

A CLASS APART

Innovative healthcare design in Singapore reflects its reputation for clinical excellence



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Knowledge transfer in a global society

The world of design and health is anything but static. Developments in modern healthcare are transforming healthcare facilities from functional centres designed around the treatment of disease to holistic centres of healing and health promotion. Leading thinkers have created new concepts and buildings that are an inspiration to others, placing patient and staff welfare at the centre of design.

To bring these ideas to you, the International Academy for Design and Health is launching World Health Design, the first truly international journal for design and health. Issued four times a year, the journal will provide a forum for the development of knowledge and dialogue, as well as stimulating debate between and amongst researchers and practitioners in the field. Editorial content will provide a range of news and views, scientific articles and research papers, project and market reports, book reviews and feature articles from around the world.

World Health Design builds on more than ten years of global interdisciplinary networking from the International Academy for Design and Health, bringing together designers, architects, engineers, health service providers, academics and industry to promote the exchange of

information and knowledge in design and health.

With its emphasis on research-based design in the development of psychosocially supportive environments, the journal reflects the values of the Academy and its vision for design and health. We have built up an international advisory board that includes top international architects and designers, health scientists and managers, as well as thought leaders in the field such as the UK's Lord Nigel Crisp, former NHS chief executive.

Collaboration with the International Hospital Federation provides us with the capacity to extend our reach to a network of 60,000 hospitals worldwide. But our wider goal is to contribute to improvements in global human

health and wellbeing through the medium of research-based design in all sectors, from education and justice to the workplace and commerce. We also consider it our responsibility to recognise the interdependent relationship between the developed and the developing world, and to provide through this journal a platform for how research-based design can be used as a tool for change.

The journal will also provide opportunities to keep you informed of our network's activities, including the 6th World Congress in Singapore, from 24-28 June, 2009, the development of the Academy Awards programme, and our pan-regional Design Quality Standards International Review Panel initiative.

We would like to express our deep appreciation to our editorial advisory board and to the many colleagues who have supported the launch of this journal. And we would like to invite all of you to actively support the journal by contributing to the dialogue, helping to bridge the gap between researchers, practitioners and industry. It is through your participation that this initiative will become a success, providing a real contribution to world health design.



Alan Dilani



Per Gunnar Svensson

World Health Design builds on ten years of global interdisciplinary networking from the International Academy for Design and Health

Alan Dilani, Ph.D.

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Subscriptions:
To ensure you receive regular copies of World Health Design, please telephone +44 (0) 1277 634 176 to place your credit card order, or email WHD@designandhealth.com (include postal address and telephone number). Yearly subscription rates: €90 / 2 years €150; Single Issue: €30 Euros. WHD is published 4 times a year by the International Academy for Design and Health UK.

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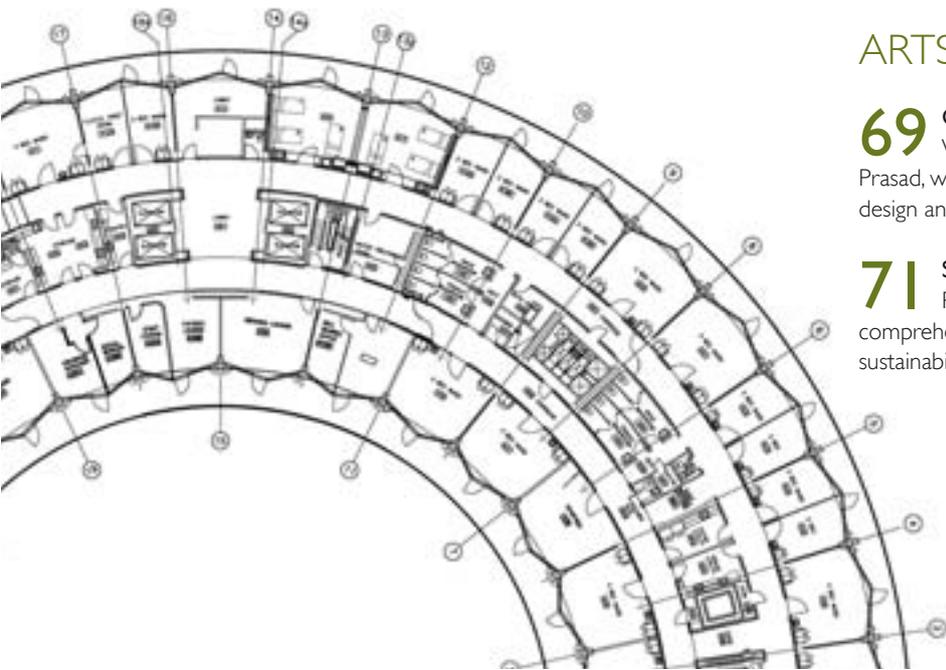
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Contributors

