

SUSTAINABLE SPACES

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REGISTER TODAY
Design & Health
6th World Congress
24-28 June 2009
Singapore
See page 41-44

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As we celebrate the first anniversary of *World Health Design*, the world is coming to terms with a global slump in trade of a scale and rapidity that we have not seen the likes of since World War II. This reminds us that while globalisation brings great opportunities, it also presents great risks.

Recognition that the world is now economically interdependent may now, however, lead to a greater political understanding that will ensure the world is better placed in the future to respond as an effective force to economic turbulence, and minimise the impact of a decline in trade on all aspects of civil life, including, and most importantly, our health and wellbeing.

Modern healthcare provision is a global matter which requires a global forum to support knowledge transfer and a continuous dialogue on issues that impact on the health and wellbeing of us all, whatever part of the world we live in.

Published by the International Academy for Design and Health, *World Health Design* is a peer-reviewed journal dedicated to increasing the strength of the arts and sciences within the interdisciplinary fields of design and health.

Today in this turbulent business climate, a rising public awareness of the importance of health and wellbeing and increased demand for well-designed, humanistic environments, set against the rising cost of healthcare, rapid advances in medical technology and ageing populations requires more than ever the engagement of an interdisciplinary network of researchers, practitioners and industry to support innovation and progress in the field of design and health.

For the past 12 years, the International Academy for Design and Health has helped to facilitate this process by organising the Design and Health World Congress, which this year will be held in Singapore from 24-28 June (see pp 41-44), and by establishing *World Health Design* to report, evaluate and help develop knowledge of research and practice in the field.

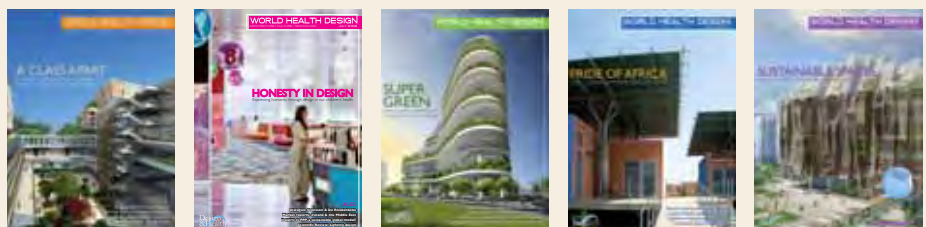
The journal contributes to the enhancement of our understanding of the key factors determining the design of modern healthcare systems, buildings and technologies worldwide, helping to spread knowledge of the successes – and failures – of different regions of the world in the development of psychosocially supportive environments.

The Design and Health World Congress and *World Health Design* are the flagships of the achievements of the International Academy for Design and Health. To continue the growth of our work and influence, however; the journal needs the support of the community it serves, so we ask you to demonstrate your commitment to the field by subscribing today and supporting further knowledge exchange.

The global competitiveness of *World Health Design* could not have been achieved without the thought leadership of our distinguished editorial advisory board and the editorial director Marc Sansom and his team of journalists. Appreciation also goes to Dr John Zeisel and Prof Romano Del Nord for their ongoing intellectual support and finally to all those that have contributed with ideas, interviews and research papers from around the world.

Finally, without your valuable input, *World Health Design* would not have been possible. We look forward to seeing you all in Singapore in June.

Prof Alan Dilani, PhD
Director general, International Academy for Design and Health



Health and wellbeing is integrally linked to global economic and knowledge development



Alan Dilani



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Contributors

Bill Rostenberg

Anshen + Allen principal, Bill Rostenberg explores the conflict and intersection between approaches to evidence-based design and sustainable design



Sunand Prasad

The RIBA president, Sunand Prasad says that building effective interdisciplinary relationships is the key to the delivery of good design in healthcare environments



Sheree Proposch

A calm, supportive and well-designed environment allows patients to feel they are in good hands and not at risk, says Bates Smart director, Sheree Proposch



Mardelle Shepley

Access to windows and window views are particularly important in intensive care units where patients are more vulnerable and staff stressed



Kate Bishop

Paediatric health design requires consideration of a range of factors seen through the eyes of children and adolescents, reveals the Australian researcher



Ken Yeang

Consultant John Cooper reviews Ken Yeang's book, *Eco Skyscrapers* and places the iconic architect within an older tradition of polemical architecture



Singapore is here

It's astonishing how the world can change in just one year. Since we launched World Health Design last April, the world appears to have been turned on its head.

Untouchable banking institutions, such as Lehman Bros have gone to the wall, while many others have been bailed out by public money as the global economy enters its worst recession since the end of World War II.

No-one can predict the future, according to the eminent eye surgeon, Prof Arthur Lim, who is concerned that the greatest health impact of the economic crisis will be on the developing world (pp 18-21). But, as he suggests, it may be a good thing if the crisis exposes the ever rising, and often inappropriate costs of healthcare provision. What role can the design of health buildings, technologies and systems play to address the problems in our health services, and which countries can we learn from? Prof Lim will be a very special speaker at the 6th Design & Health World Congress (pp 41-44), from 24-28 June in Singapore – a country that has a health system which is the envy of the developed world (pp 24-29).

He will be joined by the Singapore Minister of Health and eminent speakers from the US, Europe, the Middle East, Asia and Australasia at an event that is now unequalled as the leading global forum in the interdisciplinary field of design and health. We urge you to join and collaborate with us in Singapore in June.

Marc Sansom
Editorial director



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Eminent surgeon to open World Congress

Asia's finest eye surgeon, Prof Arthur Lim has agreed to open proceedings alongside Minister for Health, Mr Khaw Boon Wan at the 6th Design & Health World Congress in Singapore, from 24-28 June 2009

The foremost event in the world promoting interdisciplinary research and practice in the development of healthcare environments, has been given a timely boost by the news that Prof Arthur Lim, celebrated by his peers as the father of this field of medicine in Southeast Asia, will help to open proceedings by presenting his thoughts on the relationship between design and health.

A mentor and icon to eye surgeons all over the world, Prof Lim will be joined by Singapore's Minister for Health, Mr Khaw Boon Wan, who will describe to delegates how Singapore has transformed its healthcare provision into a world class system that is the envy of many countries around the world (see pp 41-44).

Design & Health 6th World Congress and Exhibition

Uniting the disciplines of architecture, design, psychology, the health sciences and economics
24-28 June, 2008 The Ritz Carlton, Singapore
www.designandhealth.com



UAE: Al Maktoum A&E unveiled

The design of the new Al Maktoum Accident and Emergency (A&E) Hospital in Jebel Ali in the United Arab Emirates has been unveiled. Chosen by the Dubai Health Authority and the Department of Health and Medical Services (DOHMS), the design by Perkins Eastman will create an advanced A&E hospital capable of providing immediate care for minor- to high-level trauma.

UK: Engineering award for ARUP

Arup has won the Engineering Consultant of the Year category at the Building Awards 2009, after beating off strong competition from Atkins, Mott MacDonald and Faber Maunsell to pick up the top prize.

Canada: CareLife takes LEED

A four-storey assisted living facility, CareLife Maple Ridge in British Columbia, Canada has received a LEED Silver certification. LEED consulting, energy engineering and mechanical engineering services for the project were provided by Stantec.

UK: HLM is top place to work

HLM Architects is the top place to work in architecture and construction having climbed 25 places since last year to secure 37th place in the *Sunday Times* Top 100 Best Small Companies to Work for 2009.

US: Hospital expands in San Diego

Sharp Memorial Hospital, the flagship facility of San Diego County's healthcare system, has completed a multi-tiered expansion to become the premier referral care centre in the region. The new 315,000 sq ft, 334-bed structure, named the Stephen Birch Healthcare Center, is the first new hospital in San Diego to open since 1993.

UAE: RTKL opens in Dubai

RTKL, the international architecture, planning and design firm, has been granted a trade licence in Dubai, United Arab Emirates, enabling the firm to open a local office and serve its growing portfolio of clients throughout the Middle East.

UK: Children's hospital win

Nightingale Associates and Tribal Healthcare, working with Principal Supply Chain Partner, BAM Construction has won its second Framework Scotland contract to design the £150m Edinburgh Royal Hospital for Sick Children, for NHS Lothian.

US: AIA recognise Dallam's work

NBBJ partner Rich Dallam has been elevated this year to the prestigious AIA College of Fellows, in tribute to his work in advancing healthcare design and pioneering innovation.

UK: Newson to write arts guidance

Ixia, the UK's national public art think tank, has appointed Willis Newson to write guidance on commissioning art for new health initiatives. The Public Art in Healthcare Guidance aims to identify, test and disseminate good practice in future public art in health programmes.

US: Remote connections in Alaska

Providence Alaska Medical Center has implemented a new programme to enhance care of the critically ill in remote communities of Alaska. The eICU Program, patented by Philips VISICU, combines early-warning alerts and remote-monitoring technology to connect off-site critical care specialists to ICU patients and their care teams within the medical centre.

US: Patient tower opens in Arizona

A new US\$86 million patient tower has opened at Banner Del E Webb Medical Center in Sun City West, Arizona. Designed by the Los Angeles office of RTKL, the 180,000-sq ft, six-storey patient tower positions the hospital to better serve the surrounding community's growing population.

UK: Awards programme opens

The Building Better Healthcare Awards programme has opened for entries in the UK. Visit www.bbhealthcare.co.uk

WHD celebrates as community pays tribute

One year after its launch, *World Health Design* is already established as the leading international resource for researchers and practitioners working in the field of design and health. Here are just some of the tributes the journal has received since its launch



There are few journals of such quality in the health market and *World Health Design* is in a different league. I particularly enjoy the international aspect

and being able to see global solutions to general or local problems. It's also unusual and refreshing to see a scientific review in a design journal.

Pat Young, design specialist, National Patient Safety Agency, UK



World Health Design is an important tool for those interested in healthcare design and research. It is one of the only sources that aims to bridge

the gap between research and practice. I look forward to seeing the next issue and contributing in any way I can to future development of the journal.

Diana Anderson, WHR Architects, US



World Health Design has been warmly received by all my colleagues. Keeping health planners and architects happy with the same publication – you must be doing a lot right!

Craig Dixon, Tribal Consulting, UK



Your new publication is absolutely fabulous! The articles are all of high substance, the projects are interesting and well-designed, the art direction and layout is superb and there are lots of colour

photos. It walks the line between the *HERD* journal and *Healthcare Design* magazine which is a really interesting concept. I am going to subscribe today.

Jain Malkin, Jain Malkin Co, US

A really impressive publication – well done!

Adrian Marriott, Tribal Consulting, UK

I congratulate the *World Health Design* team on an excellent, well presented and thought provoking publication... well done.

Kieran Morgan, health development director, Nightingale Associates, UK

World Health Design is a very nice journal and fits perfectly the purpose.

Frank Chantelot, director, TLV, France

World Health Design is really impressive. I like the mix of practice, research and news.

Susan Rodiek, Centre for Health Systems & Design, Texas A&M University, US



WHD is the missing platform for all who share the same vision for healthcare design. I am delighted to contribute to this endeavour.

Dr Ruzica Bozovic Stamenovic, School of Design and Environment, National University of Singapore, Singapore

World Health Design goes online



The only international journal dedicated to connecting researchers and practitioners who share a common goal to improve global human health, wellbeing and quality of life through better design is now available online at www.worldhealthdesign.com.

Published by the International Academy for Design and Health, *World Health Design* is a feast of global news, discussion and analysis, arts and culture reviews, architectural project reviews, regional market, business and technology reports and the latest scientific research, offering a unique and unrivalled reader experience.

By uniting the disciplines of architecture, design, psychology, the health

sciences and economics, *World Health Design* is breaking new ground, and helping to spread knowledge and understanding in the creation of health through environmental design.

Launched just over a year ago in print format, all of the journal's content is now accessible online. Presently, the content will be freely accessible to all visitors to the site, after which access to some areas will only be available to subscribers.

Director of the International Academy for Design and Health, Marc Sansom said: "In just one year, *World Health Design* has already established itself as the leading healthcare design journal in the world. We invite all our readers to participate in the design & health community, by visiting our new web site and contributing to the development of its content."

Student awards open for entries

Architects for Health is inviting architectural students from all over the world to submit projects for consideration at the third annual Student Healthcare Design Award in 2009.

Any architectural project concerning healthcare design or a response to a sample brief provided by AfH is eligible for entry by students who are presently studying or have completed their studies within 18 months of submission date.

To enter the awards, which are sponsored by global asset manager Brookfield, students must submit a 300-600 word document, describing the design brief, along with four A3 landscape PDF or JPG graphics by 3 July 2009.

For full submission details, visit: www.afhawards.org



Sustainable spaces

The patient-centric focus of the new National Heart Centre (NHC) in Singapore is reflected in the ethos of its design, developed in a collaboration between Ong & Ong and Broadway Malyan.

Drawn from a philosophy of “Placing People First”, the design concept encompasses the needs of the patient, the visitor and the staff.

The NHC’s most distinctive feature is its two fronts. The institutional front, which includes the main approach and houses the medical facilities, is quiet and formal. The garden front, at the other end, faces the garden deck in the Outram Campus Masterplan, and serves as the healing park and waiting area. The first and second storey will allow direct passage by the public from the institutional front to the garden deck, to promote integrated access to other facilities within the campus.

The new building also adopts various green building features, technologies and innovations to achieve better performance in energy efficiency, water usage, use of recycled and reusable materials, indoor environmental quality and environmental management. Examples include the passive solar strategy, which reduces heat emission and direct glare and sunlight into the building; and the use of environmental friendly building elements which are energy efficient in fabrication, self-cleansing and long-lasting.



Intuitive wayfinding is a core feature of the design, with most facilities visible from the main reception, bringing ease and convenience to the patients and visitors. The rectilinear building form provides great flexibility in space planning, reconfiguration of usage and ease of extension upwards and sideways.

The NHC has also set its sights on being a digital heart hospital, with the new building harnessing the latest information technology to improve the processes and outcomes of care. To enable its doctors to share knowledge across borders, the centre will adopt telemedicine with digital imaging capabilities to enhance productivity, patient safety and improve its empathy with the environment.

Set to complete at the end of 2012, the 35,000m², 12-level building is set to become operational in early 2013. Associate Professor Koh Tian Hai, medical director, National Heart Centre Singapore said: "In designing the new NHC building, we considered every facet of the heart patient's care and hospital experience, to deliver the best care possible while balancing cost and functional effectiveness."

To learn more about the design philosophy, visit: www.worldhealthdesign.com

Design & Health

International Academy for Design and Health



Creating global health and wellbeing through environmental design

Design & Health

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Or for a delegate booking form, contact Prof Alan Dilani: academy@designandhealth.com

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The emergence of patient-focused medicine in the 1980s, followed soon after by patient-focused design of health facilities, were part of a change in the way the relationship between consumers and producers was viewed in our working culture. We realised then what now seems so obvious – though is still neglected – that focusing on the needs of the ‘customer’ greatly increases the value that services and products release. The therapeutic value of good design has come to be widely acknowledged, both directly by creating a healing and stress-reducing ambience, and indirectly by benefiting the operational aspects – greater clinical efficiency and improved staff morale. I would argue that a well-designed environment will even improve the quality of thinking and innovation.

What remains elusive is how to consistently deliver good design and how to systemically identify and clear the obstacles to that delivery. Although knowledge and skill are important, I believe that there are two greater challenges. Firstly, consistent good design requires leadership and passion, especially at

the top of an organisation. However, not enough people in these positions are yet convinced of the argument.

The second challenge is that without excellence in collaborative processes and interdisciplinary working, you cannot achieve good design. The disciplines of architecture, engineering, landscape and project management remain inadequately integrated and silo attitudes prevail, developed from early days in the education of professionals. And the interface between these and the medical clinical professions is also insecure.

Leadership – there is no substitute for bloody-minded determination. Those of us

Designs on shared ground

Sunand Prasad says that building interdisciplinary relationships is key to the delivery of good design

that believe in, and are committed to, good design have simply to go on convincing non-believers. We need to recruit more consumers to the cause since market pressure is the most effective way of influencing the behaviour and objectives of those in public organisations who are not yet on board. Now more than ever the value argument has purchase. Bad design or the provision of second-rate environments should be as intolerable and unacceptable to the consumers of public services as patient neglect or indeed inflated banker bonuses.

Collaboration – from the identification of business needs to the maintenance and periodic modification of a facility, we need to join up the thinking as well as the project process. A key is for interdisciplinary teams to be assembled in a way that is appropriate to each stage of the process. Architects have an opportunity to step up to the plate and provide leadership. But they must understand that their knowledge has no traction without the knowledge of others – facilitating a synthesis of objectives and intellectual effort should be an integral part of being an architect.

A building project is only one of the possible solutions to an organisational or business need. True interdisciplinary working must start at the very beginning, at the stage when such a need is being identified. Too often what happens is that decisions about service configuration and the location of its delivery are prematurely fixed in a way that compromises the whole result – practices ‘frozen’ into built form. There may be raw logic in saying that first you work out the ‘why’ and the ‘what’ of an organisation, and only then the ‘how’, but in reality they interact. This alone is a strong argument for interdisciplinary working, involving researchers, clinicians, academics and managers as well as architects and engineers.

Good client-side skills are indispensable to achieving excellence in interdisciplinary working but they are lacking in many public sector organisations round the world – and certainly in the UK where they have been allowed to degrade from the quite high levels reached in the 60s and 70s. Additionally, pressure on fees means less time to think and interact. It is a false economy – one which inhibits the achievement of value through innovation.

Now the climate change emergency has brought the imperative of interdisciplinarity into sharp relief. To create sustainable environments that support low or zero carbon lifestyles and business operations requires us to fully form any constructional solution in a much more intense and concentrated way than we have been used to. Never before has it been so urgent to assemble interdisciplinary teams at the start to achieve an encompassing view of the project – because true knowledge lies in the shared ground between the disciplines and not within any one.

We need to join up the thinking as well as the project process

Sunand Prasad is co-founder and senior partner of Penoyre & Prasad and president of the Royal Institute of British Architects (RIBA)

Arguably Asia's most celebrated and finest eye surgeon, Prof Lim is acknowledged by his peers as the father of this specialist field of medicine in Southeast Asia, and a mentor and icon to eye surgeons all over the world. Yet, recognition alone of the Singaporean as one of the pioneers of modern ophthalmology would be to also undervalue his contribution – as a prolific author, teacher, artist, sportsman and some might say politician – to the enhancement of a more holistic understanding of humanity.

Prof Lim founded the Singapore Eye Research Institute and the Singapore Eye Foundation, but is perhaps most celebrated in his country of residence for his role as founding medical director of the Singapore National Eye Centre, which through the training of many future generations of leading ophthalmic eye surgeons remains a monument to his vision and relentless pursuit of excellence. Equally recognised on the world stage, Prof Lim has held numerous international appointments in major world ophthalmic organisations, and famously founded the International Intraocular Implant Training Centre Tianjin in China, which subsequently

became the Tianjin Medical University Eye Centre, and for which he was given the Friendship Award by the Chinese government – the highest award that can be bestowed on a foreign national. Established as a model for eye centres throughout China, the centre has trained more than 2,500 ophthalmologists and restored vision to more than 250,000 blind cataract victims.

Crusades

Prof Lim has also been published widely on socio-medical issues in principally the areas of mass blindness prevention, medical ethics and healthcare reforms, demonstrating through his writing a unique ability to see beyond his own reflection and develop crusades that would often challenge the authorities. As Professor Lynette Lim explains in her anthology of his works: "As a proponent of open and transparent discussion,

Arthur has always been one to face key issues squarely, even if official displeasure might arise."

One such issue that concerns Prof Lim today is that the global financial crisis will have a great impact on the development of global medicine and healthcare provision. "The US spends enormous sums of money on health, yet one quarter of its population are not covered by insurance.

"When they introduced the National Health Service in the UK, they wanted it to be the best in the world, but it has collapsed under the pressure of demand. The queues get longer and longer."

Identifying cost as the major factor, he explains: "The price that doctors and specialists charge in the US is unbelievable, and it will continue to go up unless something is done to stop it. Many countries look towards the US as their benchmark, but we should question whether their system of financing health provision is the right system? Maybe the crisis is a good thing if it exposes this issue." Suggesting that there are systems around the world that might provide a better model, he says: "The systems in Australia and New Zealand offer a different approach, whilst Singapore also has a healthcare model that is used in other countries and has performed quite well."

Cost control

The Singapore system uses a combination of compulsory savings from payroll deductions through the Central Provident Fund, a nationalised health insurance plan, government subsidies, and price controls to keep costs in check. "Patients have a say" says Prof Lim. "You have your own budget, but if you don't spend the money, then it is yours. So, if the treatment costs S\$1,000, but another provider can do it equally well for \$500, then you have the opportunity to save 50%."

Controlling costs is a central theme to solving the problems facing healthcare systems around the world, according to Prof Lim. "Much depends on the political thinking of the government. If you

Panoramic perspectives

The world would not only be a less progressive place if it were not for men like Professor Arthur Lim, it would also be a far less interesting one. *Marc Sansom* interviews the famous Asian eye surgeon who sees no mirrors, only windows





believe in a private system of healthcare provision, the advantage is that the control passes to the individual and the burden of government bureaucracy is reduced. The key difference is that for the private doctor, he has to attract the patients in order to operate and earn his money.

"For the public doctor, he will earn the same money even if he does fewer operations, so where is the incentive? To address this in Singapore and in some other countries, the doctors receive a cut of the surgical fee."

