Facility, Ballarat Base Hospital, Ballarat, Victoria

Type of healthcare facility: Mental health facility
Client/owner/commissioning authority: Department of Health Victoria and Ballarat Health Services
Architects: Billard Leece Partnership
Services engineer: Umow Lai
Structural engineer: JMP
Project manager: Ballarat Health Services
Quantity surveyor/cost manager: Slattery Australia
Building contractor: Nicholson Construction
Form of procurement: Traditional lump sum
Cost: AU$4m
Size: 1,800sqm
Construction start: February 2010
Construction completion: 2010
Project in use: 2010

Hub and spoke

Melbourne's Eastern Health Adult Mental Health development's contemporary design improved security for both staff and patients and included Victoria's first purpose-built unit incorporating modern gender-specific practice in its design

The Eastern Health Adult Mental Health Unit development was the second of three mental health projects created under a masterplan that saw an adolescent mental health relocated from Melbourne's Maroondah campus to a purpose-built facility, allowing for an expansion of the adult mental health unit. The third project, to assist reintegration of residents back into the community, was a community mental health facility in a residential setting.

The adult mental health facility was designed in two stages with two new 25-bed inpatient units, abutting the existing Maroondah Hospital. Courtyards were introduced into the central core of each unit to provide natural light to bedrooms and offices, and visual access to external areas. The overall image is contemporary, with a mixture of textures and materials used to create movement and interest to a linear single-storey facade. While the service benefits operationally from being co-located with an acute campus, its restricted site posed a design challenge.

Both units are identical with each hub-and-spoke layout providing outlook and views for bedrooms, minimised corridor travel by staff and good supervision for staff into both units as well as the high-dependency unit (HDU). The layout also allows the HDU to swing into the main units – and for provision of a gender-specific wing. This is the first purpose-built unit to incorporate modern gender-sensitive practice in its design in Victoria.

The central staff stations provide clear visibility down corridors. The design promotes a close relationship between staff and patients, assisting the therapeutic and healing process. To tackle this high-stress environment, staff respite areas are provided well away from patient areas with access to the area well supervised. Ambulance and police entry is discrete and direct to both units for access to seclusion rooms.

This new unit has purpose-built modern facilities with better amenity and layout for patients and staff including single bedrooms and en-suites. The wards also include design features which enhance visibility of patient areas, provide flexible therapeutic meeting areas and provide a safer environment, reducing the risk for self-harm for residents and improved safety for staff. Other design features include a shared public entry at street level with the potential to also access the main hospital; provision of ground-level external recreational areas that are visually protected for clients to relax in; provision of a variety of interview rooms and quiet spaces for clients to interact with staff or family privately; and clarity of movement within the design.

The facility also incorporates many significant sustainable design initiatives. These include stormwater retention on site that is utilised for flushing toilets; centralised micro co-gen, absorption chiller and boiler plant reducing energy use; 50% solar hot water service; environmentally friendly materials including timber, low VOC finishes and adhesives, Marmoleum and concrete containing industrial waste; skylights with daylight dimming controls for internal lighting; chilled beams and 100% fresh air to offices; and displacement ventilation in bedrooms.

Eastern Health Adult Mental Health Redevelopment – Maroondah Hospital, Ringwood East, Victoria

Type of healthcare facility: Mental health facility
Client/owner/commissioning authority: Department of Health and Eastern Health
Architects: Silver Thomas Hanley
Services engineer: AECOM
Structural engineer: Irwinconsult
Project manager: Aurecon Group
Quantity surveyor/cost manager: Donald Cant Watts Corke
Building contractor: Hansen Yuncken
Form of procurement: Traditional lump sum
Cost: AU$32.1m
Size: 3,218sqm
Construction start: October 2006
Construction completion: March 2008 (Stage 1), June 2009 (Stage 2)
Project in use: July 2009

REGIONAL HEALTH


Cairns Base Hospital

Sensitive to culture

The expanded Cairns Base Hospital has flexible accommodation that maximises views, creates a more supportive space for staff and patients, and provides a culturally appropriate environment for indigenous people

This major project for Queensland Health includes the expansion of the existing Cairns Base Hospital, incorporating two new buildings and the renovation and expansion of the existing four buildings on site. These include additional cardiac care facilities, a day surgery unit, new specialist clinics and pathology services, an integrated mental health unit, comprehensive cancer care unit and new radiation oncology services.

The redeveloped hospital will include 531 beds, 13 operating theatres and 54 ambulatory care wards. Inpatient services have been relocated to the north end of the site. Block D, one of the two new blocks, is the main new entrance building, and intended to be distinctive in character yet achieve a sense of connection to the existing adjacent buildings. The block consists of two inpatient towers (in an H-shape) over a theatre podium at the lower levels, connected at the upper levels by a central link. Nominally orientated to the north to minimise sun penetration, the towers are slightly skewed to each other, with wings that are offset in plan, to maximise views of the water and surrounding landscape.

The design team's major focus was to ensure maximum patient amenity without compromising staff supervision or travel. After long consideration, the final 32-bed accommodation was made up of 40% single rooms, 40% double rooms and 20% four-bed rooms. The double and four-bed rooms were designed to be interchangeable for future flexibility. The 32 beds can be nursed in two or three different pods if clinically required – the necessary support spaces were designed to allow for this model, including sub-utility rooms and staff bases.

A patient-centered model of care means that there are allied health treatment spaces on each floor, to maximise patient and staff access to these areas.

A third of patients are indigenous people, referred from all over north Queensland, and it is very important for these patients and their families that they are welcomed in a culturally appropriate manner. The design acknowledges respect of traditional elders, past and present, and there is a welcoming message from traditional owners for people who have travelled from other places.

The ground floor of the hospital campus will provide informal spaces for patients and families to gather in the fresh air with views of the esplanade, inlet and landscaped areas. Its open plan design is intended to convey a natural, non-institutional atmosphere; it is an orientation space where visitors can obtain directions, relax in a cafe surrounding and not feel an uncomfortable sense of enclosure.

The architectural and urban design expression varies from the east and west of the site to reflect the differing uses of these spaces. The main entrance on the west – the primary inpatient arrival point – is an active, purposeful space, with both pedestrian and vehicular traffic, while in contrast, spaces facing the Esplanade are softer and less open, with intimate seating spaces.

Cairns Base Hospital Redevelopment, Cairns, Queensland

Type of facility: Acute hospital
Client: Queensland Health/Project Services
Architects: Jackson Architecture, McConnel Smith & Johnson Architects and Fisher Buttrose Architects
Services engineer: AECOM
Structural engineer: Arup
Project manager: APP
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Abigroup
Form of procurement: Managing contractor
Cost : AU$541m
Size: 8,000sqm
Construction start: 2010
Construction completion: 2014
Project in use: 2014


Main Entrance

Managed growth

Mackay Base Hospital's subtropical setting provides an opportunity to extend its healing and recreational space into the outdoors – but the greatest challenge has been to keep the facility operational over a five-year building programme

The $AU400m Mackay Base Hospital Redevelopment is located in Mackay, a part of central Queensland that is experiencing considerable growth and associated demographic change. Being delivered in a three-stage, sequential programme, the masterplan proposes a new acute hospital and refurbishment of existing buildings for complementary functions.

Located in a subtropical setting, the hospital campus is a landmark facility of connected buildings, with the main mass of the hospital located on the least constrained portion of the site. In total, 10 buildings are connected by a single central communication spine, housing a total of 40 distinct departments, including emergency, intervention, imaging, inpatient units, mental health, catering and mortuary. The spread of the buildings maximises both the unique setting as well as positively using the spaces in between the buildings.

The campus was planned to make the most of the southeasterly wind, the sun's path, natural shading and the views of the river and cane fields. Each building is linked through a hierarchy of comfortable, attractive open spaces that encourage interaction, such as courtyards, external healing and recovery landscapes, rehabilitation landscape, a central street and welcoming, active public spaces. Linkages between departments and travel distances – both horizontally and vertically – have been designed for efficient hospital planning. A primary circulation hierarchy will allow for future building or expansion of individual departments without compromising the existing system.

Meanwhile, a network of streets and pedestrian/cycle routes allow circulation through the site and enhanced connectivity both within the campus and to nearby buildings.

The architecture and interiors support patient care by placing the patient at the centre of the design philosophy rather than at the periphery. Communal external balconies on inpatient units, sensitively designed bedroom interiors, low window sills, patient control of the immediate environment, softening of harsh sunlight glare at the building perimeter and comprehensive integrated art are some of the simple moves that have been made to improve the patient journey.

The architecture and interiors support employees by creating a campus hospital that is easy to navigate, with short lines of communication, a single shared administration and management hub (the first of its kind) to encourage collegiality, and a dedicated staff base with gym, relaxation and recreational space, as well as overnight accommodation for medical overnight stays, all created to enhance the staff experience of the building.