Lord Nigel Crisp
Former NHS chief executive, Crisp takes a global perspective on design, human health and bridging the gap between research and practice



John Cooper
Leading international architect and director of Anshen + Allen reflects on an ironic new world of post-modern economics and the shortfalls of PPP



Prof James Barlow
A director at the Health and Care Infrastructure and Research Centre, Imperial College London, Barlow raises concerns about mismatched lifecycles



Prof Jacqueline Vischer
A professor of design at the University of Montréal, Vischer introduces an expert inquiry into the merits of evidence- and research-based design



Diana Anderson
A medical student and architect, Anderson reports the conclusions of a Canadian study of patient and family preferences in the design of palliative care units



Irini Antoniadou
A university lecturer and president of the European Operating Room Nurses Association, Antoniadou offers a personal view on theatre design



The time is right

The greatest challenges of our time are also the key determinants of human health and wellbeing. Climate change, poverty, rapid technological advancement, terrorism and conflict, environmental degradation, chronic disease development and the impact of international trade are global problems that require global solutions.

Our interdependence with our neighbours, between east and west, and the developed and the developing world has never been greater. But globalisation also offers great opportunities, and through the medium of research-based design and interdisciplinary working, we have a powerful and creative tool at our fingertips. The time, it seems, is right for World Health Design.

In this first issue, former NHS chief executive, Lord Nigel Crisp debates the concept of 'early health, not late disease' with social architect Chris Liddle. Market reports from Singapore and Canada show how two very different cultures are leading the world in design and health. We also take a step into the enchanted concept design of a maternity and children's unit in the Ukraine that seeks to connect with the forest in which it is set. A scientific review from Latrobe Fellowship researchers examines the effect of colour and light on healing and leading international architect John Cooper takes a critical look at the public private partnership model.

Marc Sansom
Editorial director



San Diego's virtual hospital



Visitors to the online world of Second Life can tour the virtual facilities of a new state-of-the-art US\$810m healthcare facility. Unveiled recently by Palomar Pomerado Health and its technology partner, Cisco, the hospital, which is due to open in the physical world in San Diego in 2011, has been simulated to showcase its design and technology innovations and gather feedback that will be used to enhance the way care is delivered. The nature-embracing design of Palomar West is said to provide a high-performance healing environment through a constant connection with nature, with outdoor features such as garden spaces; areas for dining, meeting or relaxing; a pedestrian path and garden connecting all buildings; a green roof bringing gardens up onto the building, with views from patient rooms; and garden terraces on the nursing floor – all of which can be experienced in Second Life. Visitors can also view the virtual design of individual patient rooms, including same-handed, acuity-adaptable rooms and cross-discipline interventional procedure/operating rooms. The benefit of acuity-adaptable

rooms, say Palomar West, is that they can be transformed, even if a patient's condition changes, without having to move patients from unit to unit. Any necessary equipment can be brought into the room as required, further reducing the need for patient transport. Each patient room is also designed as a single occupancy and is identical in layout and design to maximise efficiency and minimise medical errors.

Green award for St John's

St John's Hospital in Howden, Scotland has been re-accredited with ISO 14001 – an international award in recognition of NHS Lothian's commitment to environmental awareness and standards at the hospital. The hospital first received the award in 2005.

HKS win Abu Dhabi hospital

United Eastern Medical Services, Abu Dhabi's privately owned healthcare development and investment company, has selected international architects HKS, to provide architectural services for its new state-of-the-art 160-bed women and children's hospital in Abu Dhabi.

Dammam hospital plans unveiled

Plans for a new US\$50m, 400-bed hospital in Dammam, Saudi Arabia, have been unveiled by Claridge Architects. Featuring a 14-storey outpatients block; a central inpatients block; two lower, bronze-coloured residential blocks; and a low-rise emergency building with helipad; the facility is being developed for Al Biarq Petrochemical Industries.

New Scottish building framework

NHS Scotland is set to appoint a number of principal supply chain partners (PSCPs) over a four-year term to deliver £900m of capital projects on behalf of NHS boards throughout Scotland in a ProCure21-style building framework.