On a socio-political level, Prof Lim also recognises how cost control is a new issue for modern society, which in the 19 and 20th centuries only had to concern itself with catering for small numbers of people in the upper echelons of society, rather than providing universal healthcare coverage. "In Indonesia, there are 170 million voters requiring healthcare services, so cost becomes very important."

Despite being a leading advocate of modern healthcare technology throughout his medical career, Prof Lim also raises concerns about the inappropriate cost of technology. "Some commercial firms do not always display honesty in their methods. For many years, I was using a very good instrument at a very good price, between S\$8000-S\$10,000.

"But one day they presented a new machine costing four times the price at S\$40,000, yet the changes were made principally in the packaging and the marketing and only a small technical modification that would not have cost more than S\$2,000."

On a more systemic level though, the key to keeping costs down and at the same time being more sustainable, says Prof Lim, is flexibility. A long sworn advocate of community hospitals and nursing homes, he argues that the current trend towards large, expensive general hospitals is creating the potential for medical dinosaurs. Referencing the famous American writer and futurist, Alvin Toffler's thoughts on the development of the knowledge society, he says: "Toffler wrote about three waves of society. The first wave followed the agrarian revolution, where farming stimulated mass food production. This was followed by

the industrial revolution, within which to be competitive, you needed economies of scale, which led to factories, schools, hospitals all being developed on a huge scale.

"But now we live in the post-industrial era where knowledge is important and change is very fast. In the knowledge society, the talents do not wish to group in large organisations where everybody is the same."

Toffler envisages the third wave society as being affectional, emotional and diverse, not just cognitive, characterised by subcultures and smaller, more fluid organizations able to quickly adapt to change. It is a vision that Prof Lim suggests should be applied to healthcare.

"In a meeting with the Ministry of Health discussing proposals for new large, general hospitals costing up to £3 billion, I quoted Toffler, and raised the prospect that in 20 years time when these hospital projects were completed, we may not need them anymore. Just as has happened in Europe, the UK and the US, the super-hospital which caters for many people will not survive. It will be obsolete."

In Europe, the UK and the US, the super-hospital which caters for many people will not survive. It will be obsolete

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The community principle is very important, Prof Lim explains, not just for improving the effectiveness of care but for reducing costs too, particularly in the developing world where the impact of the economic situation could hit hardest. "Many countries in the west are very critical of China and the 'barefoot doctor'. But many countries will suffer great poverty from the financial crisis, and how will we cater for their poor?"

China's struggles after the war under Chairman Mao to provide healthcare coverage for its vast rural population led to the much debated development of the barefoot doctor, who typically was a healthcare worker with minimal training who had access to the most remote populations.

"The principle of the 'barefoot doctor' was to elect someone from within the village who could be trained in medical care" Prof Lim explains. Reflecting on the patriarchal approach of modern medicine, he adds: "The failure we often make is telling people what to do, but if the village chooses a medical representative from within their community whom they respect, then it will work."

Innovation and novel approaches, such as the 'barefoot doctors', arise from challenges to our everyday perspective. Prof Lim jokes that this is particularly important for eye surgeons. "Architects are lucky as they are exposed to many things in their work. But, an eye doctor? All he does is look into eyes and nothing else! The trouble with doctors is their choice of profession!

"For some strange reason, in all countries, all the top brains choose medicine. But in the practice of medicine, you memorise a lot of things, so that once you become an eye surgeon, you do not need a brain anymore. I make a point of spending at least one or two hours a day doing something that has nothing to do with the eye." –

As his anthropologist, Prof Lynette Lim proclaims that Prof Lim is acclaimed almost as much for his art and his art collection as he is for his ophthalmic talents. And with many published works and stories to tell, he is a reminder that there is no substitute for knowledge, wisdom and experience in an unpredictable world.

Marc Sansom is editorial director of the International Academy for Design & Health

The principle of the 'barefoot doctor' was to elect someone from within the village who could be trained in medical care



Prof Arthur Lim Siew Ming

Research Areas

Prevention of Blindness; Cataract; Glaucoma

Teaching Areas

Live surgery demonstration and national & international courses

Academic / professional qualifications

1956 MBBS, National University of Singapore
1962 FCRS Moorfields Eye Hospital, London
1999 MD (Hon) National University of Singapore

National institutional appointments

Clinical Professor, Dept of Ophthalmology, National University of Singapore
Founding Medical Director, Singapore National Eye Centre
Founding Chairman, Singapore Eye Research Institute

International institutional appointments

Visiting Professor and Honorary Director, Tianjin Medical University Eye Centre, People's Republic of China
Honorary Director, Xiamen Eye Centre, People's Republic of China
Honorary Professor, The Chinese University of Hong Kong, People's Republic of China

Prof Lim has also received numerous national and international awards and honours, surgical fellowships, held numerous senior administrative positions within national and international institutions, and been published in major publications and peer-reviewed journals.

Lost in time



In July 1960, Sir Rupert Vaughan Hudson wrote in *The Lancet*: “The truth is that the open ward is an anachronism. It is socially unacceptable and medically unsound. In 1960 the public, the doctor and the nurse should no longer be expected to put up with this scandalous impromptu.”

Hudson was calling for single rooms to combat cross-infection but he was also writing from a humanitarian point of view. Adverse incidents are estimated to cost the NHS £2 billion a year with a further £1 billion attributed to healthcare-acquired infection. Designing for patient safety is one important approach to reducing patient risk.

Latent conditions typically arise from decisions made by management, architects and equipment designers. Adverse events result from errors made by those who provide direct care to patients.

Results from a recent survey commissioned by the UK's National Patient Safety Agency, show that 86% of architects have experienced circumstances that prevented the inclusion of design features which could reduce risks to patients. Sixty percent of architects reported a lack of feedback regarding design features which have created risks for patients.

This may be due to post-performance evaluations not being centrally collated as a learning resource.

Of those surveyed, 72.7% agreed that international guidance should be collated to form an international standard for designing for patient safety and 96.9% agreed that improved design briefs could contribute to minimising risks to patients. In the last 10 years, investment in healthcare buildings in the UK has totalled £3.2 billion and yet the debate continues around the fundamental question of single versus multi-bed wards and the impact on patient safety.

If Hudson was calling for single rooms 50 years ago and the health estate is still struggling to include single rooms now, we need to act urgently to build a global knowledge bank where the lessons learnt can facilitate more effective change at a quicker pace to minimise the risk of error and reduce the cost of adverse events.

Pat Young, design specialist, National Patient Safety Agency, UK

Patient safety is not a new issue. So why are we yet to learn the lessons given to us by Florence Nightingale and Sir Rupert Vaughan Hudson 150 and 50 years ago respectively? And how important is the role of design in minimising the risk to patients in healthcare environments?



In 1859, Florence Nightingale famously wrote: “The very first requirement in a hospital is that it should do the sick no harm.” These words still hold true today.

In recent years, the issue of patient safety has been dominated in the UK by its poor record on hospital-acquired infections, giving the issue a prominence here, but not necessarily found everywhere. Our office in South Africa reports that while it is a contributing factor in the move towards single rooms, especially in the private sector, other issues are perhaps more important drivers.

However, there are other areas where the design can positively influence the welfare of the patient by minimising potential risks. Falls are another frequent cause of harm for hospital patients. The relationship between a bed and the nearest toilet/bathroom can be arranged so that a patient never leaves the sanctuary of a wall. This is hugely advantageous for patients with visual and/or mobility impairment.

Indeed, patients on any journey within the hospital are at risk from falls, clinical emergencies and mistakes made during transfer. Judicious planning, creating appropriate clinical adjacencies, can minimise these journeys and the associated risk.

A design that facilitates good observation and quick and ready access to a pool of clinical staff can also enhance the safety of a patient. For example, a barn theatre installation such as the one at Nightingale Associates' Broadgreen Hospital means that during an operation, the clinical team can call on both the expertise and help of others if required.

Chris Sherwood, international development director, Nightingale Associates, UK and South Africa

Architects seem to believe that virtually all problems can be solved by architectural design



Australia's public healthcare facilities are undergoing a transformational change. Up to eight 100,000+sqm greenfield-site hospitals are currently in design or under construction. This wave of rebuilding creates an unprecedented opportunity to improve health outcomes through an inspired, innovative and informed approach to design.

Current design practice gives patient safety an important role; a great deal of effort has been given to practical and generic patient safety design features – strategies to minimise and eradicate cross-infection, to prevent falls and to reduce or eradicate medical errors (location of hand basins, provision of single rooms, location of ensuites in relation to beds, lighting levels, standardisation, automation, protocols).

A skilled architect can add great value by developing an insight into the atypical issues associated with the project and defining the big-picture impact of a well-designed building. In order to reveal atypical patient safety issues, there is the need for healthy dialogue between building users, architects and equipment manufacturers, and an awareness of exemplar facilities, prototypes and current research. This dialogue should focus on workflow analysis and the patient journey.

Some recent examples are: if the patient profile has a large or growing bariatric population, consider providing for hoist journeys from bed or trolley areas to bathroom facilities, including theatres and day medical, or from bathroom facilities to a hydrotherapy pool; in a paediatric or oncology environment, while maintaining observation from the triage desk, provide several waiting room spaces in an emergency department to allow cohorting of patients, such as infectious patients, immuno-compromised patients and, noise-sensitive patients.

We know that access to daylight and views of nature significantly contributes to a sense of wellbeing, calming patient anxiety and minimising stress. Such strategies can improve health outcomes, and also contribute to patient safety. A calm, supportive and well-designed environment allows patients to feel that they are in good hands and not at risk. This allows everyone to focus on safe and supportive patient care.

Sheree Proposch, director, Bates Smart, Australia



I googled 'patient safety' today – 33.9m items (oh, dear!). I refined my search to 'design for patient safety' – 7.5m items (humph!). I again refined my search, this time to 'facility design for patient safety' – 2.7m items (now we're getting to something more reasonable!). Lastly, I searched through Google Scholar – 87,200 items. Finally, I had an achievable body of material to read. Well, maybe. It

is clear that this is a topic receiving a great deal of attention from many directions. To be anything but a complete adherent could be perceived as heresy.

If I had done this exercise 10 years ago, not nearly so many reports, papers or journal articles would have appeared. Twenty years ago and I'm sure the number would have been comparatively minuscule. Does this mean that architects, 20 years ago, were ignorantly designing health facilities that were harming patients and staff? Some were harmed, no doubt, but we, like physicians, continually learn and refine what we do as we practice our profession and train young professionals.

It is inconceivable for a conscientious person to ignore the Institute of Medicine (IOM) publication, *To Err is Human* (1999, 2000). This, and other studies of the time, were a wakeup call to all in healthcare. It helped to create a new openness when errors were made and a sharing of information among professionals, whether architects or caregivers.

I find it interesting, however, that architects seem to believe that virtually all problems can be solved by architectural design. Patient safety is a huge issue and physical, architectural design certainly plays a role providing places where fewer errors are made. Some refer to this as simply good design (better work places, lighting, sinks in the right places, connection to nature and on). But I am continually surprised at how few of the topics described in effecting substantial improvements in patient safety are truly architectural in nature. Of 646 ICU safety incidents and contributing factors reviewed by the US Agency for Healthcare Research and Quality in June 2008, not one factor was directly architectural. I am pleased that of the 10 ICU Improvements suggested by the Society of Critical Care Medicine, number six is: "Improve the physical environment".

Charles D Cadenhead, senior principal, WHR Architects, US



Contrast and change

Clinical excellence for moderate cost? Or poverty and low health outcomes? Southeast Asia's healthcare may be sharply divided, but *Emily Brooks* finds much to celebrate

Southeast Asia is not easily pigeonholed when it comes to its healthcare. A proportion of its 570 million inhabitants enjoy gold-standard facilities and some of the best health outcomes to be found anywhere; on the flip side of the coin, poverty and its associated disease burden present serious challenges to development in many other areas. In between these extremes sit a number of countries with some of the fastest-growing economies in the world, their governments seeking to deliver quality healthcare for all and improve infrastructure to do so.

With the strengthening of primary care in recent decades, generally speaking the health of southeast Asia has improved considerably, and market analyst Frost & Sullivan identified 2008 as a crucial tipping point for the region, with "a migration from 'sick care' mentality

Above: Vietnam's Hoan My Dalat Hospital, designed by HTT Architecture

to 'health care' philosophy". However, with the economic downturn, how quickly this promise will now be fulfilled is presently unknown: global recession could have a devastating knock-on effect for nutrition, sexual health and immunisation programmes as well as affecting the growth of infrastructure.

Singapore is feted as the world's 'miracle' healthcare system, delivering outstanding results for minimum government spend (4% of GDP; life expectancy at birth is 81²).

Its success is attributed to its tiered system of funding, consisting of a compulsory savings account deducted from



salary, a voluntary insurance scheme (which, crucially, is opt-out, rather than opt-in, from birth) and a 'safety net' government endowment fund to cover treatment for those unable to afford it. A dynamic private sector runs parallel to this, so providers compete side-by-side, encouraging standards to be raised.

The basic tenet of affordable healthcare for all is a legacy of British colonisation, and Malaysia's parallel political history and rapidly rising economy has resulted in a similarly efficient service, with an 80%/20% split between public and private care.

Thailand, too, has overwhelming state involvement in healthcare. Still-developing countries such as Indonesia, Cambodia, Laos and the Philippines, while more stable than ever before, still struggle against a background of poverty, with correspondingly lower health outcomes. National health insurance schemes have seen various levels of success: the Philippines' PhilHealth scheme, which deducts 2.5% of monthly salary of employers in the public and private health sector, "has little relevance for [the] majority of the population, who remain outside its coverage for various reasons, most notably because of the existence of a large informal sector"¹³. Meanwhile, Thailand's three healthcare funds cover almost its entire population.

Across the region there is general a move towards decentralisation (to improve access, equity and efficiency) and privatisation (to ease state financial burdens for healthcare). Cambodia, for example, unveiled its first 'international standard' private hospital, Royal Rattanak Hospital in Phnom Penh, last March, funded by US\$8.5m from Bangkok Dusit Medical Services, which owns and runs 19 hospitals in Thailand and abroad. The six-storey hospital is intended to cater to domestic patients, who have previously migrated to neighbouring countries for high-quality treatment, and foreigners.

As a policy, public-private partnership (PPP) is still in its infancy. Singapore leads the way for PPP in the region, but although it has completed projects for education and a large-scale sports stadium, so far there have been no health initiatives. "This is not to say there will be none in the future," says Amy Lee, chief executive of the leading PPP legal advisors in Singapore, Lovells Lee & Lee. "After all,

There is a burgeoning trend to incorporate retail parks and step-down facilities alongside hospitals



Opportunities for retreat and restoration are provided by purpose built spaces at Singapore's new Khoo Teck Puat Hospital, with views of nature, natural light and courtyard garden settings

that gateway between India and the Far East," says its director Jason Pomeroy. "There is also an increasing trend for Middle Eastern investment to come here, because Malaysia and Indonesia are Islamic countries, as well as a burgeoning hospitality economy with the rise of integrated resorts."

"It is an energetic market," says Bruce Johnson, principal-in-charge at HKS in Dallas, which in January announced its plans for a new a 500-bed national cancer centre in Taipei, Taiwan. The 1.3m square foot centre will be emphatically patient-focused, with a design that supports this – the curved shape of the main inpatient areas maximises staff efficiency by reducing travel distances for patients and staff; a 'medical mall' area separates the inpatient and outpatient areas, so patients can wait in a less clinical environment, with the aim of reducing anxiety. Waiting areas are large and plentiful, since in southeast Asia patients are often accompanied by several family members.

A large circular drum in the atrium will enable light to penetrate down into four basement levels, where many of the radiation therapy rooms will be. "We've brought in a lot of natural light for this project, especially in the major waiting areas – you can see daylight in most places within the building," says HKS's senior designer Alex Ling. Extensive rooftop gardens offer solace both to patients and the large numbers of live-in staff, as well as having an insulating function: like many southeast Asian countries, natural resources are scarce and therefore sustainability is high on the agenda.

The sheer scale of the Taiwan project is indicative of the size of some of the building opportunities in southeast Asia. There is a burgeoning trend to incorporate retail parks and step-down facilities alongside hospitals, creating vast complexes. Singapore's Farrer Park MediPlex, opening in 2011, is just such an example. Designed by DP Architects for Singapore HealthPartners, it will incorporate a mall on its ground floor; above which a 220-bed private hospital and a 260-room hotel form high-rise west and east wings respectively. The hotel will service family members as well as patients who need some continuity of care without constant supervision. The 'medical hotel' is the first of its kind in the region and 40-60% of its patients are expected to be foreigners. It will also hold the highest 'green' building rating in Singapore, the Platinum BCA Green Mark.

The future is green

Sustainability has also been placed at the centre of the design for the new National Heart Centre Singapore, due to be completed by the end of 2012 (see also *Placemaker* pp12-13). As Jason Pomeroy, director of architects Broadway Malyan in Singapore, explains: "What we're really trying to advocate are passive, low-energy, back-to-basics ideas – for



Above and below: Malaysia's Prince Court Hospital markets itself as a five-star establishment



example, looking at orientation, cross-ventilation and minimising water consumption."The hospital responds to its tight urban site with a series of stepped 'sky gardens' to provide natural light and ventilation as well as space for recreation, social interaction and working wirelessly. The orientation of the building has been given particularly thoughtful consideration. "The two shorter faces of the façade are presented to the east and west, in order to minimise heat build-up from the low-angled sun and to minimise cooling costs," explains Pomeroy. "Then, on the two of the façades that have greater exposure to low-angled sun, there is an applied screen that helps mitigate that heat build-up and reduce the element of glare."The materials used will be considered for their life cycle and recyclability as well as the distance they will travel to the site.

Leading Singaporean private healthcare provider ParkwayHealth's new project in Novena, opening in 2011, will also have Platinum Green Mark status, using a similar 'intelligent planning' approach that encompasses building orientation, exterior shading devices, rooftop gardens and a host of other strategies. Furthermore, its design is informed by several areas of research – for example, the use of same-handed patient rooms resulting in less noise and better sleep for patients. The hospital incorporates extensive outdoor spaces as well as interior 'light courts' in nursing areas and lots of daylight provided by windows and views – a response to research that has proven that staff exposure to light, views and access to nature reduce stress and improve job satisfaction, retention rates and, ultimately, better care for patients.

Novena Hospital will also have the state-of-the-art technology that Singaporean hospitals have become known for – and this, combined with a 'five-star' hospitality-type



Top: Roof gardens and central atrium bring light and greenery into Taiwan's new cancer centre

Bottom: The atrium in Taiwan's new 500-bed cancer centre will allow light to penetrate down four levels



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environment, is a big draw for foreign patients. Medical tourism is growing significantly and while it was previously more confined to southeast Asia (patients coming from Indonesia to Singapore for treatment, for example), many countries operate an aggressive policy to attract people from further afield. Singapore with its reputation for excellence and its many JCI-accredited facilities, leads the way, with an estimated 400,000 international patients a year. Sharoja Mohanasundaram, chief executive officer of Healthbase, a US-based agency that connects patients with international hospitals for treatment, explains a further reason for its appeal: "Healthcare in Singapore is very strictly regulated by the Government and hospitals have to publish quality data about their success rates, so it's easy for patients to see that. In other countries, they do have the data but it's not so easy to get it." She also identifies certain markets for certain treatments – Singapore for high-end procedures, especially cardiac care but Thailand for cosmetic surgery, for example.

New hospitals in particular are increasingly dependent on foreign patients for long-term financial stability, says Mohanasundaram: "In Thailand they're spending lots of money on infrastructure, so they're really relying on it for payback."

International outreach

Malaysia's Prince Court is a new private hospital that is marketing itself internationally and has already seen 30% of its patients come from overseas since opening in 2008. JCI-accredited last December, its facilities reflect its ambitions as a five-star establishment – a ratio of 300 beds to 800 nurses, 100% single rooms and suites, and luxurious services such as 24-hour a la carte dining and in-room check-in and check-out. Vietnam's Hoan My Dalat Hospital, designed by HTT Architecture, is set up as a hospital and spa in one: the main hospital is a low-slung semicircular building, with separate buildings for a health and beauty spa. The buildings nod to the French-colonial style of the region, with steeply pitched roofs to cope with the heavy rain; the peace and quiet of the mountainous setting is enhanced by giving access to only pedestrians or electric cars.

Healthcare is also becoming increasingly patient-focused, and design reflects this. Singapore's Khoo Teck Puat hospital, profiled in April 2008's *World Health Design* and due to open in March 2010, has used a radical holistic approach – for example, the diabetes clinic will include endocrinologists, dietitians, oncologists and podiatrists working in close physical proximity so that patients do not have to travel long distances between departments. A large auditorium with regular lectures and events will encourage the further cross-fertilisation of ideas between departments.

**Many countries
operate an
aggressive
policy to attract
people from
further afield**



ParkwayHealth's Novena Hospital will have Platinum Green Mark status

The next stage of the site's development is to build an adjacent 220-bed community hospital that will provide care for an ageing population by embracing the American concept of 'slow medicine'. "The acute care hospital will always be very fast-paced; it will be very strict about handwashing and hygiene, and have controlled visiting hours," says Tek Lit Liak. "But next door is more like a spa – quiet and Zen-like, where you encourage patients and family members to be together, so you design facilities for family members to hang around together." This increased segmentation and personalisation of care means more satisfied patients and better health outcomes.