Mackay Base Hospital Redevelopment, Mackay, Queensland

Type of facility: Regional health
Client: Queensland Health
Architects: Woods Bagot and Billard Leece Partnership
Services engineer: Norman Disney & Young
Structural engineer: Opus Qantec McWilliam
Project manager: Ranbury
Building contractor: Baulderstone
Quantity surveyor/cost manager: Donald Cant Watts Corke
Form of procurement: Managing contractor
Cost: AU$402.28m
Size: 48,000sqm
Construction start: July 2009
Construction completion: late 2014 (forecast)
Project in use: December 2009

In harmony with history

New South Wales' first public-private partnership social infrastructure project, Orange Hospital, takes its visual cues from existing heritage buildings on the site, but nonetheless delivers a complex and highly efficient new facility

New South Wales's first social infrastructure public-private partnership (PPP) project, the redevelopment of the Orange Hospital and associated health services on the Bloomfield Campus in Orange, brings together on a single campus major acute and mental health services for the eastern cluster of the Greater Western Area Health Services.

The redevelopment involved the design, construction, finance and maintenance of a new greenfield hospital and associated buildings. The new health campus has been built on the Bloomfield Hospital site and included numerous heritage buildings once used to care for the mentally ill.

The design team's strategy for the project was to retain and respect the site's heritage masterplanning, as well as enhancing public amenities. Designers took clues from the existing buildings and landscapes to draw out opportunities in the expression in the facade and roofscape.

The campus is typified by the use of secure and functional courtyards and gardens for patient, resident and visitor use, and its efficient circulation patterns, intended to provide efficient access for both clinical and support services in a cost-effective solution.

The facility is a Level 5 Hospital with integrated cancer care and tertiary mental health services. The main hospital building consists of a 200-bed general hospital, with four operating theatres, 60 specialised treatment areas, two radiotherapy bunkers and associated primary and community health areas.

The project also included the addition of 164 sub-acute, rehabilitation, acute mental health and forensic mental health beds, with associated ambulatory and support facilities.

In 2012, the facility was awarded the Master Builders Association of New South Wales Excellence Award for a Health Building over AU$100m and an Australian Institute of Building of New South Wales High Commendation for Commercial Construction.

Orange Hospital Redevelopment, Orange, NSW

Type of facility: Regional health
Client: Western NSW Local Health District
Architects: Silver Thomas Hanley and DesignInc (STHDI), as part of Pinnacle Healthcare (OAHS)
Services engineer: Jim Hatz (mechanical & electrical), Accor (hydro)
Structural engineer: Aurecon
Project manager: Health Infrastructure/Capital Insight
Building Contractor: Hansen Yuncken
Form of procurement: PPP (public-private partnership)
Cost: AU$260m
Size: 30,000sqm
Construction start: 2008
Construction completion: 2010
Project in use: 2011


stryker
stryker
MAQUET

Advanced and adaptable

Nepean Hospital's new East Block and intensive care unit deliver extra beds and enhanced critical care in a setting that responds to the existing natural landscape – and everything has future needs in mind

This redevelopment at the Nepean Hospital in Penrith is a project in two parts: the refurbished and extended intensive care unit (ICU) and a new ambulatory procedure centre, called the East Block. While the ICU is a project bounded by existing buildings, the East Block, although an attachment to the existing Theatre Block, is largely a new building, set to the east of the main hospital complex.

The ambulatory procedure centre sits at level two of the four-level East Block, and incorporates six operating theatres (including two hybrid theatres), 26 Stage 1 recovery beds, a 48-bed perioperative unit (which includes a flexibly configured modular arrangement of pre- and post-operative beds), a central reception and admissions area, and a pre-admission clinic. Two 30-bed surgical wards occupy level three, and an undercroft area has been built to accommodate future clinical space.

The East Block required functional integration with the existing theatre block, which gave rise to the building's form, allowing a meshing of roof geometries and built forms. A series of 'fingers' or extrusions lead out into the landscape to the east, their linear forms reinforced through the use of parapet blade walls that conceal roofs and gutters. The ground level footprint is set back, enabling better utilisation of the available land and also providing cover above pedestrian areas.

The design is responsive to the natural landscape, with an emphasis on enhancing the existing planting and environment. A courtyard on level one to the east of the building, with a void above to levels two and three, enables the landscape treatment to enter the building footprint, adding natural light to level one and two above, and a sense of nature over all of its three levels. Elsewhere, places for respite and views to nature have been provided and enhanced where possible.

The design of the ambulatory procedure centre is based on the model of care of a single point of entry for all surgical patients. In the perioperative area, a flexible, modular layout of pre- and post-operative beds also helps to efficiently manage patient flow. Each 30-bed inpatient unit has been designed with a mix of one-, two- and four-bed rooms, to further support this flexible approach.

In the ICU, new state-of-the-art ICU treatment places replace the existing high-dependency unit (HDU). The design adopts an open-plan layout of bed bays around a low-level core of support spaces, maximising both sightlines and natural light. Internal glazing to isolation rooms supports current best practice for managing infectious patients.

A further new feature is dedicated teaching facility, including subdividable lecture rooms, a simulation lab and a media production facility.

Penrith Health Campus Redevelopment, Nepean Hospital, Penrith, New South Wales

Type of facility: Regional health
Client: NSW Health/Health Infrastructure
Architects: HASSELL
Services engineer: Steensen Varming & GDK Hydraulics Consulting
Structural engineer: Hughes Trueman
Project manager: Aurora Projects
Quantity surveyor/cost manager: MBM
Building contractor: Laing O'Rourke

Form of procurement: Lump sum with ECI (early contractor involvement)
Cost: AU$90m
Size: 13,000sqm
Construction start: May 2010
Construction completion: February 2012
Project in use: August 2011 (ICU), March 2012 (East Block)

COMMUNITY HEALTH

Timber tales

The co-location of the Kardinia Health Super Clinic with the Belmont Community Rehabilitation Centre has enabled an integration of services and a design that is reminiscent of the trees that used to stand on the site

The Kardinia Health GP Super Clinic is sited adjacent to Belmont's Community Health Centre, four kilometres from Geelong, Victoria's second biggest city. Following completion of the super clinic, Billard Leece Partnership was commissioned to design a new community rehabilitation centre which shares a reception with the health centre to create a community healthcare hub.

A multidisciplinary training clinic, Kardinia Health comprises medical and allied health practitioner suites, academic and general offices and information session rooms along with a cafe, waiting rooms, pharmacy and pathology. The design is intentionally non-institutional, creating a complementary yet distinctive identity that responds to its immediate context, the street and the existing site. The facade features stained and natural timber cladding with a copper-coloured canopy, signposting the entry and providing a dynamic play of form and shadow. The timber patterns are reminiscent of local tree canopies historically located on the site.

Two courtyards embrace the building's four wings, connected by a central administration/clinical hub. Exceptional wayfinding is achieved utilising distinctive courtyards, clear sightlines and views through corridors. Separating functional spaces, the courtyards provide aspect, natural light and ventilation together with outdoor seating in landscaped gardens. The interior arrangement enables most habitable rooms windows and natural ventilation. A central treatment bay has clerestory windows allowing views of the sky from beds. A collegial arrangement of staff spaces creates a community environment, encouraging the opportunity for GPs, medical students and allied health professionals to collaborate, sharing case studies and ideas.

Building orientation and space utilisation optimise solar penetration and natural daylighting on the constrained site. Other environmental features include user-controlled natural ventilation and cross-ventilation in common areas and water management through rainwater harvesting and bioswales for stormwater collection.

The Belmont Community Rehabilitation Centre has an enclosed pedestrian link to the community health centre and reception. The building sits in a garden setting, with a new mobility garden providing external rehabilitation facilities and seating in a wind protected sunny courtyard between the two buildings. The centre is single-storey with large self-shading windows to all habitable rooms, providing natural light, ventilation and aspect to the surrounding garden.

Kardinia Health GP Super Clinic and Belmont Community Rehabilitation Centre, Belmont, Victoria

Type of healthcare facility: Ambulatory care/GP super clinic and community rehabilitation
Client/owner/commissioning authority: Kardinia Health and Barwon Health
Architects: Billard Leece Partnership
Services engineer: JBA (Kardinia Health), AHW Waterman (Belmont CRC)
Structural engineer: Irwinconsult
Project manager: Aurecon
Quantity surveyor/cost manager: Padghams (Kardinia Health), Sweett Group (Belmont CRC)
Building contractor: Kane Constructions (Kardinia Health), Rendine (Belmont CRC)
Form of procurement: Traditional lump sum
Cost: AU$6.5m (Kardinia Health), AU$3.5m (Belmont CRC)
Size: 1,500sqm (Kardinia Health), 600sqm (Belmont CRC)
Construction start: November 2009 (Kardinia Health), February 2012 (Belmont CRC)
Construction completion: 2010 (Kardinia Health), December 2012 (Belmont CRC)
Project in use: 2010 (Kardinia Health), December 2012 (Belmont CRC)


Assistance

Smooth expansion

The design and vision for the Gold Coast's Robina Hospital took the concept of the local hospital to another level, with a focus on wellness and the creation of a modern workplace for the staff who work there

Robina Hospital forms part of the infrastructure of the Gold Coast Health Services District, delivering public health services to the region. The project transformed the small local hospital into a major regional health facility through the expansion of existing departments and the provision of new facilities.