Sustainable standard launched

BRE Global has launched a new framework standard, BSS 6001:2008, to assess how sustainable construction products are supplied. The standard will take into account environmental, economic and social impacts and is open for consultation until May 2008. The framework will be part of a proposed Responsibly Sourced Certification scheme.

Philips installs 50th Ambient Suite

Royal Philips Electronics has installed its 50th Ambient Experience suite in a catheterisation lab at Fairview Hospital in Cleveland, Ohio. This follows other recent installations at The Villages Regional Hospital in Florida, the King Faisal Specialist Hospital & Research Center in Riyadh, Saudi Arabia, and the Royal Charité Hospital in Berlin, Germany.

Construction starts in Hamilton

Canadian Minister of Public Infrastructure Renewal, David Caplan, joined staff, doctors and volunteers at the Henderson General Hospital in Ontario, Canada recently to celebrate the start of construction of the hospital's redevelopment, part of a C\$290m investment by Hamilton Health Sciences.

Skanska contract for Virginia Mason

Skanska has been awarded a US\$114m construction management contract for a new hospital building that will include an emergency department, operating rooms

and intensive care units at the Virginia Mason Medical Center in Seattle, Washington, US. The project is scheduled for completion in 2010.

Single room hospital for N Ireland

A new acute hospital under construction on the outskirts of Enniskillen, Northern Ireland is set to be the first new-build hospital in Northern Ireland to have 100% single rooms. "Providing individual rooms for patients in hospital will result in significant health benefits. Research shows that the main advantage of single rooms is the potential to reduce infections and improve patient safety," said Health Minister Michael McGimpsey.

Bedside charting for All Children's

The Florida-based All Children's Hospital has ordered 46 Flo1750 wireless mobile clinical workstations from Flo Healthcare to enable its nurses and doctors to perform medical charting at the bedside.

TRIL Clinic to research ageing

The Technology Research for Independent Living (TRIL) Centre has launched the TRIL Clinic at St James's Hospital in Dublin, Ireland. Supported by Intel and the Industrial Development Agency (IDA) in Ireland, the new clinic will combine clinical knowledge and the latest technology to conduct research into the physical, psychological and social consequences of ageing.

Design Quality Standards International:

A programme of advocacy, a tool for improvement

Professor Per Gunnar Svensson reveals how a new international panel of experts is set to support standards development in design and health.

Different cultural contexts create very different demands, such that any definition of design quality needs to be assessed within a political, social, economic and environmental context. Healthcare facilities are particularly complex, with their array of technical and scientific functions supporting a care process inherent with a level and type of risk that is unlike almost any other sector.

Defining what we mean by design quality is critical, however; to evolving a global standard for humane physical environments that support our health and well-being. Progressive governments around the world have identified health promotion as an economic necessity and a moral imperative in an increasingly competitive global economy. Yet the role of design as a strategic tool in the development of health-centric infrastructure has often been compromised in favour of short-term cost savings.

The International Academy for Design & Health (IADH) is supporting national governments, business and the public sector through the development of an international panel of experts that will benchmark national guidelines, accreditation, tender and competition requirements as well as built environment projects. The panel's development will be supported by a series of conference events, which will feed the debate concerning standards development and help to build a database of exemplar international projects.

IADH will hold Design Quality Standards (DQS) International in Florence, Italy on 23 June 2008, to run alongside the 28th Union of International Architects Public Health Seminar (UIA-PHG), with a further event in London in September. Future DQS events are planned for Wales, Africa, the Middle East and the Oceania regions in 2008/9. We will also support the development of an international 'Memorandum of Understanding' amongst Ministries of Health from around the world at the forefront of design and health, as part of the DQS initiative.

For more information on how to attend DQS International, visit www.designandhealth.com or contact Marc Sansom at email: DQS@designandhealth.com or call +44 (0)1277 634176.