Emily Brooks is an architectural writer

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Clean sweep

During the severe acute respiratory syndrome (SARS) outbreak a few years ago, it became clear that, because of their many public entrances, it can be difficult and often costly for hospitals to control the entry, and thus the infiltration, of infectious diseases^{1,2}. Few hospitals have adequate supplies of isolation and negative pressure rooms in the wards, emergency departments (EDs) and intensive care units (ICUs).

But since SARS hit Singapore in 2003, infectious diseases and potential infectious patients are now being managed with high vigilance in an upgraded infrastructure at Singapore General Hospital. Input from clinicians and nurses was obtained during the re-engineering of the departments – and, from the inception, infectious disease specialists also played an important role, educating engineers, architects and contractors about potential infection control risks.

At points of entry into the hospital and in the emergency department, patients are screened using a rapid questionnaire on their travel exposure, fever history and symptoms. Body temperature is measured and documented. Anyone with fever, or a positive

Fatimah Lateef describes the changes Singapore General Hospital has made to its infrastructure to reduce infection risk following the 2003 SARS outbreak

response to any question, is channelled to the febrile area of the ED. This febrile screening step is done outside the ED in a specially planned area before formal ED triage is done. The rationale is to identify the high-risk patients as early as possible. Other points of entry into the hospital are also regulated, especially during high-risk periods.

These fever areas are relatively new, constructed following the SARS outbreak when many healthcare systems were overwhelmed because adequate system design, public health functions, equipment and supplies, and collaborative arrangements were either not in place or not in alignment.

Circulating in the air

As air currents can transport infection – the SARS virus is transmitted primarily by bio-aerosol droplets or through direct, very close personal contact – fever and high-risk patients are now being managed separately from others. The febrile areas in the ED have undergone structural re-engineering and the ventilation system has been upgraded. Building ventilation, whether natural or mechanical, serves to dilute droplets nuclei in the air and is the single most

important engineering control in preventing the transmission of airborne infections³⁻⁵.

Rooms with negative-pressure ventilation are now available in the new fever areas. Infected air from patients in this area is prevented from staying in the area and circulating in the corridor by an exhaust system that filters it to the outside environment. The positive pressure gradient between the isolation cubicles/rooms and the rest of the area is approximately 15 Pa.

Ideally, a negative pressure room should also have windows which do not open, and having anterooms will help reduce the escape of droplet nuclei during the opening and closing of doors. The downside is that patients and staff in negative pressure rooms are at increased risk in the event of a fire. This is because fire and smoke can be drawn into these rooms from the adjacent corridors or wards by reason of the differential pressures.

Febrile patients who are non-ambulatory and too ill to walk are managed in the critical



The separate screening area for febrile patients

care/resuscitation area which has two end rooms prepared with negative-pressure ventilation and separated from other cubicles with heavy lead doors.

The observation unit in the ED is also equipped with isolation rooms for the management of potentially high-risk and infectious patients. The doors of these rooms are fitted with a self-closing device. For isolation rooms with no negative-pressure ventilation, it is important to have them well ventilated with adequate fresh air exchange.

Complying with guidelines

The hospital's Infectious Diseases Committee has developed guidelines and operating procedures for the admission of suitable patients to isolation rooms and negative-pressure rooms. However, any changes to infrastructure and facilities will not be effective if staff do not comply with guidelines and safe practices. A consolidated, multi-pronged strategy is essential. This includes not just structural changes but also mechanisms for contact tracing, syndrome surveillance, proper handwashing techniques and the implementation of universal precautions. Improving general infection control measures, procedures and preparedness has given the hospital the potential to not only enhance routine healthcare on a daily basis but also increase our chance of successfully handling the next pandemic.

Disinfection and cleaning of the febrile areas are also crucial. Disinfection with hypochlorite – 1,000ppm – is regularly done. This is for all ward environments, equipment, horizontal surfaces, surfaces touched by patients and staff and toilet facilities. In each of the isolation rooms of the observation and general wards, there are personalised handwashing facilities to reduce cross-contamination. These isolation rooms help to prevent direct and indirect contact transmission and droplet transmission.

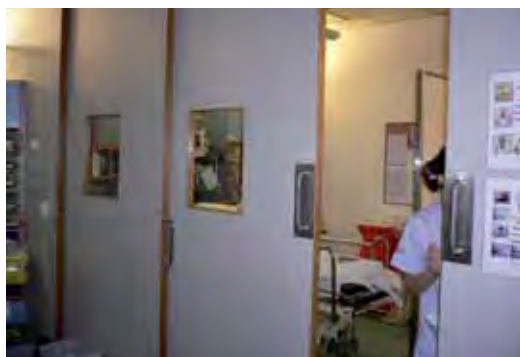
In addition, with the use of computerised records, it is now easier to trace and track patients and information – essential for contact tracing and syndrome surveillance.

To help improve coordination, the Ministry of Health, Singapore Medical Association, the College of Family Practitioners and various other healthcare organisations have created the Primary Care Pandemic Framework, to help primary care clinics work with the 18 government polyclinics to provide appropriate care for influenza and non-influenza patients during a pandemic. The framework advises on how to prepare and organise a primary care clinic for a pandemic, including modifications to clinic workflow and processes to avoid cross-infection, use of personal protection equipment, hospital referral and environmental design and cleaning⁶.

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Top: 'Fever' consultation rooms with negative-pressure ventilation
Bottom: Negative-pressure ventilation end cubicle in the resuscitation area with lead x-ray-proof door partitions

We often see construction and schedule innovation with little clinical design

Grand designs

There is energy in the air Down Under with the focus on the long-needed modernisation of healthcare facilities – and at the forefront is good design.

Kathleen Armstrong reports

There is a boom in Australia – and it is not just in the export of natural resources which have enriched the island continent. Over the last few years, and especially since the election of the Labor Government in 2007, money has been flowing into the regeneration of healthcare facilities throughout the country, bringing old stock into the 21st century.

One of the most urbanised countries in the world – over two-thirds of the population lives in its major cities¹ – it faces many of the same issues impacting on the provision of healthcare as western Europe, the US and Canada. But the picture is complicated

by a regional and rural population that is often remote and widely dispersed.

The healthcare system is a mix of public and private sector providers and funded through a mix of Commonwealth (national government), state and private insurance funds. A universal healthcare system, Medicare, was introduced in 1984 (it first made a short-lived appearance in 1974) but since the mid-1990s, policies have been introduced to encourage people to take up private insurance and use private hospitals in order to help reduce the pressure on the public hospital system. In addition, many states have begun relocating primary care into 'super-clinics', shifting the cost of care to the Commonwealth government². In June 2007, Australia had 1,301 hospitals, of which 758 were public and 543 were private³.

Ageing hospital stock, much of which had not been refurbished since the 1970s, and an ageing population, have led to the current focus on updating and redeveloping the healthcare infrastructure. In 2006 the Government endorsed the *Australasian Health Facility Guidelines*⁴ which provide recommended design guidelines for health facilities in Australia and New Zealand. The guidelines effectively cover room size and layout and have been critically received by some architects who say they can be too restrictive and have not changed to meet current trends.

According to Ronald Hicks from Rice Daubney, there is an increasing emphasis on "square-metre response" to a brief. "Schedules of accommodation often don't have the level of creativity architects



Alfred ICU

Project completion date: 2008
Contract form: Construction management
Client: Department of Human Services (Victoria)
Architect: Billard Leece Partnership
Project manager: Johnstaff Projects
Main contractor: John Holland
Structural engineer: Connell Wagner
Services and environmental engineer: Arup
Cost: AU\$25m

Plan illustrating staff workflows at the Alfred ICU



Large roof lanterns and switchable glass fill the Alfred ICU in Melbourne with natural daylight

would like to see," he says. However, creative designers will often find a way round the restrictions – and Liverpool Hospital is one such example.

The architects (Rice Daubney) were able to contribute to the clinical model as they were brought into the project at an early stage. The hospital has an open concourse, like an airport departure hall, Hicks says, making it easy for patients to find their way to clinics. The hospital also incorporates vertical stacking of specialties. And there is a greater emphasis on interventional imaging, bringing it into the theatres in response to input from clinicians.

"Although it is not a totally original approach, it has been applied in an innovative way," Hicks adds.

Rice Daubney used a 3D-CAD building information model (BIM) to enable end users to see more realistic images of proposed designs. Hicks says it has radically improved the delivery process because it creates a 'virtual building' that everyone can visualise enabling those who wouldn't normally understand architectural plans to provide input on the design.

One of the biggest projects on the table is the AU\$1.7bn redevelopment of the Royal Adelaide Hospital in South Australia which, according to Mungo Smith from UK-based MAAP Architects, will be the "greenest hospital in Australia". The design concept put together by MAAP and a local firm of architects also allows flexibility for future refits. Several lift cores mean that one can be refitted without compromising the internal arrangements of the hospital. And all of the diagnostic and recovery

areas have external walls – again, to facilitate redevelopment with minimal disruption. Green space is built right into the hospital by providing a view to the outside or to a courtyard from all points in the hospital. Subspecialties are vertically stacked next to the specialties on each floor, providing easy access both on that floor and from other departments. The project is funded through a public-private partnership (PPP) and is expected to go to tender later this year. Completion is due in 2014.

Austin-Mercy hospital campus

The redevelopment of the Austin Hospital site brought two hospitals together on one site in northeastern Melbourne – the refurbished 400-bed Austin Hospital and the 1190-bed Mercy Hospital for Women which was relocated from east Melbourne. Designed by Silver Thomas Hanley and Jackson Architecture, the aim was to create an integrated hospital campus that provided patient-focused care, maximised external views and ensured good wayfinding and access to views. Aluminium-clad façades and use of simple palettes of stone, timber, glass, terrazzo and stainless steel helped give a fresh and contemporary feel to the two towers. Extensive energy modelling also resulted in a design that is expected to reduce energy consumption by 15-25% compared to similar sized facilities, says Silver Thomas Hanley. The project was completed in 2005.



Southland Base Hospital

Project completion date: 2004
Client: Southland District Health Board
Architect: Jasmx, McConnel Smith Johnson
Cost: NZ\$55m



In resource-rich states, PPP tends to be used less or not at all

PPP funding is one of three methods used to fund the development of healthcare facilities in the country and is mainly used for large projects such as the Royal Adelaide. There are currently two other major PPP projects in planning – the AU\$1.55m Gold Coast University Hospital in Queensland and a new cancer centre in Melbourne. The 750-bed Gold Coast Hospital, designed by a consortium of Silver-Thomas Hanley, Hassell and Powell Dodds Thorpe, will replace the existing hospital and has been designed with easy wayfinding, targeted at the significant population of retired people who live in the area. “No one has to walk more than 60 metres to get where they’re going,” says Aija Thomas, principal director at Silver-Thomas Hanley.

Another PPP project currently under construction is the Royal Children’s Hospital, also in Melbourne, which was featured in the July 2008 issue of *World Health Design*.

For the most part, smaller projects are government funded using procurement processes such as design and build lump sum tenders. In resource-rich states, PPP tends to be used less or not at all. In Western Australia, the AU\$1.76bn Fiona Stanley Hospital, due for completion in 2013, will be funded completely through state funding. Designed by a consortium of Silver-Thomas Hanley, Hassell and Hames Sharley, the 643-bed tertiary hospital will be the state’s flagship hospital. Construction is due to start in mid-2009, with completion scheduled for 2013.

When the intensive care unit at the Alfred Hospital in Melbourne first opened in August 2000, it was found to have a high level of *Aspergillus*, which can be life-threatening for patients with a compromised immune system, in its ceiling and wall structure. The redevelopment of the unit, designed by Billard Leece Partnership and completed in November 2008, aimed to prevent outside air containing the fungus from passing through the building fabric and bypassing the air-handling systems.

A 100% outside air system was installed with heat recovery using run-around coils to recover heating/cooling off the exhaust air – both an

economical and clean option, according to Arup which developed the solution for the unit. HEPA filtration was used to reduce the potential concentration of *Aspergillus* and other infectious spores. The facility was served by two interconnected air heating units which maintained a positively pressurised envelope through the use of venturi air valves, catering for the local fluctuating wind pressures and the effects of changing air pressure during emergency helicopter activity.

The use of roof lanterns provided natural light for bed bays and glass, that could be switched from transparent to opaque, replaced curtains between beds in order to improve infection control and patient wellbeing. Central nursing stations each had large roof lights with switchable glass in order to provide natural lighting while minimising glare for patients.

Taking advantage of the natural surroundings is also a feature of many new facilities. The Royal Children's Hospital in Melbourne, designed by Bates Smart and Billard Leece, with HKS, has been built to integrate with the adjacent parkland. And the new Bates Smart-designed mental health facility in Dandenong, on the eastern edge of the city, incorporates 15 courtyards and uses landscaping to facilitate navigation around the building. "As you make your way to a bedroom, it feels like you are going outside," explains Bates Smart director Kristen Whittle. "There is a real indoor/outdoor connection." The building is clad in timber, providing warmth and tactility to create a more humane space.

Another consideration, particularly for healthcare facilities located in regional and remote locations is the requirements of the indigenous population. The aboriginal and Torres Strait Islander population need access to views of nature, space in which to congregate with members of their clan and areas where they can get together separately from other clans, according to Ian Moon from McConnel Smith & Johnson (MSJ).

In addition, there are particular healthcare issues, such as tuberculosis and co-morbidity, that need to be catered for. MSJ has just started putting together a masterplan for a new hospital in Cairns, north Queensland to meet these needs.



Royal Children's Hospital in Melbourne takes advantage of local parkland in its design



Office of Aboriginal and Torres Strait Islander Health (OATSIH) health facility at Yalata, South Australia

Arup has also been working on a range of facilities for the Office of Aboriginal and Torres Strait Islander Health (OATSIH).

Across the Tasman

It is a similar scenario across the Tasman Sea in New Zealand, where hospitals around the country are being redeveloped and brought up to date. The country has a federal healthcare system with 21 district health boards who have responsibility for the management of hospitals and healthcare provision within their area. Most treatment in public hospitals is free for residents. There is also a system of private hospitals, mainly restricted to elective and day surgery.

As in Australia, there was a burst of construction in the country during the 1970s which slowed down in the 1980s and 1990s. According to Marko den Breems from Jasmx, New Zealand's

largest firm in the healthcare sector, a lot of knowledge was lost during that time and it is only just beginning to be built up again – and many health boards and architectural firms, including Jasmx, team up with Australian partners for health planning for projects.

Funding for new hospitals, or the redevelopment of old hospitals, is usually provided by the district health boards and, at least currently, PPP funding is not used. And the New Zealand Ministry of Health has endorsed the *Australasian Health Facility Guidelines*.



The New Royal Children's Hospital, Melbourne
Billard Leece Partnership + Bates Smart

Bates Smart is an outstanding international design practice committed to enduring excellence in healthcare architecture. We collaborate with our clients to design sustainable environments dedicated to health and well-being. Our research-based design process combines strategic leadership with rigorous analysis and a constant search for lasting innovation.

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Den Breems says the health board model has the advantage of being close to the end users and more in touch with the local population as it is locally based. However, it also means that the design of each new hospital often means teaching a new group of people about the principles of health design as learnings are not carried over from one project to another.

Auckland Hospital was the first major redevelopment in the current phase of construction. Designed by Jasmx, together with MSJ, and completed in 2004-05, it and Southland Base Hospital in Invercargill, built around the same time, have acted as models for other hospitals throughout New Zealand, according to den Breems.

At the southern tip of the country, Southland Base Hospital is designed around a central public accessway with several internal courtyards bringing natural light into the building. Warm colours in the public spaces and wards aim to provide a space that encourages and supports wellness.

Another major project, currently under construction, is Waikato Hospital on the North Island. Designed by Jasmx, in partnership with Chow Hill and MSJ, the project incorporates a large number of construction stages so that the existing hospital can continue functioning. The design aims to build in as much flexibility as possible, as well as ensuring simplicity of circulation, connection between departments and access to daylight. Construction is due for completion in late 2013.

As in Australia, healthcare facility designs need to take into account the requirements of the indigenous Maori population, such as building in sufficient room to accommodate large family visits and overnight stays. In addition, says Ian Moon, the way Maoris treat the deceased also needs to be taken into account. "If a Maori sees a deceased person, they have to go through a cleansing routine," Moon explains. "So we design in independent corridors, where deceased people can be wheeled without being seen."

In both Australia and New Zealand it is an exciting time to be involved in the development of healthcare facilities. There is a lot happening and a real commitment to design that promotes wellness for both patients and staff. Although they may be some years behind their western European and North American counterparts in redeveloping healthcare facilities, some say this may put them in a good place – where they can learn from the mistakes of those who have gone before.

Each new hospital often means teaching a new group of people about the principles of health design



Liverpool Hospital

Project completion date: 2011
Client: NSW Health (Sydney South West Area Service)
Architect and interiors: Rice Daubney
Project manager: Capital Insight
Main contractor: Bovis Lend Lease
Structural engineer: Site Image
Services and environmental engineer: Sinclair Knight Mertz
Budget: AU\$290m (stage 2.1)

Kathleen Armstrong is a healthcare writer

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Design is all around us. When it works well, however, we often take it for granted. When bad design lets us down, our frustration mounts

Innovation by design

This month, WHD previews some of the product design innovations entered for this year's Design & Health International Academy Awards, some of which will be presented in the exhibition area at this year's Design & Health 6th World Congress in Singapore from 24-28 June.

Focused on people

Sheikh Khalifa Medical City (SKMC) is the only center in the United Arab Emirates delivering fully integrated adult cardiovascular services, and when the opportunity arose to revamp its adult cardiac catheterization lab, the 550-bed acute care hospital became the first in Abu Dhabi to offer Ambient Experience – an optimised medical environment harnessing the synergy of architecture, design and technology.

Today, the renovated patient holding area offers an open, stress-free and interactive environment designed to promote patient comfort and caregiver satisfaction throughout the interventional experience. Three private holding areas glow with soft, coloured light, creating a soothing welcome. On a wireless touch-screen, staff share a selection of 'themes' the patient can choose – experiences that come to life upon entering what was once a cold and impersonal imaging environment.

Bathed in calming audio and visual stimuli, the patient is free to escape to the virtual environment presented here. Said the hospital's acting CEO Dr Scott Strong: "It's like nothing they've ever encountered before. The lighting, the sound, the projection, the relaxation, all come together to make a more comfortable environment, in a space not often thought of as delivering a pleasurable experience."

Complementing sound and moving imagery is a 'skylight' offering more than just thematic lighting. Caregivers use this feature to illuminate areas of the patient's body, reducing eye strain and enhancing their ability to view fine vessel detail. Optimised storage and minimised visual barriers offer enhanced workflow and better patient-staff interaction. Another feature is the privacy glass. The window changes from clear to opaque at the flip of a switch, separating imaging room from control room.

Patients are assured of an increased level of privacy during procedural preparation and staff can focus on other activities between procedures without impacting the patient.

www.philips.com/simplicity



Safe and secure

Claimed to be a leap forward in healthcare fenestration, the award winning Safevent window allows patients and staff in a secure environment to fully open a window in complete safety with no restrictions, allowing maximum natural ventilation. It not only has the potential to save lives with its anti-ligature properties, but also to improve the lives of the patients and staff in facilities that use it.

Installed in over 100 acute and secure projects for 20 NHS trusts and six private hospital companies in the UK, Safevent is a low maintenance window with no locks or hinges and self-cleaning glass, featuring a double fronted horizontal sliding window, and a see-through fly mesh permanently secured into the frame – this covers the opening half of the window.



Clean your hands

When the Credit Valley Hospital (CVH) was commissioned in 1985, drinking fountains were not viewed as a threatening source of communicable diseases. However, faced with growing concerns after an outbreak of *C. difficile* in an Ontario hospital, CVH needed to pursue new infection control measures. Farrow Partnership Architects (FPA) saw that CVH's drinking fountains, which had been decommissioned but still had an existing built-in source of water, could be converted into hand washing units as a positive force for infection control.

Together with CVH, FPA developed fifteen hand washing units in the corridor of an inpatient care area over a one month period in 2008. Working with WilsonArt to develop the prototype, and in the absence of any government performance guidelines, specifications or industry standards, the handwashing units were designed to meet the following criteria:

- Convenience and ease of use
- Minimal spread of contaminated water: deep basin reduces splashing of soiled water
- Minimal amount of physical contact: faucet with hands-free operation
- Rapid prototyping: off-the-shelf components used to reduce implementation time (e.g. paper towel dispenser and disposal)
- Ease of installation: developed a self-contained unit installed into new or existing plumbing
- Warm and inviting materials: selected solid surface material over stainless steel
- Supportive of maintenance programs: use of solid surface material conducive to low maintenance

www.farrowpartnership.com



Take a seat

The Norbury Ward is an Intensive Care Unit for Adult Acute Mental Health patients at St George's Hospital Stafford. In 2005, the trust were awarded a grant of £35,000 to improve the environment. A design team, including staff and service users worked on the project, a part of which was the design of the Norbury Lounge Chair.

The Norbury Ward had acquired a negative image, resulting in staff difficulties and a sense of stigma amongst service users. The existing material decoration and furnishings of the ward were in a poor state, encouraging further neglect and abuse. The existing furniture had been plastic as this "hurt less" when thrown at the staff. Through client briefings, the ward's day room was redefined to enable the individual to choose between a sense of privacy or companionship.