The design was based around the idea of the modern healthcare environment as a place of wellness and as a workplace for highly skilled staff. The project used natural light, colour and the integration of landscape to create uplifting and inspiring spaces in both the private and public domains. The design team worked closely with landscape architects and artists to develop this aspect of the design to a high level.

The design allowed for the construction to be staged, allowing the hospital to remain fully functional throughout the works. The project was delivered under the fixed budget and in line with a fast-track programme aimed at the earliest possible provision of new health services to the Gold Coast. This was achieved by developing a thorough understanding of client needs through collaboration and partnership.

The new building provides a landmark for motorists entering Robina, using a simple material palette and clean architectural forms to offer legibility to the hospital plan. On the campus itself, facade textures and forms provide hints of colour against a backdrop of simple silver cladding, leading visitors into courtyard spaces saturated with colour and texture. Within the hospital, abundant natural light and views to near or far landscape give the spaces a non-institutional feel. Open-ended ward corridors provide views to the outside world, clinical staff bases (and even operating theatres, so often buried in deep plans in traditional hospital design) offer staff views to landscape, while courtyard spaces and rooftop gardens offer patients and visitors places to rest and recover.

Sustainable outcomes were achieved at both the macro and micro scale. At the masterplan level, the design establishes a framework that enables further development with minimal disruption. At the smaller scale, the designers appraised the specific value of sustainability measures in a 'best for project' context. Rainwater harvesting for cooling tower operation and irrigation, a holistic approach to daylighting, shading, glare and heat control, high-efficiency plant, and solar and photovoltaic systems deliver maximum return on investment.

Post-occupancy evaluations support anecdotal evidence that the design has been successful for both staff and patients alike. First-hand feedback from clinical staff, in wards and operating theatres in particular, has given the design team acknowledgement that design decisions can make a tangible difference to the daily lives of those using hospitals. This recognition of the contemporary hospital, as not only a place of support for the patient but also a modern workplace for highly valued staff, drove the design throughout. It resulted in a healthcare environment which challenges the preconceptions of how a hospital should look and feel.

Robina Hospital, Robina, Queensland

Type of healthcare facility:
Community and Teaching Hospital
Client/owner/commissioning authority:
Queensland Health and Project Services
Architects: BVN Donovan Hill
Services engineer: GHD Group
Structural engineer: Bonacci Group
Project manager: APP Corporation
Building contractor: Baulderstone

Quantity surveyor/cost manager:
Rider Levett Bucknall
Form of procurement: Managing contractor
Cost: AU$287m
Size: 23,000sqm
Construction start: March 2009
Construction completion: December 2011
Project in use: 2012

A personalised approach

Victoria's super clinics were developed to enable community-based treatment in lieu of hospital care. The evidence-based approach to their design resulted in new ways of working that greatly improved the care environment

At the time of their development, the first two super clinics, at Melton and Craigieburn, were pilot programmes developed to meet an immediate health service need – to provide health services to outer metropolitan communities in lieu of hospital care. Research undertaken at the time also indicated an increasing incidence of preventable disease in these communities. As a result of this and other research, the design focus for the super clinics became a patient-focused one rather than medico-centric, and services and facilities were re-engineered to incorporate contemporary work practices, technologies and emerging community perceptions of sustainability.

The Melton and Craigieburn super clinics each have three distinct clinical pods accessed from a common arrivals area, designed to meet the needs of specific service models including ambulatory care, allied health and emergency care. One of the key initiatives of the super clinics was the automation of the arrivals sequence, using (for the first time in Victoria) airport-style self check-in technology combined with real-time queuing information. This was combined with a staffed reception point aligned with the automated self check-in lane for patients and visitors requiring assistance. Post-occupancy evaluation showed that after some initial reservations, the self check-in facility improved the arrivals experience by empowering patients with information on their progress, particularly those from a non-English speaking background. It also showed that fewer additional reception staff were required as services were added to the super clinics. Based on this evidence, similar self check-in facilities were later incorporated at Lilydale.

In addition, audio-based patient calling systems were deleted and a 'personalised' approach reintroduced, as a result of research indicating how patients' perceptions of care were affected by their experience of moving from the public arrival areas to the clinical areas. User group feedback also showed that patients developed a perception of 'us and them' if the public could not see into the clinical areas from waiting spaces. The design team developed a series of naturally ventilated and landscaped courtyards throughout the facility, arranged to blur the threshold between the building's public and clinical spaces. The courtyards are glazed to allow views across them from the public areas into clinical zones.

An analysis of the predominate 'clinic' planning paradigm of the day, with consulting rooms in a back-to-back arrangement and a staff-only area in between for clinician discussion, suggested that clinicians leaving consulting rooms by a 'doctor-only' door to confer with colleagues gave patients a negative perception of their diagnosis. Therefore, an alternative model was developed with consulting rooms around the periphery of the building and a single door and connectivity to the outside. Larger collaboration hubs were developed to facilitate colleague discussions among clinical staff. At the Lilydale super clinic, this model was further developed into larger 'collaboration hubs' – the model is now being introduced in contemporary acute environments.

Super Clinics – Melton, Craigieburn and Lilydale, Victoria

Type of healthcare facility:
Community health and ambulatory care
Client/owner/commissioning authority:
Department of Health Victoria
Architects: Lyons
Services engineer: Waterman AHW
Structural engineer: Connell Wagner
Project manager: Thinc
Quantity surveyor/cost manager: Padghams
Building contractor: Walton Constructions
Form of procurement: Traditional lump sum
Cost: AU$42m
Size: 2,500sqm per super clinic (approx)
Construction start: 2007
Construction completion: 2009
Project in use: 2009

SCIENCE, RESEARCH & EDUCATION

Partnering for health

Queensland's Translational Research Institute features a flexible modular design that enables interaction and collaboration between healthcare providers and scientists from leading research institutes in new state-of-the-art facilities

The Translational Research Institute (TRI) is all about partnerships, collaboration between healthcare providers and scientists across several institutes. It brings staff together from four leading research institutes – the University of Queensland Diamantina Institute (UQDI), Queensland University of Technology Institute for Health and Biomedical Innovation (QUT IHBI), Mater Medical Research Institute (MMRI) and Princess Alexandra Centres for Health Research – to facilitate collaborative research which, enables the development of models in which new treatments can be developed and tested by establishing the genetic and environmental basis of human diseases.

The concept of TRI began in 2004, with proposals to the Queensland government, led by Professor Ian Frazer and Professor Derek Hart, then director of MMRI. An initial AU$10m was received from the Commonwealth government, coupled with AU$7m seed funding from the state government's 10-year Biotechnology Strategic Plan.

Further funding followed from Queensland's Smart State initiative, the Commonwealth Hospital Improvement Fund, Queensland University of Technology (QUT), the Atlantic Philanthropies and the University of Queensland (UQ). 2007 earmarked a formal joint venture (and commencement of the project design phase) between UQ, QUT, MMRI and Queensland Health.

Located on the campus of one of Queensland's largest hospitals, Princess Alexandra Hospital (PAH), the AU$340m, seven-storey building contains advanced research labs, cleanrooms and commercial space, as well as a state-of-the-art vivarium and write-up areas for over 650 researchers.

The physical environment of TRI resonates its 'bench-to-bedside' approach. The building will facilitate and represent numerous interactions and opportunities that will occur between TRI's four partner institutes and external collaborators. It uses a modular flexible layout that allows the building to maintain research and instructional flexibility. Utilities are suspended from the ceiling so modules can be easily redesigned to accommodate changing research focuses and ▶

Translational Research Institute, Brisbane, Queensland

Type of healthcare facility: Research facility
Client/owner/commissioning authority: Translational Research Institute
Architects: Wilson Architects & Donovan Hill
Services engineer: Aurecon
Structural engineer: Aurecon
Project manager: University of Queensland
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Watpac
Form of procurement: Traditional lump sum
Gross floor area: 36,000sqm
Construction start date: May 2010
Construction completion: November 2012 (TRI building), May 2013 (BPA building), May 2013 (refurbishment of R Wing)
Project in use: November 2012

project teams. Underlining the building scope was a design that would adapt to meet the needs of future generations of scientists. The building is organised around a large central atrium with a centralised staircase. Levels 3 to 6 are dedicated to purpose-built, state-of-the art laboratory spaces with accompanying write-up modules. Additional commercial modules and core facility modules complete the layout, with the core equipment available to all occupants in the building.

The core facility modules are integrated throughout the facility, located relative to specific areas of research, as opposed to within a specific institute, thus challenging the historical work layout of each partner institute. The traditional laboratory environment is elevated to a human place for people who work at the highest level in the pursuit of scientific discovery. The TRI lab modules also feature an extensive use of glass and natural light.