Professor Per Gunnar Svensson is director-general of the International Hospital Federation and president of IADH

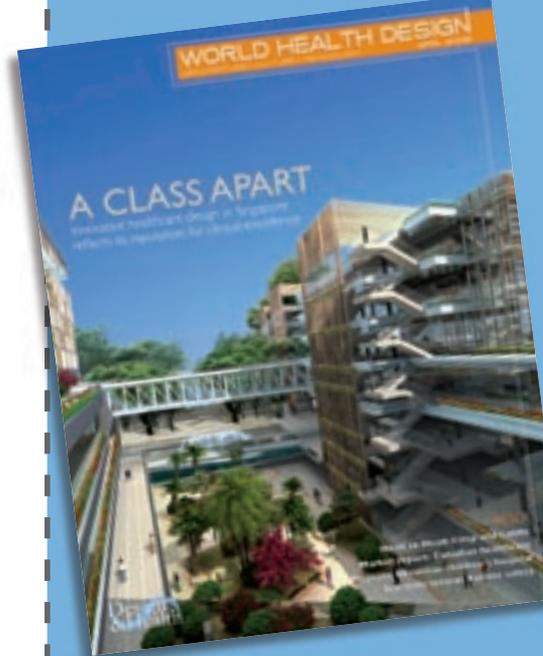


The new Meyer Children's Hospital in Florence will host DQS International in June

DQS International – Aims and Objectives

- To develop international leadership and expertise in design guidance, standards development, capital investment and costing.
- To develop toolkits and benchmarking procedures to assist providers to manage their design requirements from initial proposal through to post-project evaluation.
- To initiate international research programmes and empirical studies to better understand the impact of the built environment on health and well-being.
- To facilitate the international exchange of knowledge, expertise and best practice in the development of design guidance.
- To deliver healthy environments and facilities that are sustainable, fit for purpose and contribute to health promotion.

Last year's successful DQS Global Summit in London was supported by the Royal Institute of British Architects, Architects for Health and the Commission for Architecture and the Built Environment. Case studies were presented by lead partners, Nightingale Associates and Farrow Partnership Architects, and associate partners, Building Design Partnership and NBBJ (see pp20-29 and pp36-41).



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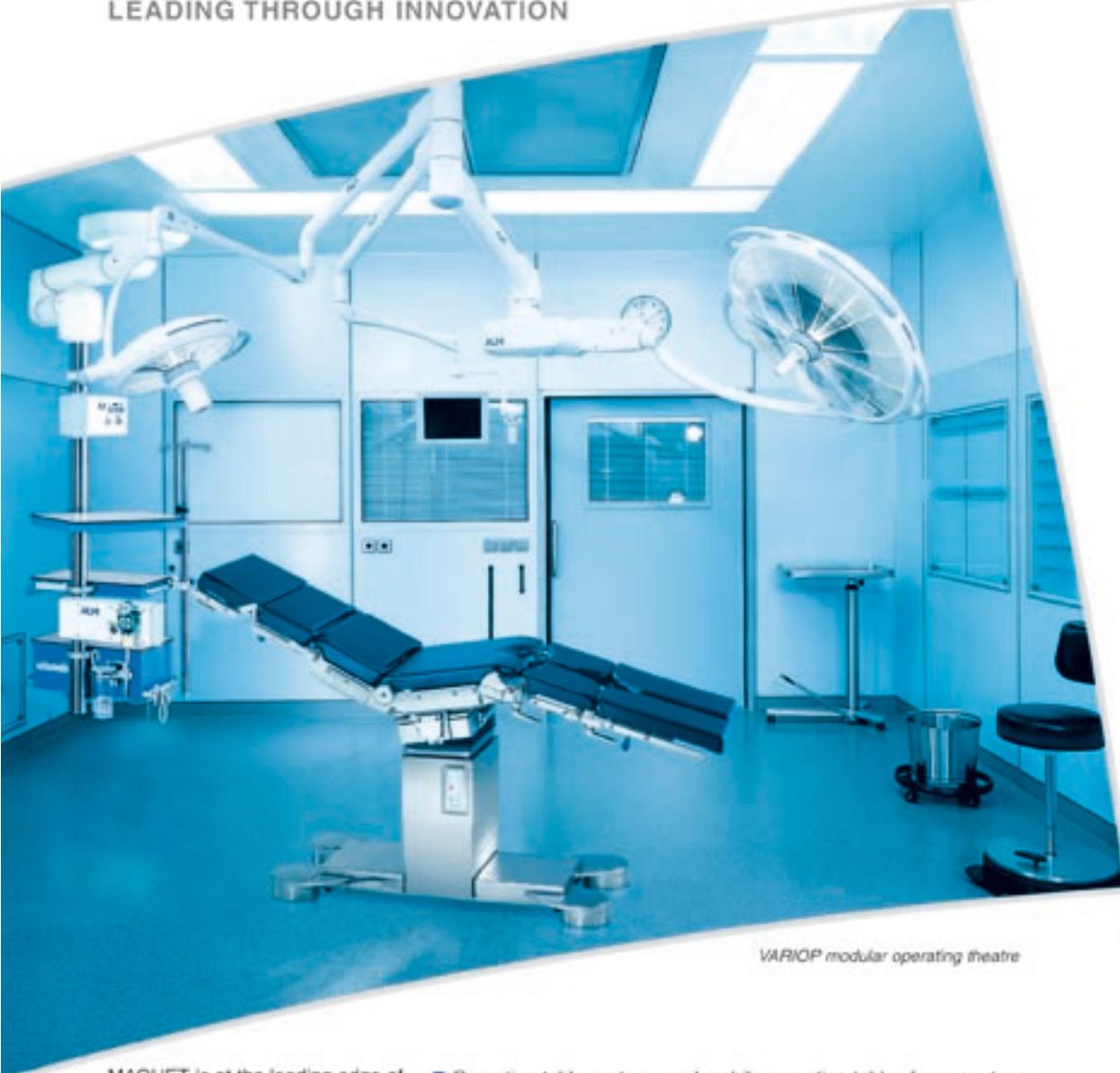
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Things fall into place in the strangest ways. Last November I gave a friend a book of Don McCullin's photographs for her birthday. It's a record of England in the 60s and 70s. Full page black-and-white plates illustrate a country of terraced houses, bleak urban landscapes and pinched-faced people, a land which was much closer to the nineteenth century than today – not only in its architecture but the economic model which these images represent.