The design team worked in association with Knightsbridge Furniture to develop the Norbury Lounge Chair. The chair's specification included: a weighted base; non retractable screws; fixed cushion; leather upholstery; toughened inverted stitched seams; reinforced dovetailed joints; materials from sustainable forestry; embracing organic form; difficult to throw.

The new chairs are said to have played a part in fostering a healing experience that has not only aided recovery but also nurtured a healthy respect for surroundings, encouraging a sense of community and social responsibility.

www.nightingaleassociates.com

Constructed of a solid sheet of stainless steel perforated with 2mm holes, Safevent prevents entry or escape (even when fully open), is anti-ligature, prevents the passing of contraband and the littering of outside areas, allows the patient full control of their environment without supervision (no locks, no keys), is easily operated by frail patients and prevents insects or vermin from entering a building. A full anti-bacterial model and an electronic model that can be controlled thermostatically, by timer, by remote, or centrally from a nurses station are also available.

Safevent is also capable of significantly reducing a hospital's carbon footprint by decreasing reliance on mechanical ventilation. Rathbone Hospital saved £250,000 in 2006 when the planned air conditioning was deemed unnecessary due to the inclusion of Safevent windows.

Mental health consultant Jenny Gill said: "As a mental health capital planner, the Safevent window offers a revolutionary solution to the issues of safety, security, privacy and dignity."

www.upvc4u.co.uk/britplas



Altnagelvin Hospital



HMP Bronzefield, Mother & Baby Unit



The importance of sunlight, daylight, colour, space and art has long been recognised in the creation of a feeling of well being and positive thought in our new hospitals. Meeting the challenges of providing custody with care and an internal environment which promotes activity and education is no different as we continue to develop and reinforce our understanding of the importance of these elements in all our new buildings.

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DESIGN & HEALTH 6TH WORLD CONGRESS & EXHIBITION

An international forum for continuous dialogue between researchers and practitioners

The role that design can play in meeting the challenges facing modern healthcare systems all over the world of ever rising demand and cost will be addressed by the eminent eye surgeon, Prof Arthur Lim in a special paper in the opening session of the 6th World Congress for Design & Health in Singapore, from 24-28 June. Prof Lim will be joined by Singapore's Minister for Health, Mr Khaw Boon Wan, who will describe to delegates how Singapore has transformed its healthcare provision into a world class system that is the envy of many countries around the world.

With a record number of delegates already registered at this stage of the preparations, participants can look forward to hearing world-renowned speakers from every part of the globe.

Detailed on the following pages, sessions will include presentations by physicians, psychologists, designers, architects, planners, artists, nursing professionals and economists, bringing together a rich blend of interdisciplinary perspectives. Topics will include the latest research findings in the field including: design quality standards; evidence-based design / research-based design; mental health; restorative justice; senior care; and children's and young people's healthcare. In addition, trends and influences on design and health will be considered in sessions covering different global locations, including: the Middle East, China, India, South East Asia, Europe and the US. Corporate showcases by leading experts from industry will also be presented (see below).

Register today by completing the form on p44, or by signing up online at www.designandhealth.com



Corporate showcase programme

25 June	12.45-13.15	Good preparation and briefing – the foundations for a good design'	Craig Dixon	Tribal Consulting
25 June	13.15-13.45	The operating room of the future	Andreas Noe	Olympus
25 June	13.45-14.15	Improved patient outcomes in fewer square feet	Charles G Siconolfi	HOK
26 June	12.45-13.15	Achieving design quality in PPP/PFI projects	Chris Sherwood	Nightingale Associates
26 June	13.15-13.45	The nature of healing	Kristen Whittle	Bates Smart
27 June	12.45-13.15	Current trends in medical centre design	Joan Saba	NBBJ
27 June	13.15-13.45	Experience lighting for the hospital of tomorrow	Sudeshna Mukhopadhyay	Philips

24-28 June 2009, The Ritz Carlton Millenia, Singapore

Preliminary Programme

Wednesday June 24th, 2009

- 14:00 - 18:00 **Registration at Ritz-Carlton Millenia, 7 Raffles Avenue, Singapore**
- 18:00 - 21:00 **Welcome Dinner and Opening Ceremony**
Welcome Speech by The International Academy for Design & Health / Cultural Performance

Thursday June 25th, 2009

- 8:00 - 8:30 **Late Registration**
- 8:45 - 9:30 **New Paradigms in Design and Health**
Minister for Health Mr Khaw Boon Wan (Singapore)
Prof Arthur Lim (Singapore)
- 9:30 - 10:30 **Session 1: Introduction**
Chair: Per Gunnar Svensson (Sweden), President, International Academy for Design & Health
Alan Dilani (Sweden), Director-general, International Academy for Design & Health
Romano Del Nord (Italy), Chair of Design & Health Scientific Committee
John Zeisel (USA), Chair of Design & Health International Advisory Committee
- 10:30 - 11:00 **Coffee Break**
- 11:00 - 12:30 **Session 2: Health and Healthcare Design in Singapore**
Chair: Ruby Lai (Singapore)
Liak Teng Lit (Singapore) A class apart: Patient-centred design and the Khoo Teck Puat Hospital
Steven J Sobak (Singapore) Life-cycle Operational Management of Healthcare Facilities
Maurice Choo (Singapore) A Clinical Perspective on the design of Medical-Hospital-Hotel complexes
Discussion
- 12:30 - 14:30 **Lunch, Technical Showcases**
- 14:30 - 16:00 **Session 3: Humanistic Architectural Responses in Health Design**
Chair: Alan Dilani (Sweden)
John Steven / Michael Moxam (Canada) Architecture for Health: The Crossroads of Community and Humanity
Ashikur Rahman Joarder (UK) The Impact of Daylight on Patient Recovery Rates
Tye Farrow (Canada) Design Quality Standards: Bringing Hospitals to Life
Discussion

- 16:00 - 16:30 **Coffee Break**
- 16:30 - 18:00 **Session 4: Cultural and Interdisciplinary Responses in Health Design**
Chair: John Wells-Thorpe (UK)
Marilyn Cintra (Australia) Arts and Culture: Embracing Diversity in the Healthcare Environment
Luca Marzi (Italy) A Multi-disciplinary Approach to Evaluating Healthcare Facilities
Luis Prosperidad (Philippines) The Asian Socio-Cultural Context: A Case Study of Renal Disease Care
Discussion

Friday June 26th, 2009

- 9:00 - 10:30 **Session 5: Design and Health Impacts on Patients, Staff and Visitors**
Chair: Alice Liang (Canada)
Mardelle Shepley / Angela Watson (USA) The Impact of Daylight in ICUs on Patients and Staff
Norwina M. Nawawi (Malaysia) Sustainable Solutions for Deinstitutionalising Healthcare Spaces
Charles Cadenhead (USA) Future Trends in Critical Care Design
Discussion
- 10:30 - 11:00 **Coffee Break**
- 11:00 - 12:30 **Session 6: Improving Organisational Image and Performance**
Chair: George Mann (USA)
Luc Dubé / Sheila Theophanides (Canada) Ergonomics and Flexibility in the Operating Room of the Future
Noemi Bitterman / Anna Becker (Israel) Staff performance: Enhancing the Image of the Operating Room
Robert Fox (Canada) Improving Knowledge Transfer: The Case of the Li Ka Shing Institute
Discussion
- 12:30 - 14:00 **Lunch, Technical Showcases**
- 14:00 - 15:30 **Session 7: The Global Health Infrastructure Challenge and the Middle East Response**
Chair: Jane Carthey (Australia)
James Barlow (UK) Delivering Sustainable Innovation in Healthcare Infrastructure Development
Ken Schwarz (UK) Creative Design Solutions for Healthcare Cities: A Case Study in Sharjah, UAE
Ken LeDoux (USA) The Integrated Healthcare City Model: A Case Study in Dubai, UAE
Discussion



Liak Teng Lit MBA, Bsc, Msc, CEO, Alexandra Hospital, Singapore



Steven J Sobak MSc, CEO, Singapore Cord Blood Bank, Singapore



Ruzica Bozovic-Stamenovic PhD, Assistant Professor, National University of Singapore, Singapore



John Zeisel, PhD, Research Fellow, Harvard School of Design, USA



Nigel Crisp, Lord, House of Lords, UK



Professor Arthur Lim, Singapore



Ken Schwarz AIA, RIBA, Senior Principal, NBBJ, UK



Jacqueline Vischer PhD, Professor of Design, University of Montreal, Canada



Bill Rostenberg, AIA, Principal and Director of Research, Anshen + Allen, USA

15:30 - 16:00 **Coffee Break**
16:00 - 18:00 **Session 8: Design and Health in China and Korea**
Chair: Mike Nightingale (UK)
Huag Xiqiu (China) Modern Healthcare Design in China
Chang-Ho Moon (Korea) Enhancing The Hospital Image by Design
David Rhodes (USA) Designing Hospitals in China – an American Architect's Experience
Jeeyeon Park (Korea) Korean Hospital Design – The Case of Jeju National University Hospital
Discussion

Saturday June 27th, 2009

9:00 - 10:30 **Session 9: Designing for Senior Care**
Chair: Ruzica Bozovic-Stamenovic (Singapore)
Ian Forbes / Lyn Chenoyth (Australia)
Environmental Treatments in Dementia Facility Design
Paul E Eshelman (USA) Sensory Factors in Alzheimer's Care Facility Design
Susan Rodiek (USA) Environmental Influences on Outdoor Usage in Facilities for the Elderly
Discussion

10:30 - 11:00 **Coffee Break**

11:00 - 12:30 **Session 10: Designing Environments for Children**
Chair: Derek Parker (USA)
Kate Bishop (Australia) Psychosocially-supportive Design Perspectives: Through Children's Eyes
Ismail Said (Malaysia) The Restorative Effects of a Hospital Garden for Paediatrics
Terry Montgomery / Lyn Northey (Canada)
Cultivating a Sense of Place: The Case of Bloorview Kids Rehab
Discussion

12:30 - 14:00 **Lunch, Technical Showcases**
14:00 - 15:30 **Session 11: Designing for Custodial Environments**
Chair: Phillip Mead (USA)
Chris Liddle / Lord Nigel Crisp (UK) The Architecture of Incarceration: Designing for Restorative Justice
Shauna Cory (USA) Learning from History: Design and Health in a Japanese Internment Camp
Evangelia Chryssikou (Greece) Psychosocially-supportive Design: Therapeutic Mental Health Environments
Discussion

15:30 - 16:00 **Coffee Break**

16:00 - 18:00 **Session 12: Design Quality Standards: Methodologies and Evaluation**
Chair: Jacqueline Vischer (Canada)
Praneet Kumar (India) Health Planning: Use of Global Standards in Developing Countries
Ray Pentecost (USA) Evidence-based Design: Developing and Validating a Common Vision
Bill Rostenberg (USA) Bridging the Gap Between Sustainability and Evidence-based Design
Yanai Elbaz (Canada) Procurement Output Specifications: The Case of The McGill University Health Centre
Discussion

18:00 - 19:00 **Trade Show and Posters**

19:30 - 23:00 **Academy Award Ceremony, Gala Dinner**

Sunday June 28th 2009

9:00 - 13:00 **Architecture Study Tours**
Study visits will be published in the final programme in May 2009

Poster Presentations

- P 01** Faye J LeDoux (USA) The Evolution of Evidence-Based Design
P 02 Sarita Chand (Australia) High Performance Clinical Workplaces
P 03 Jun Lu / Andrew Price (UK) Integrated Approach to Space Optimisation of Healthcare Facilities
P 04 Jane Carthey (Australia) Designing Health Facilities to Meet the Needs of Elderly Patients
P 05 Peter Scher (UK) Correlating Design Quality and Healthcare Facilities
P 06 Alice Liang (Canada) House & Garden in the City – A Post Occupancy Evaluation
P 07 Patsy Poulin (Canada) Designing for Tuberculosis
P 08 Kate Ramsay (Australia) Gold Coast University Hospital Change Management: An Exciting Journey
P 09 Angela Burke (UK) Emerging Technologies and their Design Implications on Future Urban Acute Hospitals
P 10 Meena Kumari (India) Indian Cancer Hospital Design
P 11 Karen Urbanoski (Canada) Post Occupancy Evaluation of a Mental Health and Addiction Residential Service
P 12 Phillip Mead (USA) Effectiveness of Bright Light Therapy for the Relief of Seasonal Affective Disorder
P 13 Richard de Neufville (USA) Using Flexibility to Improve Value-for-Money in Hospital Infrastructure
P 14 Annalisa Cipolloni (Italy) Self-Cleaning Operating Rooms
P 15 Jamil Al Shraiky (USA) The 10 Healthcare Design Innovations that Affected Patient Recovery
P 16 Susan Conner (Canada) Designing Sustainable Healthcare Financing Solutions
P 17 Y Shapira (Canada) When East Meets West
P 18 Stephen Kendall (USA) Flexible Building Design for Healthcare
P 19 Nicoletta Setola (Italy) Tools for a Configuration Spatial Analysis to Support Hospital Flows
P 20 Ray Pentecost (USA) What is Fuelling our Fear of Evidence-Based Design?
P 21 Ian Sinclair / Sharon VanderKaay (Canada) Importance of First Impressions: Closing the Say – Do Gap
P 22 Basar Erdener (Sweden) Architectural Lighting Design that Promotes Health and Wellbeing
P 23 Conor Ellis (UK) Using Design as a Catalyst for Change – and a By-Product for Achieving Value Based Reform
P 24 Ed Jakmauh (USA) Destination Medical Centers for International Patients
P 25 Charles G Siconolfi (USA) Exploring the Impact of Genetic Medicine on Hospital Design
P 26 Yunhee Lee (Korea) Space Design Characteristics of Aging Simulation Center
P 27 Eve A Edelstein (USA) The Influence of Physical Design Features on Psycho-Physiological Outcomes
P 28 Daniela Sorana (Italy) The Hospital Environment: from Source of Stress to Resource for Health
P 29 Rona Stephen (UK) The Prison Design – A Healing Concern
P 30 Jonathan Zunz (Israel) The Beilinson Hospital Transformation Story. Challenges and Benefits
P 31 Noemi Bitterman (Israel) Physiology-Based Design for Healthier Architecture

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Integrated operations

Kathleen Armstrong explores how new developments in surgical technology and procedures are changing the face of the operating theatre

Professor Erik Fosse has a vision. As head of the Interventional Centre at Norway's Rikshospitalet, he is leading the way in new surgical and interventional techniques that are changing not only the face of surgery but also the face of the operating theatre itself.

MRI and CT scanning are known to most of us only as tests whose high-tech images have transformed the way disease is diagnosed. But advances in technology are bringing these technologies more and more into the operating theatre, creating new opportunities for interventional radiology

and a new breed of 'hybrid' operating theatre. "In the future we will see more and more multiple-modality rooms in which technologies such as MRI and CT scanners are integrated into the rooms," Fosse says. For example, he and his colleagues are looking at how MRI can be used for targeted drug delivery, helping to monitor the ultrasonic release of drugs – a development that will be particularly beneficial for cancer treatment.

Fosse foresees a separation between interventional radiology and diagnostic radiology as these developments take hold. "Within five years, cath labs could be used for intervention and not for diagnostics," he predicts. But for the design of the operating theatre, such developments throw up a number of challenges, not least of which is the size of the room required to accommodate such equipment. In addition, as new technology is developed, the operating theatre may need to change to adapt to its use. Since the first hybrid room was built at the Interventional Centre in 1996, Fosse says it has changed four times – the latest rebuild taking place in late 2008.

The room is built using a 'box-in-box' principle, Fosse says, using double walls and ceiling so that cabling can be incorporated but also enabling walls to be easily removed in order to change the size of the room. An outer wall with floor to ceiling windows also means changes can be made with as little disruption as possible to the rest of the facility.

Future-proofing

Bill Rostenberg from Anshen + Allen agrees that building flexibility into the design of operating theatres is essential. Taking a 'universal room approach' to create an integrated interventional platform with layouts that can accommodate interventional processes would ensure that operating theatres can adapt to the needs of the future.

The key is building an infrastructure that enables flexibility. For example, fixed, vertical elements such as lift shafts and stairs should be placed along the perimeter of the building to create a flexible clinical zone that can be modified without the vertical elements compromising workflow or spatial configuration. Building two or three operating theatres next to each other also creates a simple solution for expansion, enabling walls to be removed to make a large hybrid suite. Understanding workflows is also essential and it is here that the challenges of bringing two different fields of work together becomes more apparent. Standards that apply to surgical suites, for example the Association of periOperative Registered Nurses (AORN) standards, do not have the same applicability for interventional radiology.

There is a different culture for sterile control. While surgeons have long operated behind a 'red line' in which everything must be sterile, "interventional cardiologists may prefer to walk in and out of the control area without having to scrub down", Rostenberg says.



Maquet is developing an integrated hybrid operating theatre with flexibility for both open and minimally invasive surgery



Cadolto's modular units can be easily adapted to changing needs



The 'blue' Olympus ENDOALPHA suite at the Amalie Sieveking Hospital in Hamburg



Lighting specialist Trumpf is looking into the development of anti-magnetic surgical lights suitable for interventional radiology use

"In the US, there is a lot of competition between specialists but what is needed here is multidisciplinary collaboration as complex procedures are becoming multidisciplinary," he adds. "Good operating theatre design requires clinical input and strong vision – not just from clinical leaders but also from the administrative side. If collaboration doesn't come from the clinicians, it needs to come from management."

Humanistic response

Anshen + Allen has created a number of integrated interventional platforms in the US and in the UK. Palomar Pomerado Health in California incorporates a series of adjacent operating theatres, a section of which is designated for interventional radiology / cath lab use and which can therefore be adapted to different clinical needs and standards. The deep floor plate is 'daylighted' with borrowed light from external windows and interior courtyards and flowing into procedure rooms from corridors.

"Humanising the deep floor plate" is something that Rostenberg sees as important. "In the US in the last 30 years there has been a lot of development of supertechnology-driven hospital departments that are almost factory-like. Floor plans are driven by clinical adjacencies bringing departments together. What it has yielded has been hospital buildings that may be clinically efficient but are deep, dark, confusing buildings and you often can't see outdoors. This is now changing."

Maquet is currently developing a fully integrated hybrid operating theatre with the flexibility to perform both open surgery and minimally invasive surgery. "The operating table in the cath lab is not designed for surgical procedures, so it is limited to minor surgery," says product manager, operating table systems, Bernhard Kulik. "The customer needs to be able to have the flexibility to perform all kinds of surgery for a more efficient workflow in the room." The new system, controlled through the imaging system, will use synchronic articulation to enable the system to rotate without the risk of colliding with the operating table. The company plans to launch its integrated hybrid operating theatre at Medica in Frankfurt in November.

Maquet has experience in flexible operating theatre design. Its Variop modular operating theatre is designed with its walls in three parts so that it can be easily changed and/or new installations integrated. The company has also developed a glass wall that has foil between two layers of glass, enabling the hospital to choose to have the wall transparent or opaque or designed with colours or images to suit the individual operating theatre environment.

Modular approach

Modular specialist Cadolto has responded to the need for larger operating spaces with the development of a 50m² modular operating theatre unit. Although the company has not yet been asked to supply a hybrid operating room, director Dr Björn Werner says its modular units are able to meet its requirements. Cadolto also produces a 35m² module, which can be combined with the 50m² unit to accommodate the control room, laminar flow system and relevant technology.

The units are supplied with theatre lights, pendants and a built-in foundation for the operating table, whether it is mounted and fixed or moveable. "Our modular operating theatres come complete with state-of-the-art laminar flow systems, hygiene systems and are adapted to meet the standards of different countries," Werner says. "When it is delivered to the site, all that needs to be done is to connect the power, water, gases and the corridor(s) that link it to the building." The only limitations are the size of the laminar flow system – a 3x3m system is normally supplied – and the ceiling height is limited to 4m, with a false ceiling to accommodate the laminar flow system.

Although modular units are more expensive up-front



A 'universal room approach' with layouts that can accommodate interventional processes (courtesy of Anshen + Allen)

than on-site construction, Werner says there is actually an economic advantage because there is less disruption and they are erected in much less time.

But even without the integration of MRI and CT technologies into an operating theatre, new audiovisual and electronic control technologies require a control room, situated next to the surgical suite, space in walls and ceilings for cabling and careful placement of C-arms, lights and screens.

Choice and control

Olympus's ENDOALPHA system integrates touch-screen control, audiovisual communication and documentation for surgical and gastrointestinal procedures. It enables the surgeon to control lights, medical devices, operating table positioning communications and imaging from a sterile touch-screen. Monitors can be mounted on boom arms or on walls and the system also enables audiovisual streaming to other operating theatres, departments, classrooms or to people outside the hospital.

Marketing manager Frank Koenike says he tries to get in early on planning discussions when an operating theatre that includes the ENDOALPHA system is being designed or renovated. "Pipes and cabling need to be incorporated into design plans so they know which cables are required and where they need to run – between networks, to the main controller and to the control room."

Olympus has also developed a blue light for the ENDOALPHA suite that is installed alongside the standard white light on the ceiling of the operating theatre. Surgeons can choose to switch over to the blue light during procedures, Koenike says, to help enhance both the clarity of the image on the monitor and orientation in the dimmed room.