The medical school occupies half of one floor to ensure that there is ongoing interaction between the medical students and the scientists working in the building. This also extends to the institute's flagship 'science in school' programme, SPARQ-ed. These education-oriented areas contain e-learning instructional labs, classrooms and break areas. Public spaces are well accommodated with a 250+ seat auditorium, the open area atrium/outdoor room, cafe and main entrance, featuring an interactive digital wall and curatorial display that depicts the former site of the building and captures the research work and outlook of the institute.

TRI's vivarium, believed to be the largest such facility in the southern hemisphere, provides a specialised population for modelling and testing cures for human disease states. The goal is to make a disease model as close to human disease as possible, and then treat the mouse just like you would treat a patient.

The institute has a full mouse hospital, with its own pharmacy, imaging suite, pathology and doctors – the same facilities that would be necessary to care for a human patient. This facility feeds into a health sciences centre with the capacity to conduct Phase I and Phase II clinical trials, once a new therapy is proven successful in initial research.

More than half of all the research group heads working in the building are also hospital appointees with clinical appointments. TRI affords them the ability to work on establishing the pathophysiology of diseases using the latest tools for constructing animal models that reflect those diseases.

A co-located 6,500sqm biopharmaceutical manufacturing facility run by health partner, DSM Biologics, provides on-site production capacity to transfer new discoveries for chronic illness and disease from the lab through to commercialisation and clinical application.

Diamond distinction

The South Australian Health and Medical Research Institute's distinctive diamond-shaped plan, diagrid facade and two atriums help to give the state-of-the-art research facility a sense of place in the surrounding parklands

The new South Australian Health and Medical Research Institute (SAHMRI) is a significant development in health and medical research for South Australia. The headquarters for SAHMRI will comprise a total gross floor area of approximately 25,000sqm and will accommodate up to 675 researchers from South Australia, Australia and internationally. The facility will provide fully flexible laboratory space to PC2 standard, consisting of both wet and dry laboratory spaces, including a vivarium, a cyclotron, open public spaces – and commercial opportunities at the plaza level. The location of the facility is a key factor, being constructed in an enviable position immediately adjacent to the site of the new Royal Adelaide Hospital (NRAH) on North Terrace. Alongside NRAH, SAHMRI acts as an urban catalyst, reinvigorating the west end of Adelaide and creating a new health precinct.

Derived from its unique site geometry and the need to create a forecourt entry adjacent to the new hospital, the diamond-shape plan grows from the ground plane to become a 'folly' in the park. The built form arrangement of SAHMRI acknowledges its sense of place within the green belt of the Adelaide parklands, while the lifting of the building allows the parklands to extend below and create the notion of a 'building in the parkland'. The lifting also acts to liberate the ground plane and create a more open public plaza to encourage staff, visitors and the general public to interact and exchange ideas.

A plaza landscaped strategy of medicinal gardens aims to provide an education tool as an interpretive journey to further create interest and encourage public interaction. The medicinal planting scheme includes structural trees (foreground, flowering backdrop and evergreen backdrop), as well as an understorey of shrubs, groundcovers and grasses planted in three thematic planting zones: Mediterranean, native and subtropical.

The sculpture qualities of SAHMRI's form aim to attract interest, inspire and promote the building's function. The ▶

South Australian Health and Medical Research Institute (SAHMRI), Adelaide, South Australia

Type of healthcare facility: Health and medical research institute
Client/owner/commissioning South Australian Government and the South Australian Health & Medical Research Institute
Architects: Woods Bagot & Research Facility Design
Services engineer: Norman, Disney & Young (mechanical, fire and hydraulics) and Aurecon (electrical, data and comms)
Structural engineer: Aurecon (civil/structural/facade engineers)
Project manager: Department for Transport, Energy and Infrastructure (project risk management)
Quantity surveyor/cost manager: Rider Levett Bucknall
Building contractor: Hindmarsh
Form of procurement: Managing contractor
Cost: AU$200m
Size: 25,000sqm
Construction start: February 2010
Construction completion: late 2013
Project in use: late 2013

transparent facade showcases the two atriums inside the building. The west atrium expresses the entry and bridge links between the laboratories, while the east atrium expresses the active workplace environment inside.

The building form is further expressed by its unique triangulated diagrid facade, inspired by the skin of a pine cone. The form and its articulated skin adapt and respond to its environment, becoming a living organism via the design of the sunshades, responding to their location and orientation to provide the most efficient protection from the sun and heat. The developed triangulated facade and sunshade design uses parametric modelling tools to integrate environmental, programmatic and formal requirements to generate a shading system that changes accordingly. This allows it to deal with sunlight, heat load, glare and wind deflection, while maintaining enhanced views and daylight to create a healthy internal environment. It also allows the outside to view the internal workings of the building to help promote the importance of the building's activity. The triangulated diagrid also deals with the organic plan and section of the building form allowing it to maintain its sculptural quality by having one harmonious skin which works aesthetically as well as environmentally.

The SAHMRI project is committed to a high level of ecologically sustainable development within the construction and operation of the new facility. The project is on target to achieve a LEED Gold rating, the first for a laboratory building in Australia.

This is achievable firstly thanks to the passive design of the floor plates that responds to the internal programme and provides maximum daylight where needed.

SAHMRI will be a highly flexible, state-of-the-art, world-class facility with advanced technological facilities and equipment to support the institute's dynamic themes and research strategy. It will demonstrate national and international leadership through its excellence, its partnership model and its iconic physical presence.

Breaking down barriers

Queensland's Ecosciences Precinct breaks down boundaries by co-locating scientists from six different disciplines, and using a tripartite lab model and central interactive street design to bring them together and inspire collaboration

The Ecosciences Precinct brings together 1,000 scientists from four state agencies and six divisions of CSIRO (the Commonwealth Scientific and Industrial Research Organisation) across diverse scientific disciplines into a single, collaborative research environment with shared laboratory, office and support facilities. Previously spread across eight different sites, often with little cross-disciplinary interaction, it was felt that the opportunities for scientific discovery were not being optimised. The challenge was to break down these existing institutional boundaries and maximise opportunities for collaboration and knowledge exchange.

The designers' suggestion was to co-locate scientists by scientific outcome, not by organisational boundary. This ambitious plan was developed in workshops with decision-making stakeholders from each of the 10 user agencies, the owner agency and two project management agencies.

The solution was to implement a flexible and adaptable building design underpinned by strategies for co-location and sharing, interaction and collaboration. Three north-orienting wings are linked by an internal multi-level street of staff social, common and meeting rooms connected by atriums, lifts and open staircases to optimise vertical and horizontal connectivity. This central interaction street draws staff out of their quiet work zones into a lively social hub encouraging the exchange of ideas. External walkways and stairs define courtyard ends and provide a supplementary network of office connectivity parallel to the main street. This allows for cohesive team environments and optimises the potential for discovery and intellectual exchange between teams and across science clusters vertically and horizontally.

A tripartite lab model optimises visual connectivity with flexibility and adaptability. The physically contained lab zones are located to the north and south to allow unimpeded staff interactions between office areas. The tripartite model for the generic laboratories consists of three adjacent zones – office, laboratory and laboratory support – accommodating varying group sizes and functions in a generic, flexible and adaptable configuration of loose lab furnishings and suspended service spines that are designed to accommodate change over time. A high level of transparency between the three zones, separated only by glass containment barriers, allows research teams to be connected whether they are at their office or lab workstation.

A new project-specific sustainable building rating tool was also developed, as laboratories are not currently addressed by the Green Building Council of Australia rating tools. Passive, low-energy design was a central feature. Measures included extensive sunshading to reduce solar heat gain and locating the central communication stairs in a prominent location to encourage their use over the lifts. Water efficiency was also a key feature in the design.

The final result was a co-location of scientific agencies 'without walls'. This is a major innovation, shedding spatial and operational barriers to optimise collaboration and knowledge exchange in the pursuit of scientific excellence.

Ecosciences Precinct, Dutton Park, Brisbane, Queensland

Type of healthcare facility: Research precinct
Client/owner/commissioning authority: Department of Science, Information Technology, Innovation and the Arts (Queensland)
Architects: HASSELL
Services engineer: AECOM, Arup, Dr Ian Taylor, S2F, SKM, Tracey Brunstrom and Hammond
Structural engineer: Arup
Project manager: Project Services
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Watpac
Form of procurement:
Managing contractor – lump sum
Cost: AU$235m
Size: 50,000sqm
Construction start: 2005
Construction completion: 2010
Project in use: October 2010

Capital collaboration

The John Curtin School of Medical Research is designed to create a focal point on the Australian National University campus and, with its open doors, encourage visitors to come in and watch the world of science in action

The John Curtin School of Medical Research (JCSMR) at the Australian National University (ANU) provides purpose-designed accommodation for one of Australia's leading biomedical research institutes. Designed as a 'low-rise' interactive building with large floorplates, the building contains a clinical research environment for JCSMR researchers as well as for staff from Canberra Hospital.