For someone who still files these decades under current affairs, this was like turning white-haired overnight. The Shadows and the Beatles may have provided the soundtrack to my schooldays but the economic models we were taught were still essentially Victorian. We knew then how Britain worked. Every town made something – worsted cloth in Huddersfield, ships in Newcastle, beer in Burton and biscuits in Reading. This model had a visible physical structure with an easily understandable historical causality which, in turn, allowed us clearly defined and polarised political opinions. I had a much better understanding of this country's economy as a 12-year-old than I do today.

This is not a grab for the comfort blanket of past certainties. My ignorance is probably shared by the vast majority of the population. The last 12 years of growth and stability have given us the empirical evidence we need to believe in an unregulated global economy. It has been good for architects in the UK. But is our complacent ignorance little more than a mature form of cargo cult, in which our need to believe masters any sense of rational enquiry? Like death, the economy has become too scary a subject on which to dwell for very long.

That is why the current sub-prime crisis is so important. For the sake of argument let us ignore the cupidity, the social irresponsibility and even overlook the absolute lack of self or governmental regulation. For sure there's a little pain out there at the moment but normal service will be resumed. No, the really shocking aspect for many of us was the extent of the derivatives market. Any service or commodity – a yacht, the mortgage on our house or the equity in a hospital – can be parcelled, wrapped and traded with so slender a connection between these packages and their origins that, six months after the crisis began, banks are still unclear about the extent of their liabilities. We now trade in trades. Nothing has any intrinsic value any more. Welcome to the world of post-modern ironic economics, where one of the UK's more successful service exports is public private partnerships (PPP) or PFI as it is known in the UK.

There is nothing inherently unethical about using institutional funding to procure public buildings or social infrastructure projects and make a return on your investment in the process. It unlocks capital which was hitherto unavailable for social investment, encouraging development and reducing the pressure on public sector borrowing. For a short period of time five years ago, it looked as though the PFI market could mature into a responsible form of public investment. This has not happened.

One of the main reasons, I believe, is that treasury departments are acutely aware of the huge profits which can be made from trading public health equities and are fully justified in regulating these. Unfortunately they are also

Welcome to the world of post-modern ironic economics

constitutionally averse to what they perceive as risk and seek to mitigate all possible threats to the public purse. On the other side, private construction capital has imposed its own conditions on this process, always suspicious of doing business with government because programmes are rarely maintained and promises are often broken.

As a consequence, the risks to all parties have been magnified out of all proportion and the procedures which have been devised to accommodate these concerns are of labyrinthine complexity. Procurement systems are very expensive, protracted and transfer most of the risk onto the unsuccessful bidders and all the construction and design teams. Nobody in the UK is making any real money out of healthcare PFI other than the equity holders and the lawyers, yet every participant is compromised by their involvement.

This a ruthless system, in which government and the equity investors collude to mitigate public sector risk and ensure substantial profits, at the expense all of the other participants, including the end user clients. It is ironic that, if the banks which have lost billions in the derivatives markets had applied a fraction of the due diligence on their own operations that they exercise on their PFI investments, they would not be in the mess they are today. Process is all, separating the designer from the end-user client and discouraging investment.