The ENDOALPHA suite at the Amalie Sieveking Hospital in Hamburg also has blue glass walls, with an additional feature – a separate panel of glass above which uses RGB (red-green-blue) technology to enable the colours in the panel to be changed to create different scenarios. Effects such as a sunrise can be programmed in when the wall is installed and the scenarios changed using the touch panel in the control room. Koenike says the walls are easy to disinfect as well as being aesthetically pleasing.

Adapting to future needs

Graeme Hall, managing director of UK-based Brandon Medical, emphasises the importance of 'future-proofing'. He says many hospitals choose technology because of its brand name without understanding whether it is really the best system for the operating theatre and its future needs. "People often buy what they call an integrated operating theatre – a minimally invasive endoscopy system that is integrated into the hospital audiovisual system. Often provided with half a dozen controls, it's not very integrated at all," Hall claims. But, he adds, there are systems that offer more. Brandon Medical has developed a protocol platform, using its Symposia digital media system, that Hall says "can integrate anything", including endoscopes, ultrasound, surgical scopes and lighting, all of which can be manipulated from a common platform. "Everything in the operating theatre that uses internet protocol technology, including radiology, can be integrated into a common platform," he explains.

This includes lighting. "In a hybrid operating theatre, lights should be positioned laterally to the left and right of the table, with the C-arm able to slide on rails from the ceiling," says Dirk Fritze, product manager for surgical lights at Trumpf. "The main concern for users is to be able to easily adjust the light, which is why its integration into the system is important, so that it can be controlled from the one screen."

The advent of operating theatres using interventional radiological equipment such as MRI and CT presents a new challenge, even for a lighting specialist such as Trumpf. Surgical lights are typically kept away from the technology's magnetic field and patients. To avoid interference with MRI and CT technologies, the surgical lights need to be made out of anti-magnetic material. The dilemma is that the lights also require heat-conducting material, which is typically metal and, therefore, magnetic.

Fritz says Trumpf is looking into the development of such lights. But technology does not come cheap. So, until operating suites using MRI and CT technology become more common, anti-magnetic surgical lights are unlikely to be economically viable for most hospitals.

The face of the operating theatre is changing and such developments will soon become commonplace, as surgery and interventional radiology and cardiology move ever closer. "The operating room of the future will look more like today's cath lab," predicts Bill Rostenberg. Making it all the more important to build flexibility into today's designs.

The operating room of the future will look more like today's cath lab



Plan of a CT-Cath operating room (courtesy of Anshen + Allen)

Kathleen Armstrong is a healthcare writer

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Design & Health Scientific Review

Either/And Evidence-Based Design



Prof Romano Del Nord is chair of the scientific committee of the International Academy for Design & Health and deputy rector of the University of Florence



Dr John Zeisel is chair of the international advisory board of the International Academy for Design & Health and president of Hearthstone Alzheimer Care

This issue's research articles, which will all be presented at the Design & Health World Congress in Singapore in June, challenge designers to respond to multiple and non-parallel goals, bridging the research-design gap with clarity and careful methods.

Shepley, Gerbi, Watson and Imgrund promise a comparative study of an old and a new Intensive Care Unit in the same hospital, focusing on the effects of increased daylighting and window views on staff, patients, and families. Only the methodology and data from the

old ICU in phase one of the study is presented. The design team for the new hospital ICU argued that increased capital costs for windows into the ICU would be offset by benefits to staff and patients. This research – when finished – should either prove or disprove this hypothesis. We anxiously await phase two comparative data from the new unit.

Kate Bishop presents the results of interviews with children that identify elements of the built environment in paediatric hospitals that provide children with positive healing experiences.

Bishop finds that the aesthetic environment, spatial variety and adaptability all contribute to children's comfort, positive frame of mind, and engagement. She provides specific guidance: Provide artwork by other children and adolescents yet avoid "simplistic images associated with young children." Provide places where kids can carry out "normal routines" including "age-appropriate areas for socialising." And enable kids to feel able to express their identity by personalising their immediate environment – their bed area.

Bishop's discussion of single and double rooms clearly raises the "Either/And" design question. While there is a drive among researchers and designers to control in-hospital infections by providing patients only with single bed rooms, Bishop's data show that 50% of the kids she interviewed preferred two-person rooms to increase social contact, ward off loneliness, and reduce fears of isolation.

All applied research and evidence based decisions raise the question: How should a responsible design decision maker respond to conflicting "evidence?" This case clearly demonstrates that evidence-based designers do not face conflicting facts, but rather data with different objectives leading to different design decisions.

Rostenberg, Baum, Shepley and Ginsberg face this potential dilemma head on by comparing the demands of evidence-based design to those of sustainable design. They demonstrate that there is no conflict between evidence-based design principles and practice, and those of sustainable design. But as with single and double rooms, the fact that there is no such conflict means that responsible designers now have a double responsibility—an either/and responsibility to resolve multiple sets of requirements that do not easily fit together.



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Post-occupancy Evaluation: A Response

Dr Fionn Stevenson; Dr John Zeisel



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Design Methodology: The Intersection of Evidence-based Design and Sustainability

Bill Rostenberg FAIA FACHA Mara Baum AIA LEED AP; Dr Mardelle Shepley AIA ACHA LEED AP; Rachel Ginsberg MLS



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Paediatric Health Design:

Understanding how to create supportive environments for children and adolescents

Kate Bishop PhD



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Patient and staff environments:

The impact of daylight and windows on ICU patients and staff

Dr Mardelle Shepley AIA ACHA LEED AP; Raymond Gerbi; Angela Watson AIA; Stephen Imgrund MD

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Dr Fionn Stevenson: The comment by Dr John Zeisel in the last issue of *WHD* that the assessment of the Dundee Maggie's Centre is "peculiarly positive" deserves deeper exploration. It is well known that confounding variables are a major problem in post-occupancy evaluation (POE) studies which try to tease out performance from highly dynamic and complex situations.

The notion of 'forgiveness', first coined by Leaman and Bordass in relation to their POE studies of offices, describes the willingness of the user to forgive the particular discomforts experienced in a building and feel more satisfied overall. In this sense, the positive assessment of the building is 'peculiar' only in the sense that there are other tacit reasons for user 'forgiveness' which we have not been able to elucidate within the limitation of this study. We are aware, for example, of the key role staff may play in the success of the building and that they may well be contributing to its 'forgiveness'. This needs further study but does not invalidate the conclusion's findings that the building design as experienced is very successful despite the particular design problems identified.

'Forgiveness' may be attributable to user memory, meaning, individual cultural factors, social conformity, etc. Nevertheless, it still has to be seen as a deep design influence and is perhaps one of the main reasons for the success of this building. Designers need to become increasingly aware of the relationship between design intention, the care model adopted and the 'forgiveness' factors mentioned above. One of the big problems with evidence-based design research is that we tend to break everything down into bits and miss this bigger picture. 'Forgiveness' is about how human beings kinaesthetically trade off different factors to arrive at an overall, synthesised appreciation of a built environment, often referred to as the 'poetics' of space. But this higher-order synthesis is usually overlooked in narrow instrumentalist scientific research and needs developing.

The speculative claim that our study "might well lead to uncritical design emulation rather than critical design improvement of future Maggie Centres", is unfounded, given that the conclusion summarises exactly what most needs improving in terms of the building's identified failings: the control systems – a common finding in POE studies of this kind. It is easy enough for architects to reconsider spatial design factors, once pointed out. Control systems, however, tend to be often left to engineers, when in fact architects may well be best placed to design their critical user interfaces more effectively, given their visio-spatial training.

Post-occupancy evaluation: A response

Dr Fionn Stevenson responds to **Dr John Zeisel's** comment ('The value of critique') in the January issue of *WHD* on post-occupancy evaluation and the Dundee Maggie's Centre



Dr John Zeisel is chair of the international advisory board of the International Academy for Design & Health and president of Hearthstone Alzheimer Care



Dr Fionn Stevenson is a reader in sustainable design at Oxford Brookes University and co-director of the architecture unit at the Oxford Institute of Sustainable Development

Dr John Zeisel: Dr Stevenson references the work of Adrian Leaman and William Bordass who introduced the concept of user 'forgiveness' in their POEs to demonstrate that, while such research identifies building design successes and failures, those who use the buildings sometimes exhibit high 'user satisfaction', even with buildings that have many design problems. I would argue, that satisfaction, the basis of forgiveness, is a poor measure of building performance. When users 'forgive' a building for its failures, they are actually using energy that otherwise could be employed to accomplish what they came to the building for in the first place: to be productive in work environments, to enjoy themselves in recreational environments and to heal in healthcare environments. Pointing out places where the design of a successful building can be improved does not put the building in a bad light; rather, such POE results provide designers with direction that can only improve future similar buildings.

I believe the data in Dr Stevenson and colleagues' excellent POE indicate very well where improvement in design of future Maggie's Centres might lie: reconsideration of the location and size of south-facing windows that lead, according to the report, to "excessive light" and possibly therefore heat gain, modification of the low level of internal light which exacerbates the glare from sunlight in large windows, and

questioning of the open-plan layout which, although it helps staff see and welcome visitors easily, may contribute to the lack of temperature and humidity control – and of course revisiting the design of the building's systems and the training staff receive on its operation.

Dr Stevenson argues that the low ratings this building received for glare, solar gain, heat and humidity are merely a matter of problematic building control systems. She argues that this is the fault of engineers who have little or no contact with the actual building users. If this argument held for poor acoustics in concert halls that make it difficult to appreciate the music or excess natural light in art galleries that harm the paintings, architects could avoid claiming any responsibility for such building failures as well. But they cannot. In such buildings 'engineering' characteristics are the responsibility of the architects – and so they are in a smaller building like the Maggie's Centre. In this case the users are people living with cancer who 'forgive' the building's design mistakes because they have come out to the countryside and are sitting with others who understand them, overlooking a beautiful and healing view of glorious Scottish mountains and valleys.

Keppie specialised in hospital buildings before the UK National Health Service (NHS) was founded, and has been at the forefront of healthcare design ever since. From the beginning of Public Private Partnerships in 1994, the practice has been unique in splitting project work equally between public sector advisory roles and private sector bidding ones, helping to understand the aspirations and working methods of both sides of the partnership equation.

This has led to almost £4bn of healthcare design experience, ranging from a £5m community hospital to the £300m Forth Valley Hospital on the design side, and the £600m Birmingham New Hospitals project with the technical advisor role. We piloted an exemplar design approach to defining public sector aspirations and affordable output specifications in the late 1990s. As part of our continuous learning programme, we are a main sponsor of the Design and Health World Congress.



Project: Forth Valley Acute Hospital (Larbert, Scotland, UK)
Illustrations © Keppie Design

Sustainability and Evidence:

The intersection of evidence-based design and sustainability

The application of sustainable design and evidence-based design strategies often seem to operate in isolation from each other. This study examines where they can, and should, intersect

Bill Rostenberg FAIA, FACHA, Mara Baum AIA, LEED AP, Dr. Mardelle Shepley, AIA, ACHA, LEED AP (principal investigators), with Rachel Ginsberg, MLS

Sustainable design and evidence-based design are each unique design approaches significantly impacting healthcare architecture today¹. Sustainable design promotes buildings that improve ecological health and indoor environmental quality, while evidence-based design advocates healthcare facilities which enable positive health outcomes through the application of best practice strategies informed by research and practical knowledge². Although each movement directly impacts current healthcare architecture, each is often implemented in isolation of the other and some even consider these philosophies to be in conflict with one another^{3,4}.

For example, how frequently do sustainable goals of reduced water consumption conflict with evidence-based design goals of increasing handwashing compliance? Does the use of HEPA or laminar air flow devices (installed to improve infection control) compromise the energy-consumption efficiency of building-wide air-handling systems? Are many of the finishes and materials which are well suited to controlling the spread of infection actually hazardous and toxic to the environment? And, perhaps most significantly, does a building footprint that introduces natural daylight into technologically complex healthcare environments (such as surgery, radiology and procedural medicine suites) inherently

increase travel distances, compromise desired clinical adjacencies and complicate opportunities for future flexibility and incremental adoption of changes in medical technology and operations?

Project overview

The research project, upon which this paper is based, was jointly funded by the Boston Society of Architects, The American Institute of Architects / College of Fellows Upjohn Research Initiative and Anshen + Allen. The purpose of the research was to:

- identify best practice facility examples reflecting evidence-based design (EBD) and sustainable design (SD) philosophies;
- determine if evidence-based design and sustainable design approaches are more frequently applied in a mutually supportive and integrated manner; or separately and in isolation of one another;
- identify the kinds of data being collected by facilities considered to be exemplar, or best practice, representatives of EBD and SD; and
- solicit opinions regarding the potential for both areas of inquiry to be integrated into a comprehensive and synergistic design process.

Research activities consisted of the following phases:

Phase 1: Advisory groups Advisory groups were formed to provide direction regarding critical questions about the relationship between evidence-based design and

sustainable design that would be addressed in the EBD-SD survey and to identify built healthcare projects which they consider to represent 'centres of excellence' in EBD and SD. The principal investigators augmented these facility lists with additional projects identified through a literature review.

Phase 2: Best practice facility survey Researchers surveyed national experts in evidence-based design and sustainable design to identify notable EBD and SD centres of excellence. Twenty-six experts in each area were emailed a list of projects identified in Phase 1. The national experts were asked to identify the top 10 built healthcare facilities in North America representing best practices in either EBD or SD. Sustainable development experts were only asked to consider sustainable design projects and evidence-based design experts were only asked to consider evidence-based design projects. The results of this survey were used to identify best practice facilities to be surveyed in Phase 3.

Phase 3: SD-EBD survey Researchers surveyed healthcare administrators at the facilities identified in Phase 2. The administrators had been involved with, or were aware of, the design process for these projects and were involved with the operation of the facilities.

Phase 4: Literature review For each of the facilities whose administrators responded to the Phase 3 survey, researchers conducted a literature review. This review focused on discussion by the design team and hospital

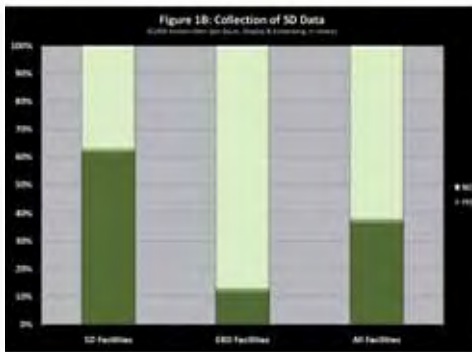
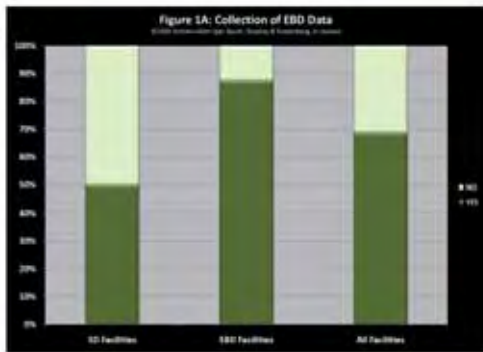


Figure 1 Rates of EBD and SD data collection¹

Figure 2 Prevalence of data collection of EBD and/or SD data by subject facilities¹

administrators regarding the relationships between issues or strategies associated with both evidence-based design and sustainable design. However, the majority of the articles were not peer-reviewed; as such, they only suggest the quantity and quality of knowledge available to design professionals engaged in healthcare architecture.

Best practice facilities

The evidence-based design and sustainable design experts identified nine EBD and nine SD facilities considered to represent best practices in each subject area. These 18 hospitals are distributed around all regions of the US and represent a range of sizes and programmes. Six of the facilities either have obtained or are pursuing a Leadership in Energy and Environmental Design for New Construction (LEED NC) rating⁵; the facilities have collectively acquired all possible levels of LEED certification: Certified, Silver, Gold and Platinum.

Eight administrators from both facility types responded to the surveys. Their responses reflect an opinion that, overall, EBD and SD are compatible, although some specific implementation strategies may be perceived to be in conflict. These findings are discussed in greater detail in an article currently in review¹.

Facility data collection

In general, more of the facilities surveyed are collecting evidence-based design metrics data than sustainable design metrics data. While 88% of EBD and 50% of SD facilities surveyed indicated that they collect data related to EBD topics (such as patient satisfaction and medical errors), only 63% of SD and 12% of EBD administrators reported that their facilities track SD topics, such as energy and water consumption (see Figure 1).

Most of the facilities surveyed (69%) collect only one type of data – evidence-based design or sustainable design. Approximately 12.5% of the facilities collect data on both EBD and SD topics and 18.5% do not collect data related to either EBD or SD. Of the seven facilities that collect EBD data, only one also collects SD data (see Figure 2). This is markedly lower than the total number of facilities (5%) that collect SD data. Of the facilities that collect SD data, half collect EBD data. Of the facilities that collect EBD data, only one also collects SD data (see Figure 2). This is markedly lower than the total number of facilities (12) that collect EBD data.

Administrators of the facilities that collected data were asked to identify the type of data they collected. Regarding EBD data, five administrators listed patient satisfaction and two listed staff satisfaction as the data they were most interested in tracking. Patient-related metrics also represented the most frequently cited set of issues among the other EBD metrics identified. Regarding SD data collected, most (60%) were related to energy consumption. Each facility, however, appeared to be measuring it in different ways. Two administrators indicated that they collect data on total energy consumption and recycling. Other metrics – such as central plant energy use and the use of specific types of energy (steam, electricity, natural gas, etc) – were each identified only once (see Figure 3).

Individuals surveyed were asked two final narrative response questions about the lessons they learned from designing and operating their facilities. For example, administrators were asked what EBD- and SD-related changes they would make if they were to rebuild their facilities. Four EBD and five SD representatives answered this question. Most EBD administrators suggested changing specific design features, such as flooring types or waiting room

design. However, only one SD administrator listed proposed changes to specific building elements. Most of the SD administrators' comments focused on changing the design process (see Figure 4).

In an effort to give the administrators the opportunity to provide additional comments on the larger topics of evidence-based design and sustainable design, the final narrative response question was open-ended. These responses are summarised in Figure 5.

Most of the EBD administrators focused their 'lessons learned' comments on specific building features, noting that many current models for EBD research place emphasis on discreet physical design features implemented to achieve particular clinical outcomes (such as the installation of patient lifts to reduce patient and staff injuries that may result from lifting patients manually⁶). While one surveyed facility is undertaking research that addresses big-picture holistic issues, this appears to be an atypical exception.

Most of the EBD and SD strategies proposed are related to well-accepted and acknowledged practices within their respective categories. Only one of the eight evidence-based design building design changes proposed – access to nature – coincides with sustainable design goals, while two of the three sustainable design strategies – linoleum flooring and daylight harvesting – overlap with evidence-based design goals.

Linoleum is a healthier and more sustainable alternative to vinyl and daylight 'harvesting' includes a variety of techniques in which daylight is transmitted internally to otherwise dark deep floor plates.

This can be accomplished through daylight fixtures, courtyards, atria or skylights. This concept is important for hospitals, which tend as a building type to use deeper floor plates than do other building types. A third

Figure 3. Types of data being collected at EBD and SD best practice facilities'

Types of EBD Data Collected	Types of SD Data Collected
Patient health, safety and wellbeing	Energy
Patient satisfaction	Total energy consumption over time
Patient safety	Electricity
Clinical outcomes:	Natural gas
Falls	Chilled water
Infection rates	Steam
Medical errors	Individual building energy use [for buildings on a campus]
Centralised vs. decentralised nurse stations	Central plant energy use [for an entire campus]
Perception of control	Energy use per square foot
Staff health, safety and wellbeing	Water
Impacts on staff*	Total water consumption over time
Staff satisfaction	Cooling tower make-up water
Fiscal health	Water use per square foot
Staff retention	Waste
Nurse time in patient rooms	Recycling
Aggregate metrics	Solid waste
Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) scores	
Centers for Medicare & Medicaid Services (CMS) process indicators	

* The language of the metrics in this list is taken directly from the surveys with minimal interpretation. 'Impacts on staff' can include several things, including staff satisfaction, efficiency, walking distances, or attrition.

Figure 4. Proposed Building Design and Design Process Changes'

EBD Building Design Changes	SD Building Design Changes	SD Process Changes
Rubber floors	Linoleum flooring	Incorporate LEED early in the design process
Increase work space for nursing staff	Improve daylight harvesting	Better integrate building design process with the range of needs of diverse user groups, including their requirements for owner-furnished equipment
Locate nursing works space closer to patient rooms	Consider ground source heat pumps	Increase the involvement of all levels of staff
Private waiting areas for families instead of large waiting rooms for multiple units		
Provide patient choices in waiting room seating		
Access to nature		
Art		
Improve wayfinding systems		
Improve lamp colour		

medical practice are inherent in healthcare facilities, this type of conflict may be more pronounced in healthcare projects that are driven disproportionately by sustainability (versus a more balanced approach that equally considers sustainability and evidence-based design). For example, right-sizing of building systems and equipment is often a sustainable design goal, because running mechanical and other systems at a reduced capacity is typically significantly less energy-efficient than running the same systems at or near capacity – while designing features that provide future flexibility is typically an evidence-based design goal.

If a facility's systems are right-sized for the immediate demand, there may not be much additional capacity for alternate uses either during initial occupancy or in the future. An optimal solution would be one that efficiently runs systems for initial demands yet also provides for integrated incremental expansion for future demand changes. While such solutions are challenging for any building type, the challenge is more significant for healthcare facilities because utility requirements for equipment are both greater and more likely to change substantially than in conventional facilities.