JCSMR houses 500 scientists in biological containment labs and adjacent offices, as well as an integrated 'shared' microscopy facility, shared stores and a PC3 biological resource facility and behavioural research suite. It also includes a range of collaborative informal spaces including landscaped courtyards and staff lounges. All of the collaborative shared spaces are connected together by an internal 'social street', designed to promote cross-disciplinary collaboration and whole-of-school awareness. Secluded areas allow individuals to retreat in quiet contemplation.

The project took eight years to complete over three stages with the laboratories designed to cater for significant changes during the construction period. The 'super-lab' laboratory modules were planned for optimum flexibility for small groups or large research teams, to meet the changing research cohorts and integration of new high-throughput equipment. All laboratories include flexible services and moveable benching and are characterised by abundant natural daylight. Electrophysiology labs are located at ground level on stable slabs to minimise vibration affecting the recording equipment. All of the labs and support rooms have large floor-to-ceiling glazed screens to provide visual interconnection across the building between dry and wet workspaces.

The building incorporates environmentally sustainable design initiatives including east-west passive solar orientation, natural daylighting, automated lighting control to the office and laboratory areas, mixed-mode air conditioning, thermal chimneys and a mass labyrinth below the entry forecourt to pre-cool air into the school's teaching spaces.

Externally, the facade of the building expresses the work undertaken by the school, using the double DNA strand as the generative idea. Two 'strands' at the top and bottom of the facade are articulated continuously around the building. On the entry facade, these strands twist around an invisible centreline, alluding to the popular three-dimensional image of the double helix used in molecular biology. The institute's wide steps and civic plaza create an appropriately scaled entry into the new research facility and also serve to connect the building to the ANU campus.

The main entry level includes the public spaces in the building – the auditorium, café, interactive educative displays and views into the working laboratories. The public is invited explore the education centre or watch the high-throughput robots and lab technicians at work. The glass window in the floor of the foyer also provides views into the workshop, where scientific research equipment is being custom-made for scientists.

John Curtin School of Medical Research, Canberra, ACT

Type of healthcare facility:
Biomedical research institute
Client/owner/commissioning authority:
Australian National University
Architects: Lyons
Services engineer: Umow Lai & Associates
Structural engineer: Hughes Trueman
Project manager: Hindmarsh Group
Building contractor: Hindmarsh Group
Quantity surveyor/cost manager:
JM Still & Associates
Form of procurement: Construction management
Cost: AU$135m
Size: 23,000sqm
Construction start: December 2004
Construction completion: February 2012
Project in use: April 2006 (Stage 1), March 2009 (Stage 2–3), February 2012 (Stage 3)

Tertiary and Acute Care

Blacktown Hospital, Blacktown, New South Wales

Type of healthcare facility: Tertiary hospital
Client/owner/commissioning authority:
NSW Health Infrastructure
Architects: SKM-S2F
Services engineer: SKM, AECOM and Warren Smith & Partners
Structural engineer: Robert Bird & Partners
Project manager: Appian Group
Quantity surveyor/cost manager: Rider Levett Bucknall
Form of procurement: Design finalisation contractor
Size: 32,000sqm
Construction start: 2011
Construction completion: 2013 (third quarter)

Box Hill Hospital Redevelopment, Box Hill, Victoria

Type of healthcare facility: Acute hospital
Client/owner/commissioning authority:
Department of Health Victoria/Eastern Health
Architects: Silver Thomas Hanley/Daryl Jackson (STHDJ)
Services engineer: WSP Buildings
Structural engineer: Meinhardt
Project manager: Department of Health Victoria
Quantity surveyor/cost manager: Donald Cant Watts Corke
Building contractor: Baulderstone
Form of procurement: Managing contractor
Cost: AU$447.5m
Size: 56,600sqm (new), plus 30,000sqm (existing)
Construction start: 2011
Construction completion/project in use:
Late 2014 (new building),
Late 2015 (refurbished building)

Casey Hospital – Sub-Acute, Berwick, Victoria

Type of healthcare facility: Sub-acute hospital
Client/owner/commissioning authority:
Department of Health Victoria/Monash Health
Architects: Billard Leece Partnership
Services engineer: AECOM
Structural engineer: Irwinconsult
Project manager: Johnstaff
Quantity surveyor/cost manager: Sweett Group
Building contractor: Kane Construction
Form of procurement: Traditional lump sum
Cost: AU$22.2m (Commonwealth government)
Size: 2,200sqm
Construction start: February 2013
Construction completion: June 2014
Project in use: 2014

Dandenong Hospital Emergency Department, Dandenong, Victoria

Type of healthcare facility: Acute hospital emergency department
Client/owner/commissioning authority:
Department of Health Victoria/Monash Health
Architects: Bates Smart/Irwin Alsop
Services engineer: Waterman AHW
Structural engineer: Irwin Consult
Project manager: Coffey Projects
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Kane Constructions
Form of procurement: Lump sum
Cost: AU$25m
Size: 2,860sqm
Construction start: July 2009
Construction completion: October 2010
Project in use: January 2011

Frankston Hospital Inpatient Expansion and Emergency Department Redevelopment, Victoria

Type of healthcare facility:
Inpatient accommodation and emergency department
Client/owner/commissioning authority:
Department of Health Victoria/Peninsula Health
Architects: Lyons
Services engineer: Waterman AHW
Structural engineer: Aurecon
Project manager: Johnstaff
Quantity surveyor/cost manager: Slattery Australia
Form of procurement: Lump sum
Cost: Inpatient expansion: AU$36m;
emergency department redevelopment: AU$40m
Size: 10,546sqm
Construction start: July 2013
Construction completion: October 2014

Frankston Hospital Redevelopment Stage 2, Frankston, Victoria

Type of healthcare facility: Acute hospital
Client/owner/commissioning authority:
Department of Health Victoria/Peninsula Health
Architects: Lyons
Services engineer: Waterman AHW
Structural engineer: Aurecon
Project manager: Johnstaff
Quantity surveyor/cost manager: Slattery
Building contractor: Kane Constructions
Form of procurement: Lump sum
Cost: AU$45m
Size: 8,395sqm
Construction start: August 2008
Construction completion: 2010
Project in use: October 2010

Geelong Hospital Emergency Department upgrade, Geelong, Victoria

Type of healthcare facility: Hospital emergency department
Client/owner/commissioning authority:
Department of Health Victoria/Barwon Health
Architects: Silver Thomas Hanley
Services engineer: Umow Lai & Associates
Structural engineer: Irwin Consult
Project manager: Aurecon Group
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Kane Constructions
Form of procurement: Traditional lump sum
Cost: AU$26.1m
Size: 2,427sqm
Construction start: March 2007
Construction completion: February 2009
Project in use: March 2009

Ipswich Hospital Expansion, Ipswich, Queensland

Type of healthcare facility: Acute hospital
Client/owner/commissioning authority:
Queensland Health – Project Services
Architects: Woodhead
Services engineer: Norman Disney & Young
Structural engineer: Cardno
Project manager: Thinc
Quantity surveyor/cost manager: Turner & Townsend
Building contractor: Lend Lease
Form of procurement: Managing contractor
Cost: AU$129m
Size: 4,755sqm: 3,950sqm (new);
805sqm (refurbished)
Construction start: 2011
Construction completion: 2013 (forecast)
Project in use: 2013 (forecast)

Kingston Centre Redevelopment Stage 2, Cheltenham, Victoria

Type of healthcare facility:
Aged care rehabilitation and residential facility
Client/owner/commissioning authority:
Department of Health Victoria/Monash Health
Architects: Silver Thomas Hanley/Tectura Architects
Services engineer: AECOM
Structural engineer: Bonacci Group
Project manager: Aurecon
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Cockram Construction
Form of procurement: Traditional lump sum tender
Cost: AU$45m
Size: 7,290sqm
Construction start: March 2010
Construction completion: 2012

Knox Hospital Development (Wantirna Health), Wantirna, Victoria

Type of healthcare facility: Multi-purpose hospital
Client/owner/commissioning authority:
Department of Health Victoria/Eastern Health
Architects: Tectura Architects
Services engineer: Irwinconsult
Structural engineer: Brown Consulting
Project manager: Aurecon (Connell Wagner)
Quantity surveyor/cost manager: AECOM (Davis Langdon)
Building contractor: Kane Constructions
Form of procurement: Traditional lump sum
Cost: AU$30m
Size: 6,462sqm
Construction start: August 2006
Construction completion: October 2007
Project in use: November 2007

Logan Hospital Expansion, Brisbane, Queensland

Type of healthcare facility: Acute hospital
Client/owner/commissioning authority:
Queensland Health – Project Services
Architects: Woodhead
Services engineer: Norman, Disney & Young / MRP
Structural engineer: Arup
Project manager: RCP
Quantity surveyor/cost manager: Rider Levett Bucknall
Building contractor: Thiess
Form of procurement: Managing contractor
Cost: AU$143m
Size: 10,000sqm
Construction start: 2012
Construction completion: 2014 (forecast)
Project in use: 2014 (forecast)