The final piece of the jigsaw fitted last month. I was with a UK contractor/developer who confirmed that traditional procurement was a much better development route and would cost £700 per square metre less than PFI with a much shorter programme. Peddling a discredited PPP system to the rest of the world is only marginally better than selling powdered milk to African mothers.

John Cooper is a director of Anshen + Allen



The international sub prime crisis lays bare PPP's popular delusions.

Financial folly

Nigel Crisp and **Chris Liddle** go head to head and agree that global human health requires a research-based approach to design that supports the concept of 'early health, not late disease'.

Leadership is many things but most of all, in the words of management theorist John Adair, it is the manifestation of practical wisdom, consisting of a powerful blend of intelligence, experience and goodness. Upon meeting Lord Nigel Crisp (right), my deep impression was of a character who not only possesses these special traits in abundance, but has also earned the right through thoughtful professional endeavour and an alert political radar, to deploy them on issues of global significance.

What leadership is not is indifference. Each time I meet with leading social architect Chris Liddle (below), I am reminded of Elie Wiesel's millennium address on the 'perils of indifference'. It is an accusation that could never be thrown at Liddle, whose passion, enthusiasm and desire to make positive changes through the medium of design sets him apart.

As I walked back past the UK's Houses of Parliament following my appointment with Crisp and Liddle, I considered how the dynamism of their relationship might unfurl in architectural or health management form and, at the same time, began to understand a little more about the power of an interdisciplinary approach.

Crisp consults to Liddle's firm, HLM Architects, but as a description it does little to reflect the real value of their relationship, which is defined by a shared passion for improving human health and well-being.

But they share much more too, not least an understanding that health is a global issue that requires local delivery. Since leaving the NHS in early

2006, a cornerstone of Crisp's work has been as a government consultant on issues of international health development, which included a report published last year on *Global Health Partnerships* and the UK contribution to health in developing countries'.

Health statistics show a stark contrast between the developed and the developing world (Figure 1) and Crisp says that cultural, economic and political differences must be considered in decisions about how local health systems are organised and what services are delivered. "The most pressing needs in developing countries are for balanced and integrated health systems with an emphasis on public health and primary care, not hospitals and tertiary care, although these have their place. Providing healthcare to a needy population with an average total expenditure (public and private) of \$36 a person each year – and a range going down to around \$5-\$10 in parts of Africa and India – is very different from providing for an affluent population in a developed country.

"There are also cultural issues – things are done very differently in different countries. You simply cannot apply UK methods and behaviours. This is not about giving people a UK product, but about a process of working together to meet a need."

There are some common issues too, however, that Crisp says characterise the economic, social and physical interdependencies of a globalising world, upon which national health systems and policies in the 21st century should be founded. In particular, he identifies three core themes: early health, not late disease; patient and public involvement; and knowledge, evidence and standards.



Advance





warning system

Early health, not late disease

The concept of 'early health, not late disease', says Crisp, encapsulates public health, health promotion and educational concerns. With the management of symptom-based, advanced diseases reported to consume 70-80% of healthcare resources, Crisp says it is an approach that makes economic as well as clinical sense: "The earlier you can tackle a problem, preferably before it starts – and that's about stopping smoking rather than dealing with cancer – not only are the patient's chances better, but the costs are also reduced."

He points out, however, that there is nothing new in this theory. "If you study Florence Nightingale's prescriptions for health in India, where she spent 30 years of her life working, she said, 'you need to sort out the land tenure issues; you need clean water; and you need to get on top of the economic issues, as well as focusing on the clinical issues.'"

Our thinking needs to consider the entire social and economic sphere, agrees Liddle, and not just healthcare. "Health is no longer just about hospitals. It's about how primary care plays a much greater role at the front end in our schools and in the community, and how cross-sector design projects can deliver this."

"We need to think about the world as a joined up system – about education and health systems, rather than schools and hospitals," says Crisp. "In the UK, there are some excellent examples of sensible health screening of children in schools that breaks out from a mindset that confines healthcare provision to the hospital setting."

He adds, however, that the importance of an effective interface between health and education is a lesson we can learn from the developing world. "It's a case of designing fit-for-purpose health systems based around the patient's needs," adds Crisp. "If you look at what children die of in Africa, an immunisation programme based in a primary and community care setting is far more effective than a brand new modern hospital."