Several similar themes emerged from the SD administrators. One theme commonly cited by SD administrators was that opportunities for successful execution of sustainable designs are improved by the ability to address and incorporate sustainability early, frequently and with as many relevant stakeholders as possible. Related to the comments above regarding special equipment, two respondents emphasised the importance of considering the needs of end users or tenants in the design process. This type of comment is frequently cited as being a critical element of the green building process^{7,8} and also for evidence-based design processes.

Overall, the survey yielded diverse opinions regarding opportunities for compatibility – and the lack thereof – between evidence-based design and sustainable design. One EBD administrator boldly stated: "There is no relationship between evidence-based and sustainable design and they should not be piggybacked," while two other administrators disputed this notion.

Accordingly, the survey's premise itself was challenged with comments suggesting that a belief that evidence-based design

proposed SD design change – ground source heat pumps – uses the thermal stability of the earth adjacent to a building to improve energy efficiency.

Interpretation of the survey results indicated that SD administrators primarily addressed design process issues while EBD administrators more frequently addressed specific design features themselves. However, only one respondent recommended changing specific building features without also addressing the design process. Furthermore, one survey highlighted the importance of

considering special 'end-user-requested' equipment, such as instrument sterilisers, when designing building systems for optimal energy performance. This raises an important issue that such equipment – which is unique to healthcare facilities and thus is not typically factored into building systems designs for other building types – has a significant impact on energy performance. This comment underscores the importance of improving both the design process and the development of specific design details.

Because changes in equipment and



ideas that heal. places that perform.

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and sustainable design are separate and that facilities must “choose one over the other” is faulty. This respondent stressed the importance of finding synergies between strategies that support both goals. Similarly, another administrator commented: “Assuming that an owner is committed to both, one need not be sacrificed for the other.”

Myriad challenges facing those wishing to more fully integrate evidence-based design and sustainable design were underscored throughout the survey. One respondent noted that some standard green building practices conflict with hospital licensure or building code requirements. Healthcare providers and designers who wanted to go green had few resources beyond those developed for generic building types before publications such as the *Green Guide for Health Care* were developed. Even with the publication of such healthcare-focused sustainability monographs, it remains critical for design teams to enhance their understanding of healthcare-specific building requirements in order to better integrate these with sustainability practices.

Conclusions

Sustainable design projects have a lot to gain from the EBD culture of research and knowledge dissemination, while evidence-based design projects can benefit from the sustainability community’s longevity in quantifying and qualifying performance metrics. Significant research efforts on how to best apply sustainability issues to healthcare architecture are clearly necessary and design teams that are considering collecting data on either sustainable design or evidence-based design issues can look to the Center for Health Design and the US Green Building Council’s National Green Building Research Agenda for help and guidance. While sustainability appears to be better accepted as an integral component of general architectural design today, evidence-based design concepts applied to healthcare architecture have also received much recognition in recent years. There is both the need and opportunity for the two to become better integrated with each other and thus further collaborative growth and development of each is necessary.

Translating knowledge into practice

Research studies such as this one are the first step in cultivating a greater understanding of

Figure 5. Selected Responses to Open-ended Request for Comments*

Comments from EDB Administrators	
1.	There is no relationship between evidence and sustainable design and they should not be 'piggybacked'.
2.	There is no question that evidence-based design is instrumental in both the patient and staff satisfaction at our facility.
3.	Assuming that an owner is committed to both, one need not be sacrificed for the other. However, accomplishing both is often a challenge.
Comments from SD Administrators	
1.	Determine your sustainability goals early in the project, and employ an integrated design team. By keeping sustainability in the front of the designers, the successes are much bigger and easier.
2.	We have found that some 'typical' sustainable design ideas run contrary with hospital licensure or building codes. Our project was started before the Green Guide for Health Care, and we were continually being measured against a generic building type.
3.	After completing the survey one theme that seemed implicit in the questioning of this survey was this idea that sustainable design and evidence based design were separate design strategies and we had to choose one over the other. This certainly may apply to small design features [this healthcare organisation] incorporated in its hospital, however, we tried to design and select features from both design fields. One thing we took away from our project is you have to look at the multiple impacts that the design will have on patients, employees and the community and factor how evidence-based design and sustainable design can enhance the overall look, feel and function of a hospital.
4.	Focusing on operations is also a key to a successful programme.

how the buildings we design affect clinical, environmental, operational and financial outcomes for patients, caregivers and healthcare executives. Research is but a means to an end – the end being the art and science of designing better buildings which directly contribute to improved outcomes.

Each architectural project has its own unique set of opportunities and constraints. Even projects with stated sustainability and evidence-based design goals are often replete with decisions requiring one goal – either sustainability or evidence-based design – to be prioritised over the other. As a follow-up to the formal survey and data collection activities of the research study described herein, we are examining a range of possibilities for how, what appear to be, prioritisation conflicts can be resolved in a more balanced way on projects currently in design.

In response to the question posed in the second paragraph of this paper – “... does a building footprint that introduces natural daylight into technologically complex healthcare environments (such as surgery, radiology and procedural medicine suites) inherently increase travel distances, compromise desired clinical adjacencies and complicate opportunities for future flexibility and incremental adoption of changes in medical technology and operations?” – we

have initiated our own inquiry which we refer to as “humanising the deep floor plate”. As part of this investigation, we are studying a range of design approaches for creating an exemplar surgical and interventional platform that addresses a range of sustainable, or qualitative, criteria – such as natural daylighting, clear wayfinding and creating a humane interior scale – while at the same time meeting evidence-based, or quantitative, criteria – such as providing for future flexibility, maintaining short travel distances between the operating rooms and recovery space, and accommodating complex medical technology that can be shared among various specialists. In most instances, it is easy to address either the sustainable or the evidence-based design criteria in isolation, but the challenge becomes incrementally more difficult when addressing one set of needs without simultaneously compromising the other set.

Project priorities

The following paragraphs describe three discrete projects currently in design. Each project has both clearly stated sustainable and evidence-based goals which are successfully addressed by various innovative design concepts. However, the ways in which the surgical/interventional platforms are designed vary significantly from project to project. These



Figure 6. Surgical platform designed with evidence-based design as a primary driver



Figure 7 Surgical platform designed with sustainable design as a primary driver

variations reflect different site conditions as well as different values and priorities regarding primary versus secondary design drivers. In other words, while each project satisfies the stated sustainable and evidence-based design goals, one project prioritises the qualitative goals of sustainability, one project prioritises the quantitative goals of evidence based design, and one project prioritises a balanced integration of both sustainability and evidence-based concepts.

Figure 6 illustrates a dense urban hospital where building the maximum allowable site coverage was necessary in order to accommodate the full programme. While there were few opportunities to ‘penetrate’ the deep floor plate with courtyards, skylights or building separations, some opportunities for peripheral corridors to bring ‘borrowed’ natural light into procedural spaces were leveraged. The floor evolved as a deep block of space with indentations minimally carved along a few edges. As a result, critical functional adjacencies remained intact, frequent travel distances for vulnerable patients were kept extremely short and multiple strategies for future flexibility prevailed – but harvesting of natural daylight internally was limited.

Figure 7 illustrates a similar programme arrayed on a less restrictive site where an abundance of natural daylight triumphed as a driving goal. In contrast to Figure 6, this solution evolved as separate narrow blocks of space connected with bridges or corridors surrounding courtyards and building setbacks to form a composition of sub-components that make up the floor plate. As a result, each room has access to daylight, wayfinding is simplified through one’s ability to see ‘building landmarks’ through exterior windows and the scale of this technologically-complex suite appears humane and intimate. Travel distances, however, are lengthened in some locations and flexibility is somewhat compromised due to the floor’s narrow footprint.

Figure 8 illustrates a hybrid approach where qualitative and quantitative design drivers were balanced to the extent possible. The site is less restrictive than that in Figure 6 but more restrictive than that in Figure 7. The configuration evolved beginning with a dense deep footprint which was then carefully penetrated by two strategically placed courtyards arrayed in such a way that they separate the procedural zone from the pre-op and recovery zone of the platform,

yet retain a relatively deep dimension for each zone. Daylight is harvested both by maximising perimeter and courtyard light and carrying it into procedure rooms with integral windows. The resulting configuration and articulation of the floor minimises critical travel distances, provides multiple opportunities for future flexibility, and yet provides internal spaces that are naturally illuminated and are characterised by clear wayfinding and a humane scale.

Because each project is driven by the unique prioritised values of its respective team, it would be inappropriate to suggest that one project is more successful than another. Similarly, it would be inappropriate to suggest that sustainability is more important than is evidence-based design, or vice versa. Rather, one could deduce that no two projects are identical, especially when designing environments that accommodate extremely complex medical procedures, diverse patient populations and unique caregivers. The success of each project should be determined not by how well it meets any one specific design objective, but rather by understanding how each goal has been prioritised for that specific project and by how well each goal has been met relative to the degree that other goals have not been compromised.

- 1 IR / CATH
- 2 OR
- 3 ENDOSCOPY
- 4 PACU
- 5 PRE-OP
- 6 PATHOLOGY
- 7 LIGHT COURT
- 8 CLEAN CORE
- 9 STAFF CORE



Figure 8. Surgical platform designed with both sustainable design and evidence-based design as primary design drivers

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Through Children's Eyes: Understanding how to create supportive healthcare environments for children and adolescents

This study of children and adolescents in hospital identified a range of factors key to improving their experience in the healthcare environment

Kate Bishop PhD

Understanding children's and young people's experience of hospital environments and what constitutes their ideas of a supportive environment can only strengthen the capacity of designers, healthcare professionals and policy makers to create hospitals which support their needs. However the challenges of completing healthcare design research with children and adolescents in hospital environments means that not much of it exists.

Over the last 15 years, participatory research with children and adolescents has been embraced by many disciplines. This is in response to the recognition that children and adolescents have critical and unique perspectives on their experience, which have the capacity to challenge adult assumptions

about their lives and to ground them in the reality of children's lives!

This paper discusses a participatory qualitative case study, completed with children and adolescents in a children's hospital in Sydney, Australia. The participants involved in the study were aged between nine and 18 years and had been resident in the hospital for at least seven days.

The aims of the research were firstly to understand what constitutes a supportive paediatric setting from children and adolescents' perspectives; secondly, to describe the roles of the physical environment in children's feeling of wellbeing; and thirdly, to illustrate the value of participatory research to healthcare design.

The findings from this study indicate that children and adolescents seek to actively manage, negotiate and cope with their time



Outside the main entrance of The Children's Hospital at Westmead

in hospital. They value an interactive, engaging and aesthetically pleasing environment and a friendly, caring welcome from the hospital community. Children's and adolescents' assessment of the appropriateness of the environment is linked to the aesthetics of the environment, the volume of age-appropriate activities there are available within the hospital and the friendliness and welcome they receive from the hospital community.

Their feeling of wellbeing in hospital is dependent on their capacity to remain engaged, maintain a positive frame of mind and to feel comfortable in the hospital setting. The concept of person-environment fit for children in a hospital setting, which emerges from this study, is a dynamic interaction between patients and their environment which is influenced by the patient's individual circumstances and the amount of time they spend in the environment^{2,3}.

Supporting children's experience of fit in a hospital setting means being mindful of the need to support children's choices, needs and purposes and their capacity for self-help⁴. In particular, a supportive environment should not resist children's efforts at self-help and should recognise the dynamic cycles of mutual influence between patient and environment that underpin children's struggle for their feeling of wellbeing in hospital.

The key physical attributes identified in



Wards overlooking the children's garden



The book bunker combines a learning opportunity with social interaction



A treatment room in The Children's Hospital at Westmead

this study include aesthetics (colour, artwork and brightness), spatial variety (in particular the function and variety of non-medical spaces) and, thirdly, the value participants gave to adaptability and flexibility in the environment.

Supportive hospital environment

As stated, research with children and adolescents in hospital environments is limited. It provides an incomplete patchwork of considerations relevant to children's experience of hospitalisation. However, the evidence that exists on children's experience of hospitalisation is formative, identifying aspects of the experience that children and adolescents consider supportive in a healthcare context.

From the earliest research on children's experience of hospitalisation, or with children and adolescents in hospital environments, there have been a number of persistent themes. Early research revealed that personal considerations include the need to provide opportunities for self-care management, confidentiality, competence, control and choice⁵⁻⁷. Social considerations include the

need for social support and social contact with friends and families^{5,6}.

Organisational considerations involve the need to provide adequate cognitive stimulation, and access to recreational and learning activities⁵⁻⁷. Physical environmental considerations include the need for personal space, privacy, independent movement and comfort within the environment⁵⁻⁷.

More recent research has supplemented these findings and added further considerations for all domains including physical environmental considerations, such as the need for age-appropriate spaces and interiors, especially for adolescents⁸⁻¹⁴; respecting the importance of having personal possessions for patients and being able to personalise their bed area^{8,15}; identifying a preference for colour and artwork in the environment^{8,16,17}; and identifying the importance of having access to gardens in the hospital environment¹⁸⁻²⁰.

Social considerations such as understanding the importance of having access to school^{13,21}; understanding the importance of good provision for families and their needs²¹⁻²³; and the need for active support, professionalism,

respect and friendliness from staff^{21,22} have also been established in recent research.

Organisational considerations include the need for the provision of age-appropriate activities, especially for adolescents⁸⁻¹⁴; and the need for information that supports children's and adolescents' understanding of their own situation and their capacity to participate in their own healthcare management^{21,22,25,26}. Food and its quality, variation, and choice were also important considerations for adolescents^{8,9}.

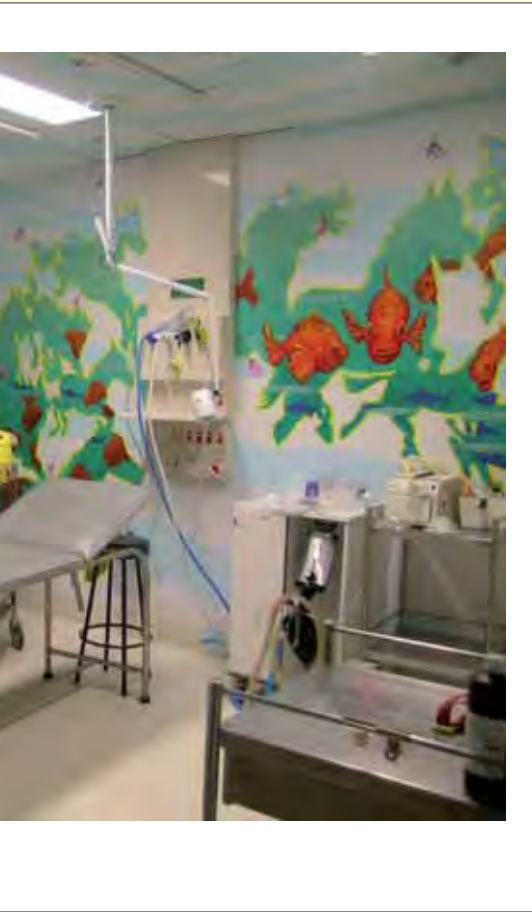
There are three notable limitations of current research into children's and adolescents' experience of hospitalisation. The first is that the current understanding does not provide a holistic picture of their experience; secondly, many of the findings do not supplement the identification of an important attribute within children's and adolescents' experience with an understanding of why it is important and what role it is playing; and thirdly, not all of these studies were completed with children and adolescents who were in, or had experienced, a hospital environment.



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To be able to assemble the key attributes in a hospital environment effectively, there has to be a greater understanding from children themselves of how they use them and what for.

To reach this understanding, research needs to be carried out with children and adolescents in the context of healthcare environments, or with those who have experienced hospital settings.

Research design and methods

Our study consisted of a single qualitative case study. Qualitative research offers children and adolescents an opportunity for them to give direct accounts of their experience and reveal their competence as critics and commentators on their own lives²⁷⁻³⁴.

The case centred on the experience of longer-term patients in a modern paediatric hospital – The Children’s Hospital at Westmead in Sydney, Australia. Participants had to have been admitted to the hospital for at least seven days at the time they were interviewed. The study was completed in four stages involving 55 children and adolescents aged 7-18 years; 41 of these were patients

in the hospital and 14 participated in a pilot study completed with children and adolescents who were not patients. Twenty-four of the 55 participants were involved in pilot studies, including nine boys aged 7-16 years and 15 girls aged 7-18 years. Thirty-one participants were involved in the main study, including 13 boys aged 9-17 years and 18 girls aged 10-18 years.

Stage one consisted of a series of pilot studies designed to refine the questions for research and methods of data collection. This stage provided children and adolescents with the opportunity to shape the development of the study and the methods used.

Stage two consisted of the data collection phase for the main study. Children and adolescents were asked to complete a single interview which consisted of three tasks. Task A included an informal discussion centred on a set of photographs of the hospital environment taken by participants in the second pilot study. Task B involved answering a set of 30 questions spanning the possible domains and dimensions of children’s experience of hospitalisation and wellbeing derived from both the literature and the findings from the pilot studies. Task C involved a game task which functioned as a consistency check within each interview.

Stage three involved the analysis of the data. The interviews resulted in three sets of data, including two sets of narrative data from tasks A and B which were analysed using concept mapping³⁵ and thematic analysis techniques³⁶⁻⁴⁰, and the game task results which required tallying. The results from each of the three data sets were triangulated to create preliminary findings. These were then taken back to a group of six patients who were representative of the profile of participants in the main study as part of a member-checking exercise, before stage four, when conclusions were finalised.

Research findings

A supportive paediatric environment: The findings from this study provided a preliminary definition of a supportive paediatric environment which includes:

- an environment that supports children’s feelings of wellbeing by addressing their need to feel comfortable in the environment, maintain a positive frame of mind and remain positively engaged;

- an environment that facilitates children’s goodness of fit by supporting individual choice, control and self-help and by minimising unwanted distractions (such as noise, light and unsolicited social contact); and

- an environment that maximises the opportunities to include features which are identified by the study as indicating child-friendliness. These include maximising the volume of age-appropriate activities in the environment, and providing a bright and colourful environment and a welcoming and friendly social environment.

Children’s feeling of wellbeing in hospital:

The study also revealed that the concept of feeling of wellbeing is a subjective and fluctuating self-assessment that encompasses three principal components:

- children’s capacity to feel comfortable in the environment where comfort is understood to be comprised of physical, social and emotional considerations;

- children’s capacity to maintain a positive frame of mind that encompasses their capacity to minimise the impact of difficulty and boredom, and maximise the opportunity of having positive and entertaining experiences; and

- children’s capacity to remain positively engaged, which encompasses children’s active involvement and participation in their experience of hospitalisation, enabling them to exert control and to experience competence and empowerment.

Participatory research and healthcare design:

Participatory research with children and adolescents in healthcare environments challenges the way children and young people are conceptualised and therefore the way they may be accommodated in design.

This study indicates that children and adolescents should be conceptualised as active shapers, managers and negotiators of their experience in hospital which is in keeping with the sociological conceptualisation of children as social agents in their own lives⁴¹.

This breaks from a more traditional conceptualisation of patients as passive recipients of care at the mercy of stressful, overbearing healthcare environments.

The conceptualisation that emerged in this study encompasses children’s preference for inclusion and participation in all aspects of their experience and their expectation of

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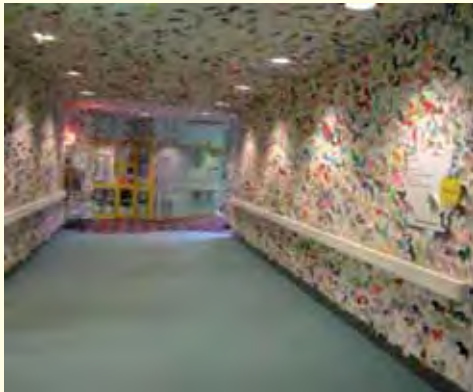
active self-management as far as possible. In particular participatory research challenges adult assumptions about children's lives and challenges adult's depictions of them. This in turn will challenge the way they conceive of accommodating children and adolescents within any design. It also has the capacity to ground adult understanding in the reality of children's experience rather than the imagined reality of children's experience. This identifies the importance of completing research with children and adolescents in the contexts in which their experience is taking place.

A specific example of how information from children and young people themselves may challenge trends in healthcare design, if they were allowed to, concerns the configuration of ward rooms. Currently there is an increasing trend to support the design of wards which consist entirely of single rooms. This is driven largely by a medical agenda to improve infection control, although this is not well substantiated in research at present⁴². In this study, half of the sample preferred single rooms and half preferred shared rooms.

Sharing was preferred by participants because it provided company and prevented them from being alone and feeling lonely. Shared rooms consisting of two people were considered the optimum. Single rooms were preferred because they gave the participant control over the social contact they would have with other patients, as well as more privacy with their families. In light of the current trend for single rooms, the experience of a modern hospital for many of the participants in this study would be without the social support and contact that they need and it may even give rise to new fears of being alone. If children's views on this subject and children's holistic needs were allowed to influence the final design preference and solution adopted, a very different design trend may be advocated.

Design recommendations

This study sought to identify attributes of the physical environment that were involved in children's and adolescents' feeling of wellbeing in a hospital environment. The three main design recommendations that resulted from this study include environmental aesthetics, spatial variety and the need for adaptability and flexibility in the environment.