McKellar Centre Redevelopment, North Geelong, Victoria

Type of healthcare facility: Sub-acute rehabilitation
Client/owner/commissioning authority:
Department of Health Victoria/Barwon Health
Architects: Lyons
Services engineer: Scott Wilson Irwin Johnston
Structural engineer: Earth Tech
Project manager: Atkinson Project Management
Quantity surveyor/cost manager: Sweett Group
Building contractor: Hooker Cockram
Form of procurement: Traditional lump sum and construction management
Cost: AU$99.7m
Size: 21,260sqm
Construction start/completion: 2001/2008
Project in use: Staged opening: Dec 2004; May 2007; May 2008

Mornington Centre Sub-Acute Beds, Mornington, Victoria

Type of healthcare facility: Sub-acute hospital
Client/owner/commissioning authority:
Department of Health Victoria/Peninsula Health
Architects: Billard Leece Partnership
Services engineer: Waterman AHW
Structural engineer: John Mullen and Partners
Project manager: Coffey
Quantity surveyor/cost manager: Sweett Group
Building contractor: Hansen Yunken
Form of procurement: Guaranteed bill of quantity
Cost: AU$25m (Commonwealth government)
Size: 3,600sqm
Construction start: August 2012
Construction completion: February 2014
Project in use: March 2014

New Bendigo Hospital Project, Bendigo, Victoria

Type of healthcare facility: Acute hospital
Client/owner/commissioning authority:
Department of Health Victoria/Bendigo Health
Architects: Bates Smart/Silver Thomas Hanley
Services engineer: Norman Disney & Young
Structural engineer: Irwin Consult
Project manager/PPP consortium: Exemplar Health
Building contractor: Lend Lease
Form of procurement: PPP (public-private partnership)
Cost: AU$630m
Size: 54,445sqm (approx)
Construction completion: 2016

Princess Alexandra Hospital, Woolloongabba, Queensland

Type of healthcare facility: Tertiary level teaching hospital
Client/owner/commissioning authority: Queensland Health
Architects: Cox Architecture/McConnel Smith & Johnson
Services engineer: WBM Bassett
Structural engineer: Arup
Quantity surveyor/cost manager: Rider Levett Bucknall
Building contractor: John Holland/Baulderstone
Form of procurement: Stage 1 + 2 (lump sum)
Cost: AU$300m
Size: 85,000sqm
Construction start: 1997
Construction completion: 2002
Project in use: 2002

Royal Brisbane and Women's Hospital, Herston, Queensland

Type of healthcare facility: Tertiary level teaching hospital
Client/owner/commissioning authority: Queensland Health
Architects: Daryl Jackson/Di Carlo Potts Associates
Services engineer: Norman Disney Young/Meinhardt/CMM (Aurecon)
Structural engineer: Quantac McWilliam
Project manager: Capworks Management
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Lend Lease/Multiplex/Thiess
Form of procurement: Managing contractor
Cost: AU$170m (Centre); AU$50m (East); AU$34m (West)
Size: 71,800sqm (Centre); 28,100sqm (East); 11,000sqm (West)
Construction start: 1996
Construction completion: 2002
Project in use: 2000 (Centre); 2002 (East); 2002 (West)

Royal Melbourne Hospital Allied Health Project, Parkville, Melbourne

Type of healthcare facility:
Tertiary hospital – integrated allied health services
Client/owner/commissioning authority:
Department of Health Victoria/Melbourne Health
Architects: Billard Leece Partnership
Services engineer: Lehr Consultants International
Structural engineer: John Mullen and Partners
Project manager: Johnstaff
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Cockram Construction
Form of procurement: Construction management
Cost: AU$10m
Size: 1,962sqm
Construction start: March 2011
Construction completion: August 2012
Project in use: August 2012

Royal Melbourne Emergency Department Redevelopment, Parkville, Victoria

Type of healthcare facility: Tertiary hospital
Client/owner/commissioning authority:
Department of Health Victoria/Melbourne Health
Architects: Hassell
Services engineer: Waterman AHW
Structural engineer: John Mullen Partners
Project manager: Johnstaff
Quantity surveyor/cost manager: Donald Cant Watts Corke
Building contractor: Leighton Contractors
Form of procurement: Construction management
Cost: AU$56.3m
Size: 9,000sqm
Construction start: 2006 (staged construction)
Construction completion: 2010
Project in use:
2007–2010 (staged openings)

Sunbury Day Hospital, Sunbury, Victoria

Type of healthcare facility:
Day hospital – acute ambulatory care
Client/owner/commissioning authority:
Department of Health Victoria/Western Health
Architects: Baade Harbour Australia
Services engineer: Waterman AHW
Structural engineer: Harrington Gumienik Partners
Project manager: Aurecon
Quantity surveyor/cost manager: Sweett Group
Building contractor: Cockram Constructions
Form of procurement: Construction management
Cost: AU$21.4m
Size: 2,717sqm
Construction start: August 2009
Construction completion: November 2011
Project in use: January 2012

Sunshine Hospital Expansion and Redevelopment: Acute Services Building, St Albans, Victoria

Type of healthcare facility: Acute hospital
Client/owner/commissioning authority:
Department of Health Victoria/Western Health
Architects: Silver Thomas Hanley
Services engineer: AECOM
Structural engineer: Irwinconsult
Project manager: Johnstaff
Quantity surveyor/cost manager: Donald Cant Watts Corke
Building contractor: Kane Construction
Form of procurement: Traditional lump sum
Cost: AU$90.5m
Size: 12,000sqm
Construction start: November 2010
Construction completion: August 2012
Project in use: February 2013

Warrnambool Hospital Redevelopment, Warrnambool, Victoria

Type of healthcare facility: Acute regional hospital
Client/owner/commissioning authority:
Department of Health Victoria/South West Healthcare
Architects: Health Science Planning Consultants
Services engineer: Waterman AHW
Structural engineer: Barry Gale Engineers
Project manager: Sinclair Knight Merz
Quantity surveyor/cost manager: David Langdon
Building contractor: Construction engineering
Form of procurement: Traditional lump sum
Cost: AU$16m (Stage 1); AU$70m (Stage 1B); AU$26.2m (Stage 1C)
Size: 18,500sqm
Construction start: April 2008
Construction completion: August 2012
Project in use: October 2012

Werribee Mercy Hospital Maternity and Special Care Nursery, Werribee, Victoria

Type of healthcare facility: Acute hospital
Client/owner/commissioning authority:
Department of Health Victoria/Werribee Mercy Health
Architects: Billard Leece Partnership
Services engineer: LEHR Consultants International
Structural engineer: John Mullen & Partners
Project manager: Aurecon
Quantity surveyor/cost manager: Sweett Group
Building contractor: Mackie
Form of procurement: Traditional lump sum
Cost: AU$14m
Size: 2,253sqm
Construction start: 2009
Construction completion: June 2011 (staged completion)
Project in use: July–December 2011

Werribee Mercy Hospital Stage 1A, Werribee, Victoria

Type of healthcare facility:
Sub-acute facility within acute hospital
Client/owner/commissioning authority:
Department of Health Victoria/Werribee Mercy Hospital
Architects: Billard Leece Partnership
Services engineer: AECOM
Structural engineer: JMP
Project manager: Aurecon
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Cockram Construction
Form of procurement: Construction management
Cost: AU$28m
Size: 4,300sqm
Construction start: August 2012
Construction completion: October 2013
Project in use: October 2013

Wesley Hospital East Wing, Brisbane, Queensland

Type of healthcare facility: Multi-purpose hospital
Client/owner/commissioning authority:
Uniting Care/The Wesley Hospital
Architects: pdt-sth
Services engineer: Cushway Blackford and Associates
Structural engineer: Cardno
Project manager: Aurecon
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Baulderstone
Form of procurement: Managing contractor
Cost: AU$102m
Size: 12,200sqm
Construction start: March 2008
Construction completion: March 2010

Cancer Care

Albury Regional Cancer Centre, Albury, Victoria

Type of healthcare facility: Regional cancer centre
Client/owner/commissioning authority:
Department of Health Victoria/Albury Wodonga Health
Architects: Billard Leece Partnership
Services engineer: Waterman AHW
Structural engineer: Irwinconsult
Quantity surveyor/cost manager:
Donald Cant Watts Corke
Project manager: Aurecon
Form of procurement: Traditional lump sum
Cost: AU$70m (Commonwealth government)
Size: 7,700sqm
Construction start: 2013
Construction completion: 2015 (forecast)
Project in use: 2015 (forecast)

Rockhampton Cancer Care Centre, Rockhampton Base Hospital, Queensland

Type of healthcare facility:
Regional comprehensive cancer care centre
Client/owner/commissioning authority: Queensland Health
Architects: Hassell
Services engineer: Sinclair Knight Merz
Structural engineer: Aurecon
Project manager: Capworks Management
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Hansen and Yuncken
Form of procurement: Managed contract
Cost: AU$65m
Size: 5,230sqm
Construction start: Mid-2012
Construction completion: Mid-2015
Project in use: Mid-2015