Involvement and participation

"We've moved from a world where we did things to and for people, to a world where we do things with people, or they are doing it for themselves," says Crisp. "The creation of health is a shared responsibility. Diabetes patients receive two hours of care a year from health professionals and 60 hours a year from themselves, but if they don't take their jobs, the professional aspect isn't worth doing."

Central to this idea in healthcare is the concept of the patient journey, which is a critical paradigm change in healthcare planning from the technically-driven perspective of clinical pathways. "The patient journey is an approach that is based on the idea that patients will require care from more



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Interview: Leadership

than one place, service or health worker," explains Crisp. "Care may be received from the GP, the acute sector and tertiary care."

From an architectural perspective, it's about how you design the physical environment to respond to, facilitate and support the patient journey, says Liddle. "And it's not only about medical services, it's the whole hub-and-spoke environment of social services, schools and the community."

One of the tools Liddle uses to involve end users are patient and prisoner reference groups in the design of healthcare and custodial facilities. "It's a great responsibility to try and make a place that people will enjoy as a positive experience, and it's a great comfort as a designer to listen to people talk about their personal experience of being in a hospital or a prison. I firmly believe that, as designers, the closer we can get to the point of activity, the better architecture we will create."

Knowledge, evidence and standards

The third core theme common to all health systems, says Crisp, is the development and practical application of knowledge, evidence and standards. "We live in a world where there is so much knowledge available. In many parts of the world, we come across similar projects with excellent results but one of the most striking things was the lack of learning from each other. While evaluations are being done, there appeared to be no means for the systemic and rigorous spread of good practice."

Health systems, adds Crisp, need to consider within a global context how to firstly "create the evidence through the task of research and evaluation" and, secondly and equally as important, how to disseminate and "make the evidence available in ways that people can use, as a means of sharing and learning from each other across national, institutional and language barriers".

How you derive the evidence from a rigorous approach to research is the key, says Liddle: "People often shy away from research, believing it to lack a foundation in reality. We need to demystify the value of research-based design, because there's a lot further to go if we can build on what we already know. Our patient and prisoner reference groups generate many interesting design ideas that we believe will work, but where can we try them out? Where is the space for research-based design?"

Crisp adds that dissemination of knowledge and evidence is also about how people learn. "Everybody likes to reinvent their own wheel. In the NHS, we introduced a programme that targeted accident and emergency departments to see and discharge patients within four hours. But the patterns of use in a large teaching hospital are very different from those in a small district general hospital, so we invited five different A&E departments to report back to each other on how they addressed the same problem of reducing waiting times in a process that we called 'assisted-wheel reinvention'. The result was they learnt faster, reinventing their own wheel more quickly."

An interdisciplinary approach to research-based design, stresses Liddle, can be a foundation for how we make places that support health and well-being.

But, says Crisp, there is still a big issue about raising the importance of design, particularly within health management. "Why should I pay attention to the value of design? There is still an argument that needs to be won to engage thought leaders and decision-makers, about the economic as well as the clinical value of good design. Because, that's what we're in the health business for – quality and value for money."

Marc Sansom is editorial director of World Health Design

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Lord Nigel Crisp (below right)

- 1986 General Manager for Learning Disabilities in East Berkshire
- 1988 General Manager and Chief Executive of Heatherwood and Wexham Park Hospitals
- 1993 Chief Executive of the Oxford Radcliffe Hospital
- 1997 Appointed South Thames Regional Director of the NHS Executive
- 1999 Appointed London Regional Director
- 2000 Appointed Chief Executive of the NHS and Permanent Secretary at the Department of Health
- 2003 Received Knight Commander of the Order of the Bath (KC)
- 2006 Awarded Life Peerage



Christopher Dunbar Liddle BA (Hons 1st Class) dip ARCH(dist) RIBA ARIAS FFB (Above left)

- 1969-76 Educated at Sheffield University
- 1976-78 Architect, Roth & Partners
- 1978-80 Design architect, Jack Bonnington Partnership
- 1980-82 Chief Architect, Hassall Homes
- 1982 Associate, HLM Architects
- 1994 Partner, HLM Architects
- 1999-08 Chairman, HLM Architects
- 1969-02 International Lecturer - Architecture & Design
- 1989-08 International speaker PFI/PPP
- 1984-08 Recipient of Civic Trust, RIBA, Conservation and Urban Re-generation Awards

The methods of

Evidence-based design (EBD) is the new buzz-word in the field of design and health. **Jacqueline Vischer** asks five leading experts to give their reflections on the merits of EBD relative to research-based design.