Art project: Butterfly installation



The roles of environmental aesthetics: The environmental aesthetic features that children and adolescents discussed in this study included artwork, colour and brightness. Through these three aesthetic elements, children and adolescents perceive messages of welcome, comfort, appropriateness and fun. In combination, these three elements help children and adolescents to sustain a positive frame of mind and to remain positively engaged, both of which directly contribute to their feeling of wellbeing. The key features in relation to each of the three elements include:

- Artwork: art should be age-appropriate and without the simplistic images associated with young children. It should include artwork completed by other children and adolescents, as this artwork in particular conveyed messages of support and welcome and the importance of children's welfare

to the organisation.

- Colour: the environment should include a large amount of colour – preferably bright colour – and this should vary around the environment.

- Brightness: brightness is a nebulous concept that represents a composite assessment of a range of environmental features, potentially involving many different aspects of the environment, including the need for a lot of colour, artwork, light and plants in the environment. Anything in the environment can contribute to the assessment of brightness, ranging from the social attitudes

of the hospital community to the colour of carpet and furniture, and the size and placement of windows and skylights.

The importance of spatial variety and function: Spatial variety encompasses the need for non-medical places and spaces offering a range of different activities, atmospheres and spatial qualities, including outdoor and natural areas. This spatial variation plays a key role in enabling patients to meet their needs for environmental contrast, emotional self-regulation and self-restoration and to exercise control and self-management. Specifically,

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these recommendations include:

- providing facilities which enable children and adolescents to carry out normal routines with their friends and family, such as cafes, shops, common room areas, play areas and age-appropriate areas for socialising (particularly for adolescents); and
- providing access to outdoor areas and natural environments for contrast and to enable patients to escape and to experience a restorative environment. 'Natural' green places (gardens, in this study) are preferred areas and play a key role in patients' emotional self-regulation and self-restoration and their ability to access privacy, as well as providing greatly appreciated environmental contrast with the indoor environment of the hospital.

The value of flexibility and adaptability:

Providing flexible and adaptable environments or environmental attributes means providing patients with the capacity to alter their immediate environment. This translates into providing patients with the capacity to experience control, express their identity and reveal their interests, to alter the environment aesthetically and to personalise it with familiar and valued objects.

Being able to personalise their bed area was the best representation of this in this study. The value in being able to do this for patients is in their capacity to feel more comfortable in the environment and less removed from their lives outside of hospital. It also reduces the strangeness of the environment and the experience of hospitalisation. Any opportunity

to increase the capacity for patients to manipulate their environment in a hospital design would be appreciated by children and adolescents.

Conclusion

The findings reveal that children's and adolescents' experience of the paediatric setting involves a number of major areas of influence including their personal situation, their social experience, their interaction with the physical environment, the opportunities and characteristics of the organisation, and the effect of time.

The findings also reveal that children's feeling of wellbeing within this experience is linked to their ability to feel comfortable in the environment, to maintain a positive state of mind and to remain positively engaged with the experience and the environment. Children and adolescents reveal that they are active shapers, managers and negotiators of their time in hospital.

Completing research in a healthcare context is difficult. However, it is only through children's and adolescents' participation in research and design processes that we can be sure that we have identified the specific considerations which are formative in their experience as patients. We should not be designing paediatric healthcare settings that do not reflect evidence from children's and adolescents' lived experience of hospital environments.

Participatory research with children and young people can provide rich insight into their experience of a paediatric hospital setting



Example of a personalised bed area



School room at The Children's Hospital at Westmead

which can only enrich our understanding and our capacity to provide hospital environments that support their needs.

Author

Kate Bishop PhD is an Australian researcher and design consultant specialising in children, youth and environments

The full thesis is available online and can be downloaded from the Australian Digital Thesis database at <http://hdl.handle.net/2123/3962>

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Patient & Staff Environments: **The impact of daylight and windows on ICU patients and staff**

Access to windows and window views are particularly important in intensive care units where patients are more vulnerable and staff are likely to be more susceptible to stress

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When Concord Hospital in New Hampshire decided to replace its existing intensive care unit (ICU), a focus on both patient and staff needs was deemed essential. While patient requirements were typically recognised as a priority, staff needs were often poorly addressed. Based on the culture at Concord Hospital, the design team decided to support both patients and staff by creating access to daylight and views, not only from patient rooms but also from staff areas.

This research project looks at the impact of windows and window views on patient outcomes and staff behaviour in an ICU, comparing the old ICU at Concord Hospital to the newly constructed one, which was designed to increase window views and daylight within the facility.

The new ICU was planned for the second floor of an addition that is located on a sloping and constricted site, next to an existing road. To accommodate the unit within a two-storey grade change, the design team carved out gardens around the addition, creating views into a large, sunken garden on the north, which would have otherwise been underground. The adjacent roof to the west was planned as an accessible garden.

As a result, all patient rooms and many staff areas have direct views to gardens or distant

views of nature. While some of these design elements required more effort and capital investment, the design team believed that this would be offset by the benefits of nature views and daylight on the unit.

Literature review

Evidence exists suggesting that windows in ICUs can reduce patient delirium^{1,2}. In addition, views of nature can reduce postoperative stays, negative evaluative comments in nurses' notes and requests for strong analgesics in acute care units³.

Furthermore, natural sunlight can reduce the perception of pain and requests for medication⁴.

Regarding staff, windows have been found to improve job satisfaction and retention in offices⁵, although no studies were found that addressed the impact of windows on healthcare staff.

Research relevant to this topic includes studies on the impact of windows, the impact of views and daylight, and the nature of stress in intensive care units on patients and staff.

Studies on the impact of windows

Markus⁶ emphasised four factors which influence window design: sunshine, awareness, view and lack of privacy.

In his study he noted that being close to a window was highly desirable regardless of the size of the visual field. Keighley⁷ found that satisfaction regarding windows was influenced by area and proportion

and the number and width of mullions. The most preferred windows were horizontal apertures occupying 25-30% of the exterior wall. Roessler⁸ found that unpleasant feelings of enclosure were minimal with a window width of at least 1.5 metres.

The ideal was two lateral windows with a total width of 3-4 metres in a six-metre-wide room. Finnegan and Solomon⁹ found differences regarding job satisfaction, how interesting the job was perceived to be, physical working conditions and overall experience in favour of windowed spaces.

Windows in healthcare settings

In 1972 Wilson compared the incidence of postoperative delirium in patients located in windowed and windowless ICUs².

Twice as many windowless patients demonstrated delirium and, among patients with abnormal haemoglobin or blood urea, the incidence was threefold. Hallucinations were more than twice as high in a new windowless unit than in the old unit¹.

Ulrich³ noted that gall bladder surgery patients who had nature views had a shorter length of stay, took less pain medication and made fewer negative comments than those who had views of a building wall.

Verderber¹⁰ found that windows with high sills, distant from the viewer or obscured by walls and furnishing, were ranked as poorly as having no windows at all. Verderber and Reuman¹¹ compared inpatient and staff experience to windows and views

Patients were more negatively impacted by rooms with limited fenestration than staff. Being located more than 10 feet from a window significantly impacted patients who were immobile, visually impaired or non-Caucasian.

Sunlight and daylight in healthcare

Ne'eman¹² noted the following positive contributions of sunshine: warmth, functional lighting, contact with the outside and biological effects of solar radiation.

He found that 2% of patients and 62% of staff considered sunlight to be a nuisance, while 91% of patients and 31% of staff considered sunlight to be pleasurable.

In hospitals, when forced to choose between good views without indoor sunshine and unpleasant views with indoor sunshine, 50% preferred the former while 31% preferred the latter.

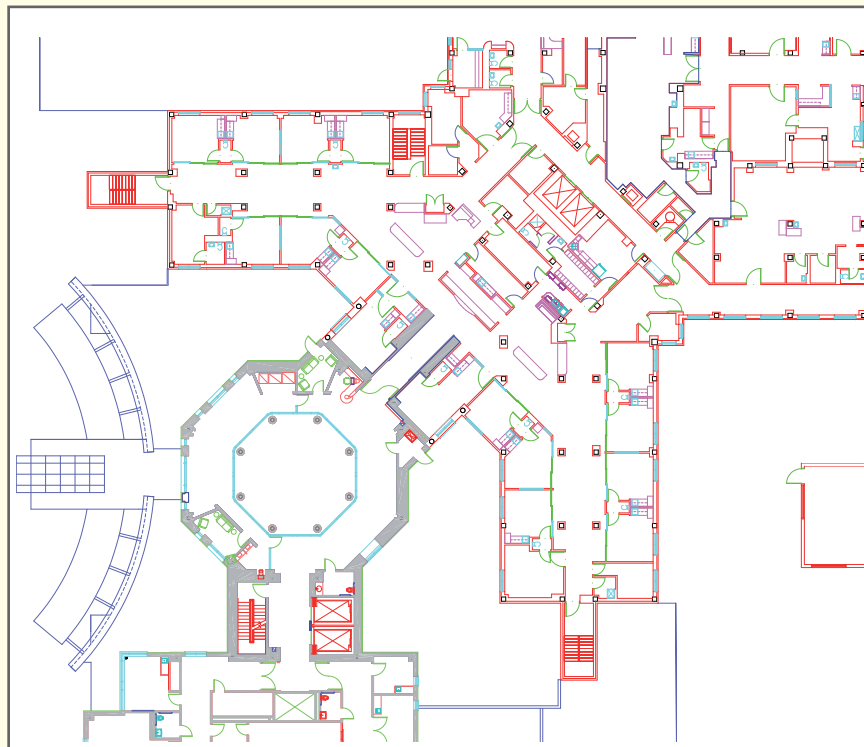


Figure 1: Phase One ICU unit

Walch *et al*⁴ compared the use of pain medications in patients who were on the bright and dim side of a hospital. Those on the bright side were exposed to 46% higher sun intensity and perceived less stress and less pain and took fewer analgesics.

Patient stress

Of all the participants in the ICU setting, patients are the most vulnerable to stress. Lusk and Lash¹³ have identified three main categories of ICU stressors: psychological (danger of death, social isolation), treatment-related (artificial ventilation, tubes, painful procedures) and environmental (unfamiliar surroundings, activity and noise, worrisome sights and sensations, sleep deprivation).

The most comprehensive body of literature regarding the experience of ICU patients addresses a phenomenon known as ICU psychosis or ICU syndrome. Behaviours associated with this syndrome include disorientation and dysfunction.

These problems express themselves in the following behaviours: lack of awareness of one's environment, memory loss, sleep disorders, hallucinations, anger, fear and depression¹⁴.

While some occurrences of delirium may

also be specifically associated with a physical life-threatening disorder¹⁵, most researchers acknowledge the independent impact of the environment as well.

Multiple authors have identified the physical environment as a contributor to ICU syndrome¹⁶⁻¹⁸. In a literature review by Easton and Mackenzie¹⁹, noise, constant light levels, unfamiliar environments and sensory overload were implicated in ICU syndrome.

Many of the negative environmental attributes lead to sleep deprivation, which in turn may have a critical impact on psychosis.

Medical staff

Stress has a significant impact on all participants in the healthcare environment; while staff may appear to be less affected than patients, there is significant research to suggest that the medical professions are among the most emotionally challenging.

ICU nurses may be particularly susceptible to stress²⁰. In a recent study, Mealer, Shelton, Berg, Rothbaum and Moss²¹ found a higher incidence of post-traumatic stress syndrome in ICU nurses (see also Maloney²²).

With specific regard to the physical environment, researchers have identified the following factors that negatively impact staff:

inappropriate access to equipment, inadequate storage space, poor design, inadequate function of biomedical equipment²³ and poor equipment, inadequate work space, noise, poor work environment, lack of supplies, too many people and inappropriate lighting²⁴.

The literature on ICU physician stress is more limited, although it is clear that doctors experience intense challenges in the medical environment. Coomber, Todd, Park, Baxter, Firth-Cozens and Shore²⁵ found that one-third of ICU physicians were distressed, one-tenth were depressed and 3% experienced suicidal thoughts (see also Firth-Cozens²⁶).

Of the stressors that were reported, the most frequent were the poor prognosis or death of a patient and the physical setting. The highest stressor was allocating beds when the unit was full, because sufficient capacity to provide care may be critical to patient survival. Goodfellow *et al*²⁷ found that 27% of ICU physicians experience psychiatric difficulties.

Methodology

This study compared the impact of increased daylighting and window views on staff, patients and families by comparing the behaviours and outcomes of subjects in an old intensive care unit (Phase 1), characterised by lower overall daylight levels and limited views of nature, to behaviours of subjects in a new ICU (Phase 2), which had higher daylight levels and improved views of nature.

The new ICU was occupied when the old ICU was shut down. Both ICUs were located in the same hospital and staffed by the same medical personnel, with the exception of those lost by attrition and new hires. This paper focuses on the results from Phase 1.

Phase 1 site: The old 11,600 building gross square foot ICU consisted of two adjoining wings in a building constructed in 1956 in a cruciform configuration.

The unit consisted of 16 beds with eight beds on each wing. Each unit had a central nurses' station at the intersection of the two wings with support spaces between the two stations and access from both.

Decentralised standing-height computer workstations were located on each wing closer to the patient rooms.

The view from each nurse's station and workstations did not allow for any exterior views other than one obstructed view

through the window of the patient room nearest to the station, assuming the cubicle door was in the open position.

The only unobstructed exterior views available to staff were from two offices and a small staff lounge. Most views were of other buildings nearby.

Fourteen of the patient rooms were approximately 174 square feet, each with two larger isolation rooms. In each patient room the free-standing headwall unit was angled at

45 degrees from an exterior corner of the room. Consequently, the patient's view was oriented 135 degrees away from direct view of the windows.

Phase 2 site: The new 19,100 building gross square foot ICU is configured in two linked sub-units completed in 2008. The ICU consists of 20 beds with two large clinical work areas and decentralised nurse's stations between pairs of rooms.

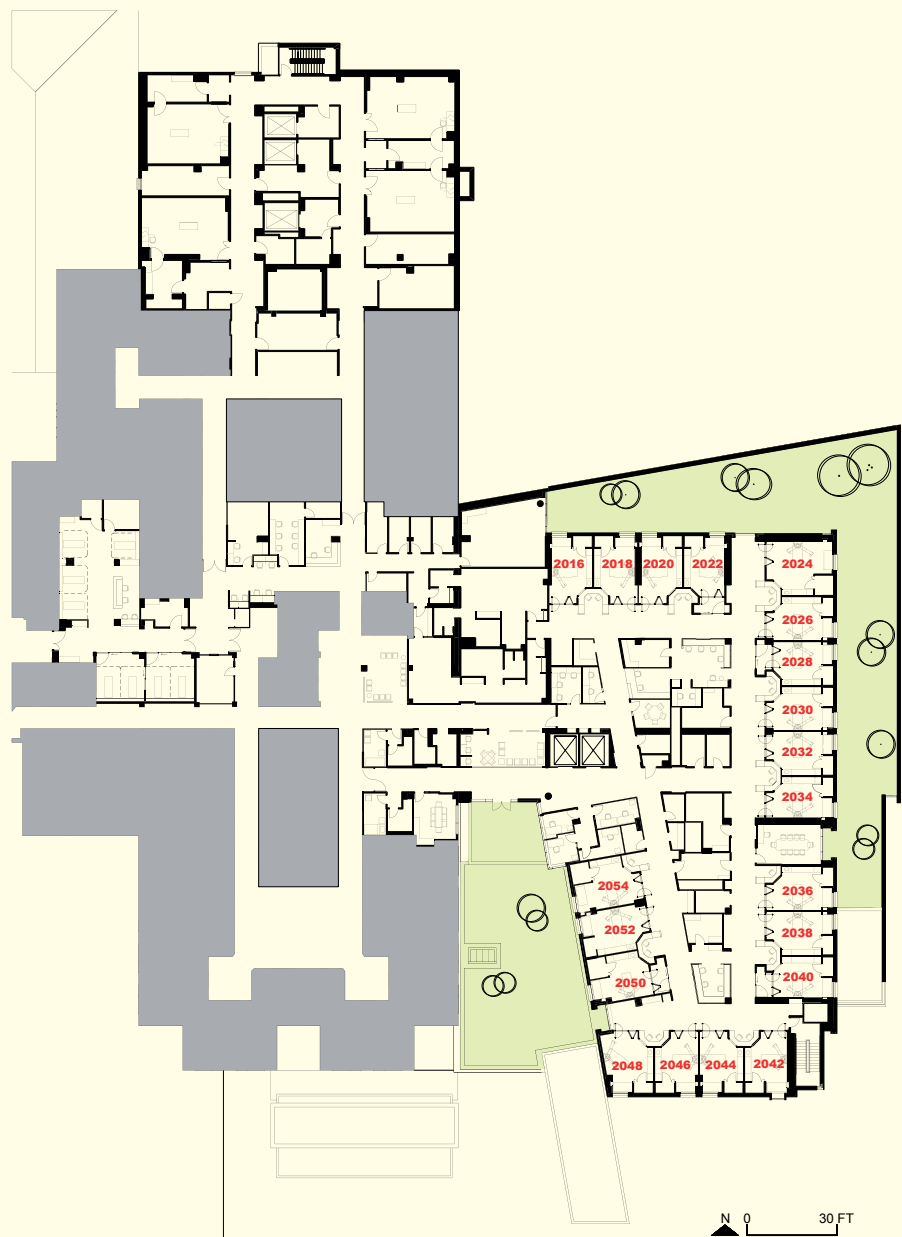


Figure 2: Phase 2 ICU

Both large clinical work areas have direct views to the outdoors via the termini of the corridors, while decentralised stations have views outside through patient rooms and through windows at the termini of the corridors of the facility.

Several patient rooms, a corridor terminus, the staff lounge and two offices have views of a rooftop garden. The majority of the remaining patient rooms, a conference room and the terminus of another corridor look out to a newly planted garden.

The patient rooms range in size from 256 to 328 square feet, plus four isolation rooms ranging from 280 to 292 square feet, including the anteroom. In each patient room, the patient bed is oriented perpendicular to the window wall to allow for a direct view out of the window; a wall-mounted boom system for monitors and medical gases allows the bed to be oriented directly toward the window if clinical conditions allow.

Staff attrition, absenteeism and medical errors: Subjects included all medical staff assigned to the unit on a regular basis between October 2006 and September 2007 (Phase 1) and between March 2008 and February 2009 (Phase 2).

Patient length of stay, mortality and pain perception: During these timeframes, patient subjects included those who were staying in the ICU due to cardiac surgery (coronary bypass, aortic valve replacement), pneumonia and chronic obstructive pulmonary disease (COPD); patients who were residing in the ICU for two days or more; and patients whose rooms faced directly south, east, north or west. Fifty-eight were selected for inclusion in Phase 1.

Procedure: The protocol for this study was reviewed by the Institutional Review Board of the hospital. The anonymity of all subjects was maintained throughout the study.

Independent variables: The following data was gathered regarding window attributes (per Verderber¹): proximity of head of bed to window, window to total wall area ratio (percentage), and sill height above floor.

Sunlight intensity data (per Walch *et al*⁴) was also gathered. Light intensity (lux) was measured twice daily in patient rooms at approximately 9:30am and approximately

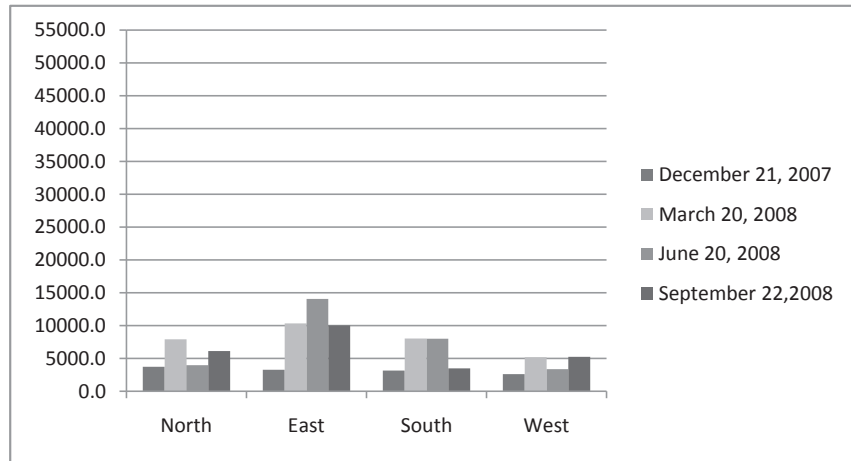


Figure 3: Lux levels in old unit

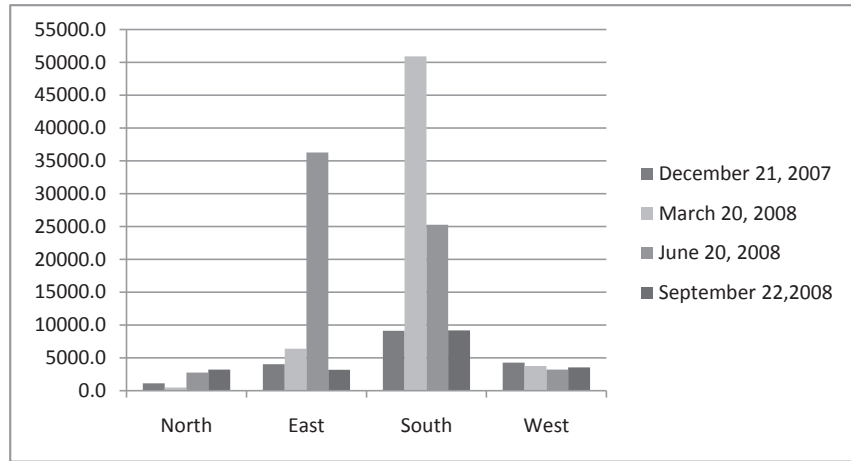


Figure 4: Lux levels in new unit

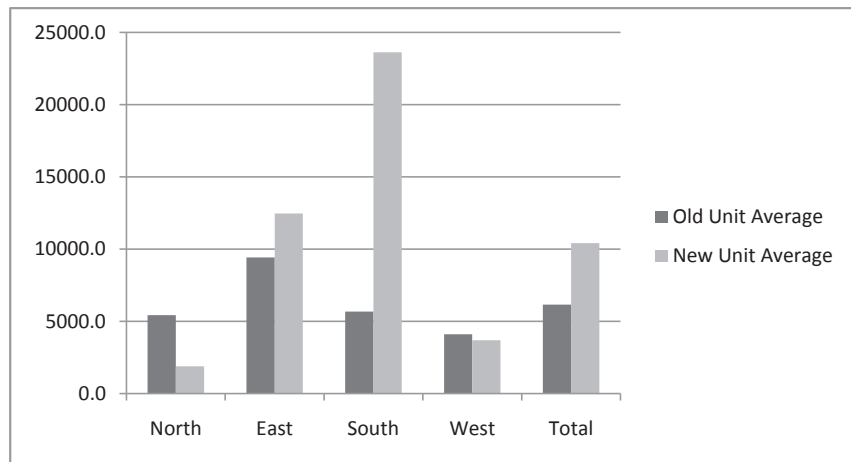


Figure 5: Comparison between units regarding average lux level

3:30pm within five days of 21 June, 21 September, 21 December and 21 March. Prior to measurement, the door was closed and artificial lights turned off. Window blinds were opened. Direct, reflective and ambient measurements were taken.