Mental Health

Austin Health Community Care Unit, Heidelberg, Victoria

Type of healthcare facility: Mental health facility
Client/owner/commissioning authority:
Department of Health Victoria/Austin Health
Architects: Hassell
Services engineer: WSP Lincolne Scott Australia
Structural engineer: Irwinconsult
Project manager: Aurecon
Quantity surveyor/cost manager: Donald Cant Watts Corke
Building contractor: Ireland Brown
Form of procurement: Traditional lump sum
Cost: AU$14.2m
Size: 1,600sqm
Construction start: February 2012
Construction completion: May 2013
Project in use: August 2013

Casey Residential Aged Care, Doveton, Victoria

Type of healthcare facility:
Aged care facility with mental health unit
Client/owner/commissioning authority:
Department of Health Victoria/Monash Health
Architects: Tectura Architects/Silver Thomas Hanley
Services engineer: Bassett Kuttner Collins (AECOM)
Structural engineer: Bonacci Group
Project manager: Atkinson Johnstaff
Quantity surveyor/cost manager:
Davis Langdon/Padghams
Building contractor: Kane Construction
Form of procurement: Traditional lump sum contract
Cost: AU$34.5m
Size: 5,758sqm
Construction start: June 2007
Construction completion/project in use: October 2008

Coral Balmoral – Veterans Psychiatric Unit and Post Trauma, Heidelberg, Victoria

Type of healthcare facility: Secure mental health facility
Client/owner/commissioning authority:
Department of Health Victoria/Austin Health
Architects: Hassell
Services engineer: WSP Lincolne Scott Australia
Structural engineer: John Mullen Partners
Project manager: Aurecon
Building contractor: Kane Constructions
Quantity surveyor/cost manager:
Donald Cant Watts Corke
Form of procurement: Traditional lump sum
Cost: AU$15.5m
Size: 2,500sqm
Construction start: August 2009
Construction completion: February 2011
Project in use: March 2011

Dandenong Hospital Mental Health Redevelopment, Dandenong, Victoria

Type of healthcare facility: Mental health
Client/owner/commissioning authority:
Department of Health Victoria/Monash Health
Architects: Bates Smart/Irwin Alsop
Services engineer: Waterman AHW
Structural engineer: Irwinconsult
Project manager: Coffey Projects
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Kane Constructions
Form of procurement: Lump sum
Cost: AU$69m
Size: 9,200sqm
Construction start: January 2010
Construction completion/project in use:
Stage 1: August/September 2011 (actual);
Stage 2: June/July 2013 (forecast)

Gold Coast University Hospital Mental Health Unit, Southport, Queensland

Type of healthcare facility: Mental health unit
Client/owner/commissioning authority: Queensland Health
Architects: GCUH Architecture (PDT + Silver Thomas Hanley + Hassell)
Services engineer: Sinclair Knight Merz
Structural engineer: Sinclair Knight Merz
Project manager: Lend Lease
Quantity surveyor/cost manager: Lend Lease
Building contractor: Lend Lease
Form of procurement: Managed contract
Cost: AU$65m
Size: 8,277sqm
Construction start: 2008
Construction completion: 2012
Project in use: May 2013

Logan Hospital Adult Acute Mental Health Unit, Meadowbrook, Queensland

Type of healthcare facility: Mental health unit
Client/owner/commissioning authority: Queensland Health
Architects: Woodhead
Services engineer: Norman, Disney & Young
Structural engineer: Cardno
Project manager: Queensland Health – Project Services
Quantity surveyor/cost manager: RLB
Building contractor: Woollam Constructions
Form of procurement: Traditional lump sum
Cost: AU$14.4m
Size: 2,270sqm
Construction start: February 2011
Construction completion: April 2013
Project in use: May 2013

Regional Health

Busselton Health Campus, Busselton, Western Australia

Type of healthcare facility: Regional health facility
Client/owner/commissioning authority: Western Australia Department of Health / Country Health Service
Architects: Hassell
Services engineer: AECOM
Structural engineer: BG & E
Project manager: NSW Health Infrastructure
Quantity surveyor/cost manager: BMW/Aurora Projects
Building contractor: Doric Construction
Form of procurement: Novated Design and Construct
Cost: AU$95m
Size: 16,000sqm
Construction start: 2012
Construction completion: 2014

Leongatha Hospital Residential Aged Care, Leongatha, Victoria

Type of healthcare facility:
Regional aged care unit within hospital campus
Client/owner/commissioning authority: Department of Health Victoria/Gippsland Southern Health Service
Architects: Vincent Chrisp & Partners
Services engineer: BRT Consulting
Structural engineer: Barry Gale Engineers
Project manager: Davis Langdon
Quantity surveyor/cost manager: Plan Cost Australia
Building contractor: Walton Construction (Stage 1)
Form of procurement: Traditional lump sum
Cost: AU$10m
Size: 1,620sqm
Construction start: January 2006
Construction completion: December 2008
Project in use: February 2009

Nambour General Hospital, Nambour, Queensland

Type of healthcare facility: Regional general hospital
Client/owner/commissioning authority: Queensland Health
Architects: SKM-S2F
Services engineer:
SKM-S2F (mechanical & electrical consultants)
Structural engineer: Glyn Tucker Consulting Engineers
Project manager: Ranbury Management Group
Quantity surveyor/cost manager: Donald Cant Watts Corke
Building contractor: Watpac Construction
Form of procurement: Managing contract
Cost: AU$282m
Size: 20,000sqm
Construction start: 2007
Construction completion: 2012
Project in use: 2012

Port Macquarie Base Hospital Expansion, Port Macquarie, New South Wales

Type of healthcare facility: Regional hospital
Client/owner/commissioning authority:
NSW Health Infrastructure
Architects: Hassell
Services engineer: Umow Lai/Wood & Grieve/ACOR
Structural engineer: Enstruct Group
Project manager: Aurecon
Quantity surveyor/cost manager: Altus Page Kirkland
Building contractor: Watpac
Form of procurement: Traditional lump sum
Cost: AU$110m
Size: 12,500sqm
Construction start: August 2012
Construction completion: December 2013
Project in use: March 2014

Wagga Wagga Health Service Redevelopment, Wagga Wagga, New South Wales

Type of healthcare facility: Regional acute hospital
Client/owner/commissioning authority:
NSW Health Infrastructure
Architects: Billard Leece Partnership
Services engineer: Steensen Varming/ACOR Consultants
Structural engineer: Mott MacDonald
Project manager: NSW Health Infrastructure
Quantity surveyor/cost manager: Davis Langdon
Form of procurement: GMP / managing contract
Cost: AU$282m
Size: 24,000sqm
Construction start: October 2013
Construction completion: 2016
Project in use: 2016

Warracknabeal Nursing Home Redevelopment (Yarriambiack Lodge), Warracknabeal, Victoria

Type of healthcare facility: Integrated rural health service
Client/owner/commissioning authority:
Department of Health Victoria/Rural Northwest Health
Architects: Baade Harbour Australia
Services engineer: BRT Consulting
Structural engineer: EarthTech
Project manager: Bruce Cook & Associates
Quantity surveyor/cost manager: Altus Page Kirkland

Building contractor: Locks Construction
Form of procurement: Traditional fixed lump sum
Cost: AU$21.8m
Size: 4,158sqm
Construction start: January 2007 (main contract)
Construction completion: May 2008 (main contract)
Project in use: June 2008

Community Health

Annerley GP Super Clinic, Woolloongabba, Queensland

Type of healthcare facility: GP super clinic
Client/owner/commissioning authority:
University of Queensland – Faculty of Health Services
Architects: Woodhead
Services engineer: GHD
Project manager: Capital Insight Project Management
Building contractor: Amicus

Form of procurement: Managing contractor
Cost: AU$1.6m
Size: 1,200sqm
Construction start: June 2010
Construction completion: September 2010
Project in use: January 2011

Nexus Health Super Clinic, Wallan, Victoria

Type of healthcare facility: GP super clinic
Client/owner/commissioning authority: Nexus Primary Health
Architects: Billard Leece Partnership
Services engineer: Waterman
Structural engineer: Irwinconsult
Project manager: Wes Gault
Quantity surveyor/cost manager: Sweett Group

Building contractor: Monaco Hickle
Form of procurement: Traditional lump sum
Cost: AU$6m
Size: 1,600sqm
Construction start: December 2012
Construction completion: November 2012
Project in use: November 2012

North Richmond Community Health Centre, Richmond, Victoria

Type of healthcare facility: Community health centre
Client/owner/commissioning authority: Department of Health Victoria/North Richmond Community Health Centre
Architects: Lyons
Services engineer: AECOM
Structural engineer: Bonacci Group
Project manager: Aurecon
Quantity surveyor/cost manager: Davis Langdon

Building contractor: Kane Constructions
Form of procurement: Construction management
Cost: AU$19m
Size: 3,012sqm
Construction start: 2010
Construction completion: July 2012
Project in use: August 2012