Data was also collected regarding views (% of nature of total view) as seen from the head of bed.

Dependent variables: Data was gathered for both phases by hospital staff and included: staff attrition, staff absenteeism, medical errors, patient length of stay, patient mortality and perceived pain.

Results

This paper summarises the results of light level measurements for the new and old ICUs as well as data from Phase I regarding staff absenteeism and patient demographics, length of stay, pain perception and medical errors.

Light level measurements: The total average lux levels for each of the two units are shown in Figures 3 and 4. These results demonstrate a significant variation in light levels for the new unit compared to the old unit. Figure 5 compares the new and old units simultaneously and serves to demonstrate the overall higher average in the new unit.

Patient demographics, length of stay and pain perception: The average age of the 58 patient subjects (40 men and 18 women) was 66.6 years. The average length of stay of these subjects was 3.51 days, ranging from two to 15 days. Staff evaluated patient pain as a part of standard patient care protocol every few hours. The average pain described by patients (and on some occasions assessed by staff) on a scale of 0 to 10 was 1.48, ranging from 0 to 9 (see Figure 6).

Staff absenteeism: Data from Phase I indicated that staff absenteeism varied from 158 to 722 hours per month and averaged 368.33 hours (see Figure 7).

Medical errors: In the ICU, medical errors are reported voluntarily on a Process Improvement Data Sheet (PIDS). During Phase I, 79 errors were reported, 36% of which were errors in the administering of medications, followed by errors associated with order entries (15%) (see Figure 8).

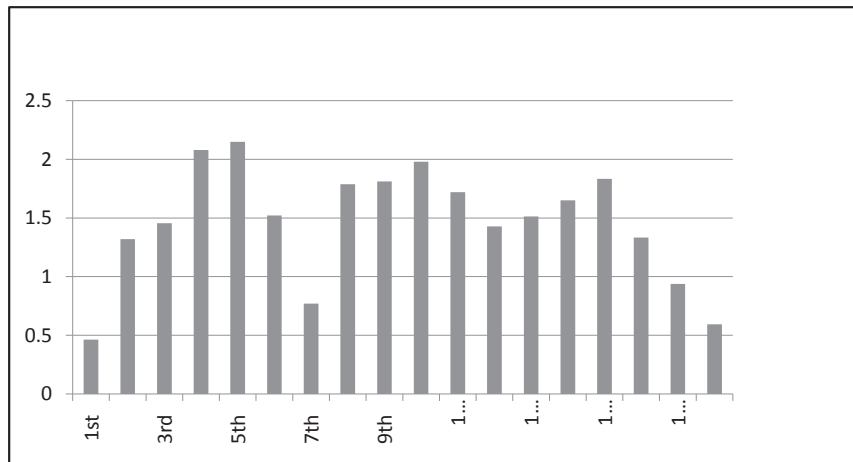


Figure 6: Average perceived pain, 18 sequential observations, on a scale of 0 to 10

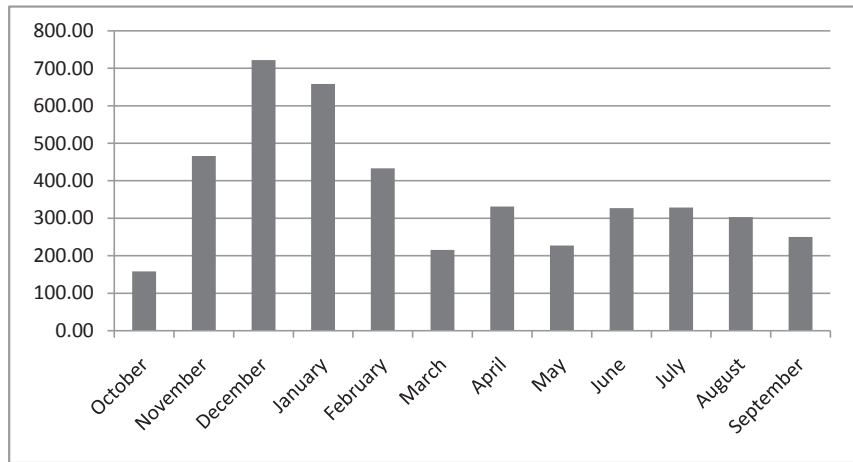


Figure 7: Hours of staff absenteeism in the old unit in Phase I

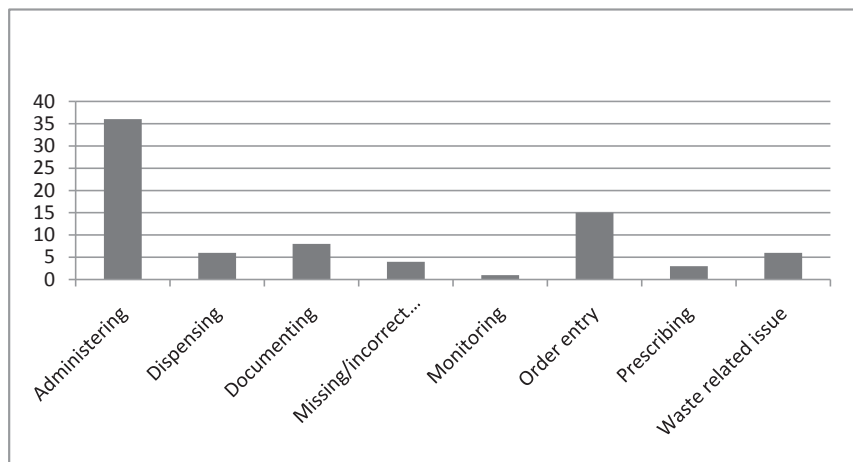


Figure 8: Process Improvement Data Sheet filings

Discussion

Much has been written about the impact of daylight and views of nature in waiting areas and acute care patient rooms, although little information is available regarding the impact of these environmental amenities on intensive care units.

Of all the spaces in hospitals, however, ICUs are among the most important, if a designer is concerned with providing the most sensitive design solutions in the locations where the participants (patients, families and staff) are most vulnerable.

According to Powell Lawton's Environmental Competence Press Theory, the more compromised the personal resources of the individual, the more sensitive they are to negative aspects of the physical environment – and a balance must be achieved between the psychosocial competence of the individual and the challenge of the environment.

Both patients and staff are likely to be more stressed in the intensive care unit setting and, therefore, require a more supportive physical environment.

This study provides a description of a methodology that could potentially be applied in similar studies involving pre- and post-occupancy evaluations.

The results provide data regarding the light

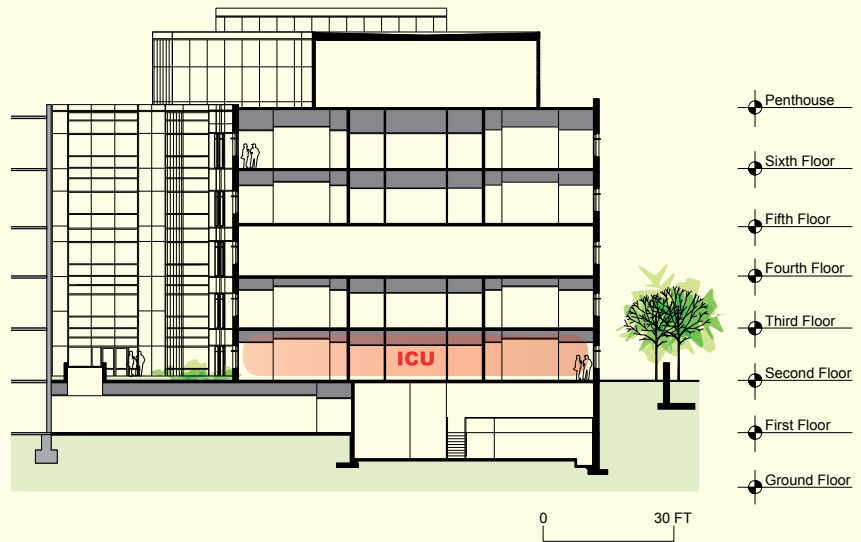


Figure 9: Environmental competence press theory (based on Lawton & Nahemow²⁸)

levels in the old and new facilities as well as the patient length of stay and pain perception associated with the physical environment in the old ICU. Also provided is data regarding staff absenteeism and medical errors on the old unit.

This data can be used to compare to outcomes associated with the new facility when it becomes available, as well as serve as a reference and comparator for other studies on this topic.

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Image courtesy of Lund Humphries

**Madness & Modernity:
Mental illness and the Visual Arts in Vienna 1900
Exhibition and book**

Wellcome Collection, London, 1 April to 28 June 2009

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Gemma Blackshaw and Leslie Topp (editors)

Lund Humphries 2009, Hardback, 166pp., ISBN 978-1-84822-020-1, £35.00

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Secession to sanity

While Sigmund Freud developed his theories of psychoanalysis, a group of Viennese artists, designers and architects developed a fresh, outward-looking approach to the design of mental health institutions, highlighted in a new book and exhibition. *Colin Martin* reports

Fin-de-siècle Vienna was the urban crucible in which 20th-century modernism was forged in visual arts, literature, music, philosophy – and in psychiatry. Historian Edward Timms has published Venn diagrams showing how overlapping memberships of Viennese intellectual and cultural circles facilitated the development of modernist ideas and debate within

and across professional disciplines. In 1897, Gustav Klimt founded the Viennese Secession, a group of artists, designers and architects which rejected tradition and created a new art for a new age. At the same time, Sigmund Freud was developing his psychoanalytical theories.

Many Viennese viewed themselves as living in a 'nervous age.' Mental illness was stigmatised but controllable nervous disorders such as hysteria and neurasthenia were accepted and even perceived by some as fashionable. An exhibition in London and a newly published book examine the influence of contemporary Viennese psychiatry on early modernism and how modernist architecture and design influenced the lives of mentally ill or neurotic patients.

Psychiatrist Richard von Krafft-Ebing believed people were made



Poster advertising the sanatorium section of 'am Steinhof', with watercolours by Erwin Pendl



Purkersdorf Sanatorium, 1903-04 (Josef Hoffmann)

neurotic by the pressures of urban life and that providing patients with light and air in peaceful rural areas was important in treating nervous disorders. His pragmatic approach was a rational alternative to Freud's 'talking cure'. Rationally designed early 20th-century mental hospitals and sanatoriums encouraged patients to look outwards, in contrast to the inward focus Freud advocated in the cluttered environment of his 19th-century consulting room.

To provide historical context, the first exhibit is a model of the Narrenturm ('Tower of Fools'), a drum-shaped asylum of five stacked rings, each with 28 cells opening onto circular corridors. Built in 1784 to isolate and confine 'dangerous lunatics', its poorly fed inmates were chained to their cell walls and slept on straw sleeping mats. Builders of new Viennese psychiatric institutions in the first decade of the 20th century admired some of the rational aspects of its design but were repelled by the inhumane treatment of patients.

Two video installations by artist and film maker David Bickerstaff compensate for the lack of direct contact with the exhibited buildings. The first film explores the Narrenturm. Its soundtrack includes cooing pigeons and their wings flapping in flight, evoking the calm and freedom denied to inmates. Footsteps resounding on the wooden floors of its corridors hint at the monotony of incarcerated lives. Bickerstaff's second film installation explores Europe's largest mental hospital, built on a sloping 100-hectare site overlooking Vienna.

Viennese Secessionist architects Otto Wagner and his pupil Josef Hoffmann each designed a sanatorium for the mentally ill during the first decade of the 20th-century. Wagner won first prize in a competition for the commission to design the Lower Austrian Provincial Institution for the Cure and Care of the Mentally and Nervously Ill, 'am Steinhof' (1903-07). His site plan for 60 pavilions in a park-like setting was accepted but he only built St Leopold's (1902-04), a magnificent church for 2,500 patients and 500 hospital staff. Its gleaming white cube and golden dome dominate the summit of the hospital's main axis. Wagner's practical design included a sloping floor to facilitate its cleaning, a necessity as many patients were incontinent.

'Am Steinhof' was described by a contemporary critic as "a white city, shimmering in the bright summer sun". Male patients were housed in pavilions to the east of the main axis, with female patients to the west. Curable and quiet patients lived in pavilions closer to the hospital exit, with incurable and disruptive patients

housed further away, another example of practicality. Most patients slept in dormitories and spent their days outside, working or relaxing, but disturbed patients were isolated. Badly chipped white paint on the outside of a thick wooden door, from an isolation cell, provides mute testimony to patients' resistance to incarceration.

The main hospital treated public patients free of charge; however, there was also a self-contained sanatorium complex designed for private patients who could afford to pay. It treated less serious nervous conditions, such as hypochondria and cocaine addiction, as well as mental illness. An advertising poster depicts its elegant modern interiors and therapeutic facilities.

Hoffmann was also commissioned to design a new building for the private sanatorium, which Krafft-Ebing had established at Purkersdorf in 1890, in woodlands outside Vienna (1903-04). Its pristine design, geometrically simple and technologically advanced, was developed out of "necessity, need and the importance of hygiene", according to Hoffmann. Its severe interiors and furnishings reflected fashionable avant-garde taste. Repetitive geometric designs, including Hoffman's textiles *Sehnsucht* ('Yearning') and *Notschrei* ('Cry for Help'), were used for their calming effect. Rephrasing a later modernist mantra, this building could be described as a "machine for curing".

Colin Martin is a London-based writer on architecture, art and design, with a particular interest in their intersection with medicine and science



Architectural model of the Narrenturm (replica of older, undated model in the Niederösterreichisches Landesmuseum) Image courtesy of the Technisches Museum, Vienna

Wagner's practical design included a sloping floor to facilitate its cleaning, a necessity as many patients were incontinent

Arts and Culture

Great art puts you in touch with your humanity – the wordless response it evokes in our hearts and minds brings us to a point of stillness and empathy. Where better to place it than in the dehumanising environment of hospitals and healthcare institutions? The National Patient Environment and the Arts Conference 2009 certainly did much to remind us of the vital role the arts can play in the restoration and healing of the human spirit, from the life-affirming diversity of creative projects that Dr Sam Everington has established at his renowned Bromley by Bow 'healthy living centre' in London to the brilliant artistic interventions placed in three of Manchester's newest healthcare buildings by the Lime arts in healthcare organisation, despite the many pitfalls and problems thrown in their way by procurement and construction processes.

Ably hosted and chaired by Susan Francis, special advisor for the Commission for Architecture and the Built Environment (CABE), the day-long event kicked off with a handful of poems – from familiar classics to the highly original and the humorous – read by Isobel Montgomery Campbell, editor designate of the Poems in the Waiting Room charity.

From that uplifting start we were brought into the extraordinary world of Everington's practice, designed and run unlike any other GP's surgery, with its principles of accessibility, humanity and transformation through creative and entrepreneurial expression. Some 100 projects are now run from its base, in the heart of one of East London's poorest areas. The buildings that house this all-embracing facility are remarkable – curving, sometimes tree-like structures that create opportunities for interaction and also reflection, set in formerly neglected local authority land now reclaimed as community parkland. Sculptures, stained glass, paintings and community art works decorate every nook and cranny – not lofty, baffling, conceptual art, but art as therapeutic intervention. We learned that stained glass can be used to educate patients about their 'five fruit and veg a day' as well as illuminate a quiet corner, and paintings of babies can help to lift the shame associated, in some ethnic communities, with children born with special needs.

It is nearly always the individuals involved that make the difference between a well-intentioned scheme and a truly outstanding one – in the arts as in every other field. Though the energy, positivity and commitment of the King's Fund's 'Enhancing the Healing Environment' initiative cannot be doubted, the outcomes of its environmental improvement projects – always designed by a team of local healthcare or community professionals but never in conjunction with a designer – fell far short of what seemed to be achieved by genuine arts professionals. A superficial enhancement through pastel colour schemes and new but still relentlessly institutional furniture are all that can be expected of a team that has no rigorous understanding of architecture and how it affects light and movement, or a truly gifted visual artist who can transform and illuminate a space with one well-chosen work.

Jenny Secker, professor of mental health at Anglia Ruskin University, and her team have tried to quantify the benefits to health and wellbeing. But science so often fails us when trying to pin down the exact causes and effects of wellbeing. Ultimately, she could only reiterate what anyone with a modicum of common sense could see from the many excellent projects listed throughout the day: that involvement and exposure to well-run projects, harnessing creativity and self-expression, boost confidence, self-esteem and motivation, expand horizons and increase social engagement at all levels of mental 'health'.

Veronica Simpson is an architectural writer



Conference venue, Savoy Place in London

The creative touch

The contribution of the arts to creating a healing environment shone out at the UK's recent National Patient Environment and the Arts conference, as *Veronica Simpson* reports



Conference chair and CABE special adviser
Susan Francis



Eco Skyscrapers

Authored by: Ken Yeang,
Edited by: Ivor Richards
Contributors: David Scott, Steve Featherstone
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Ken Yeang acknowledges early in his introduction that the title may be, and probably is, an oxymoron. It was wise to disarm us as early as possible and then beguile us with his trademark vision of green skyscrapers which reassert the beauty of living high above the ground.

The summer palace on the summit of Siguriya in Sri Lanka, the Mayan ziggurats and Angkor Vat are separated by distance, time and culture but they share an understanding of the value of height, elevating their ruling or priesthood owners above the tree canopy and the near focus of the forest, enabling them to see the horizon and gain a privileged and empowering perspective.

Raymond Williams suggests in his wonderful book *The Country and the City* that the fog which enshrouds London and takes a central role in the Sherlock Holmes stories is a metaphor for the Victorians' inability to understand the metropolis which they had created. Only the gimlet-eyed detective can see through the miasma and lead his clients to an understanding of the city's complex relationships and the causality of the events which had brought them to him.

Corbusier's early polemical projects for high-rise living combine these twin strands, creating communities that rose above the cramped poverty of Paris to bring light, order and opportunity to their inhabitants, providing them with a command of the high ground and a control of the horizon, literally and metaphorically. Their architectural legacy was more prosaic – mass housing for the poor, high-rise apartments for the wealthy and civic expressions of commercial power.

The potential for creating towns in the sky was never properly realised, despite a continuing tradition of visionary design. Buckminster Fuller; Haabraken, Cedric Price, Archigram *et al* redrew the future, creating provocatively beautiful designs for restructuring the urban fabric, which remained tantalising unrealised yet exerted a formative influence on the architecture of the last four decades.

Ken Yeang and Ivor Richards's book *Eco Skyscrapers* continues this tradition. It presents an unapologetic and compelling argument for a sustainable high-rise architecture which embraces the opportunities which a multifunctional brief and a multi-disciplinary approach can bring. Ken Yeang has been designing tall structures for two decades. Fifteen of these are illustrated and presented in some detail as case studies, documented and illustrated in a standard format.

Most are unrealised – I reckoned only three had been built – and as a consequence present an uncompromised vision of complex buildings based on a real integration between engineering and architecture. Yeang's towers accommodate vertical communities – these are genuinely multivalent mixed-use buildings. Twisting floor plates overlap. Vertical green gardens

are carved out of the plan, spiralling upwards through the building's sections, to provide stacked natural ventilation and cooling. Lift cores and service shafts shade those surfaces most exposed to the sun. The green walls and planted courts achieve a laudable biodiversity that is the essential component in these buildings as is Yeang's absolute belief in the inseparability of engineering and architecture. The vertical courts that cut through the building's section create a far more complex environment than conventional high-rise structures. But they are one of several components which make these skyscrapers far more interesting constructs than the 'iconic' and vapid shape-making of the last 15 years and place Yeang within an older tradition of polemical discursive architecture.



John Cooper is an architect, writer and consultant

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