North Lakes Health Precinct, North Lakes, Queensland

Type of healthcare facility: Community healthcare
Client/owner/commissioning authority:
Queensland Health – Project Services
Architects: Daryl Jackson
Services engineer: AECOM
Structural engineer: Farr Engineers
Project manager: Queensland Health – Project Services
Building contractor: Hutchinson Builders
Quantity surveyor/cost manager:
Queensland Health – Project Services
Form of procurement: Traditional lump sum
Cost: AU$40m
Size: 9,030sqm
Construction start: November 2007
Construction completion: April 2009
Project in use: May 2009

Plenty Valley Community Health GP Super Clinic, South Morang, Victoria

Type of healthcare facility: GP super clinic
Client/owner/commissioning authority:
Plenty Valley Community Health
Architects: Billard Leece Partnership
Services engineer: JBA
Structural engineer: Irwinconsult
Project manager: Johnstaff
Quantity surveyor/cost manager: Plancost Australia
Building contractor: Ireland Brown
Form of procurement: Traditional lump sum
Cost: AU$4.5m
Size: 1,300sqm
Construction start: February 2011
Construction completion: December 2012
Project in use: December 2012

Stawell Health & Community Centre Redevelopment, Stawell, Victoria

Type of healthcare facility: Community health centre
Client/owner/commissioning authority:
Department of Health Victoria/Grampians Community Health/
Stawell Regional Health
Architects: Tectura Architects
Services engineer: Waterman AHW
Structural Engineer: Brown Consulting
Project manager: Johnstaff
Building contractor: Allmore Constructions
Form of procurement: Traditional lump sum
Cost: AU$20.0m
Size: 4,820sqm
Construction start: January 2008
Construction completion: April 2010
Project in use: May 2010

Science, Research & Education

Doherty Institute, Parkville, Melbourne, Victoria

Type of healthcare facility: Research and educational facility
Client/owner/commissioning authority:
University of Melbourne/Melbourne Health
Architects: Grimshaw/Billard Leece Partnership
Services engineer: S2F/SKM
Structural Engineer: John Mullen & Partners
Project manager: Donald Cant Watts Corke
Quantity Surveyor/Cost Manager: Donald Cant Watts Corke

Form of procurement: Design and construct
Cost: AU$210.0m
Size: 26,000sqm
Construction start: August 2011
Construction completion: October 2013
Project in use: March 2014

Hunter Medical Research Institute, New Lambton Heights, New South Wales

Type of healthcare facility: Medical research institute
Client/owner/commissioning authority:
Ingham Health Research Institute
Architects: Sinclair Knight Merz/Denton Corker Marshall
Services engineer: Sinclair Knight Merz
Structural engineer: Arup
Project manager: APP
Quantity surveyor/cost manager: Davis Langdon

Building contractor: Cockram Construction
Form of procurement: Design and construct
Cost: AU$90m
Size: 15,900sqm
Construction start: September 2010 (Main works)
Construction completion: June 2012 (Main works)
Project in use: July 2012

Ingham Health Research Institute, Liverpool, New South Wales

Type of healthcare facility: Health research institute
Client/owner/commissioning authority:
Ingham Health Research Institute
Architects: McConnel Smith & Johnson Architects (MSJ)
Services engineer: Steensen Varming Engineers
Structural engineer: Taylor Thompson Whitting Engineers
Project manager: Capital Insight
Quantity surveyor/cost manager: Wilde and Woollard

Building contractor: Richard Crookes Constructions
Form of procurement: Lump sum
Cost: AU$38m
Size: 8,100sqm
Construction start: 2009
Construction completion: 2012
Project in use: 2012

Melbourne Brain Centre, The University of Melbourne, Parkville, Victoria

Type of healthcare facility: Biomedical research institute
Client/owner/commissioning authority:
The University of Melbourne
Architects: Lyons
Services engineer: S2F
Structural engineer: Bonacci Group
Project manager: Donald Cant Watts Corke
Quantity surveyor/cost manager: David Langdon

Building contractor: Brookfield Multiplex Construction
Form of procurement: Construction management
Cost: AU$161m
Size: 17,789sqm
Construction start: September 2009
Construction completion: May 2011
Project in use: May 2011

National Life Sciences Hub, Charles Sturt University, Wagga Wagga, New South Wales

Type of healthcare facility:
Science, research and education facility
Client/owner/commissioning authority:
Charles Sturt University
Architects: BVN Donovan Hill
Services engineer: Umow Lai
Structural engineer: Taylor Thompson Whitting Engineers
Project manager: Savills

Quantity surveyor/cost manager: WT Partnership
Building contractor: Joss Construction
Form of procurement: Lump sum contract
Cost: AU$30m
Size: 6,697sqm
Construction start: 2010
Construction completion: 2012
Project in use: 2012

Queensland Children's Hospital Academic and Research Facility, South Brisbane, Queensland

Type of healthcare facility: Research facility
Client/owner/commissioning authority:
Queensland Health
Architects: Hassell
Services engineer: WSP
Structural engineer: Cardno
Project manager: Aurecon
Quantity surveyor/cost manager: Aquenta
Building contractor: Abigroup
Form of procurement: Lump sum
Cost: AU$94.0m
Size: 15,000sqm
Construction start: October 2012
Construction completion: August 2014 (forecast)
Project in use: August 2014 (forecast)

The Braggs, University of Adelaide, South Australia

Type of healthcare facility: Education and research institute
Client/owner/commissioning authority: University of Adelaide
Architects: BVN Donovan Hill
Services engineer: Bestec
Structural engineer: Wallbridge and Gilbert
Project manager: Mott MacDonald
Quantity surveyor/cost manager: Rider Levett Bucknall
Building contractor: Baulderstone
Form of procurement: Novation
Cost: AU$96m
Size: 9,600sqm
Construction start: 2011
Construction completion: 2013
Project in use: March 2013

University of Western Sydney Clinical School and Research Centre, Blacktown, NSW

Type of healthcare facility:
Medical university and research centre
Client/owner/commissioning authority:
The University of Western Sydney
Architects: McConnel Smith & Johnson Architects (MSJ)
Services engineer: Erbas & Associates
Structural engineer: Woolacotts
Project manager: Hooker Cockram Projects
Quantity surveyor/cost manager: Davis Langdon
Building contractor: Cockram Construction
Form of procurement: Lump sum
Cost: AU$20.6m
Size: 4,850sqm
Construction start: 2011
Construction completion: 2011
Project in use: 2011

Walter and Eliza Hall Institute of Medical Research, Parkville, Victoria

Type of healthcare facility: Medical research institute
Client/owner/commissioning authority:
Walter and Eliza Hall Institute of Medical Research
Architects: Sinclair Knight Merz/Denton Corker Marshall
Services engineer: Sinclair Knight Merz
Structural engineer: Arup
Project manager: Aurecon
Building contractor: Baulderstone
Quantity surveyor/cost manager:
Donald Cant Watts Corke
Form of procurement: Traditional lump sum contract
Cost: AU$150m
Size: 31,283sqm
Construction start: February 2008
Construction completion: 2010 (expansion); 2012 (extension)
Project in use: November 2012

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PROJECTS

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Gold Coast University Hospital
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Oral Health Centre
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Royal Hobart Hospital
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WOMEN AND CHILDREN'S HEALTH

Queensland Children's Hospital
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CANCER CARE

Kinghorn Cancer Centre
Photographer: John Gollings

Olivia Newton-John Cancer and Wellness Centre
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p164, left: Dianna Snape
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p165, top: Tony Miller
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MENTAL HEALTH

Youth Mental Health Building, Brain & Mind Research Institute
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FEATURE PROJECTS

TERTIARY AND ACUTE CARE

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Frankston Hospital Redevelopment Stage 2
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Wesley Hospital East Wing
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Albury Regional Cancer Centre
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Rockhampton Cancer Care Centre
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Eastern Health Mental Health Redevelopment
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COMMUNITY HEALTH

Annerley GP Super Clinic
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Nexus Health Super Clinic
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North Richmond Community Health Centre
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Stawell Health & Community Centre Redevelopment
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SCIENCE, RESEARCH AND EDUCATION

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A critical review of the design and build of healthcare infrastructure in Australia

Published by the International Academy for Design & Health

Edited by Kate Copeland with Marc Sansom, Kathleen Armstrong and Emily Brooks

Australian Healthcare Design 2000–2015 is a review of past, current and future projects and trends in healthcare design in Australia. It is a unique reference publication for researchers and practitioners working in the field of healthcare design, both within the region and internationally. Fronted by a collection of essays from prominent Australian academics and practitioners, it also contains a comprehensive catalogue of projects delivered during the most remarkable period of capital investment in health infrastructure ever seen in the region.

The publication coincides with the International Academy for Design & Health's 9th World Congress in Brisbane in July 2013. Australia's successful bid to host the event reflects the huge amount of new healthcare building that is taking place across the region, and the body of research and knowledge that has developed there as a result. This book aims to communicate to the rest of the world that the region has some of the most advanced healthcare buildings of our time.

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