The idea that immediate, *in situ* identification of space-use research problems pertinent to an ongoing design process can lead to basing design decisions on empirical research outcomes is immensely appealing, because the one thing no design project has today is time.

And more conventional design research takes time – to fund, to design, to do and to interpret. Post-occupancy evaluation (POE), for example, is a favoured approach to design research where the systematic study of users' responses in buildings

generates information designers can apply to programming and new design. But POE takes time, and in taking a broad-brush approach to building performance and users' needs has often failed to yield results directly applicable to a specific project.

But saving time is not always a good thing in research. Taking short cuts can compromise the quality of research. Defining the research problem is often a study in itself, and the wrong definition of the problem will yield useless results – no matter how good the research. Who does the research can also muddy the waters: everyone is familiar with researcher bias and the effect researcher expectations can have on results.

So the positive side of evidence-based design (EBD) is that it is relevant, it is practical, it is fast and it can be applied in real projects. The dark side of EBD is that time and other practical limitations might have ethical implications, leading to a compromise of research protocol or erroneous methods of data collection and analysis.

By adopting EBD as an updated approach to space-use research, it is important, therefore, not to substitute it for conventional research, which maintains its value in our high-speed and high-pressure culture. And conventional design research includes more than laboratory studies of human behaviour – there is applied research, field research and also action research. The lesson to learn is that design research is increasingly rich and complex, and EBD can, in the right time and place, be one of the tools at our disposal.

Jacqueline C. Vischer
Professor of design, University of Montréal

our madness



The therapeutic environment is, fundamentally, related to the creation of the 'quality of space'. Place-making in this respect involves many elements of design, including clear signage, uncomplicated wayfinding, acoustic and thermal comfort, connection with the external environment, views that create calm in patients and pleasure for

staff, a secure environment, a non-threatening scale, cleanliness to achieve a positive reduction on the transmission of healthcare-acquired infection, space planning, and single rooms that increase levels of privacy and dignity.

There are three key groups that benefit spiritually and physically from well-designed clinical facilities – the patient, the visitor and staff. Yet, the experience of each group differs markedly, particularly in relation to the time spent in the facility. A patient's length of stay in an acute facility is typically limited to an average of four days. Their visitors will be subject to a similar attendance regime. It is the staff that enjoys the longest stay – suggesting that it is this community who should have the biggest say in the design of an environment.

Unfortunately it is often difficult for staff to visualise what good designers can create for them in terms of spatial quality, ambience and comfort. Hence, the practice of post-occupancy surveys or audits is an essential part of the learning process for both staff and designers. A research project, for example, that comprehensively evaluated existing exemplar projects from a user's perspective would significantly enhance the knowledge base and allow designers to present to staff, patients and carers about to embark on construction projects, examples of the components parts of a therapeutic environment. The new project in turn would be assessed and become part of the next wave of evaluations.

Phil Nedin
Global healthcare business leader, ARUP



Over time, we have charted the evolution of healthcare design and can attribute many changes in design to the improvement of patient outcomes – smaller wards lead to decreased infection and mortality rates, increased patient satisfaction and better staff efficiency. It is difficult to identify whether evidence of poor outcomes in

existing facilities became the conscious or informed basis for design improvement or if the changes were made intuitively – but the results were positive regardless.

Now, resulting from the need to replace outdated hospitals, ageing of the baby boomers, advances in technology and the shortage of nursing staff, the US is facing one of the largest hospital building booms in history. This gives healthcare designers an unprecedented opportunity to re-think hospital design.

Guiding the change will be rigorous research linking the hospital's physical environment to patient and staff outcomes – or 'EBD'. And, although there is a great deal of information and research available to the designer and the informed client, a critical mind must determine how to use it to develop an appropriate solution to a problem. In the final analysis, EBD should result in measurable improvements in clinical outcomes, staff productivity and turnover, patient satisfaction, and financial performance.

Faye Le Doux
Vice president, Ellerbe Beckett

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Inquiry



While often used interchangeably, research-based design (RBD) and EBD have some distinguishing differences. RBD is more rigorous and is based on studies using comparative research instruments and outcome measures. EBD is rooted more in healthcare provider observation and anecdotal evidence – no less important. Both are focused on providing the best possible healing and safety-focused environments.

Evidence-based medicine has been around for over 30 years. Research-based results often take 15-20 years to transition from research

outcomes to actual medical practice.

Roger Uhrich's 1984 landmark study on evidence-based design launched an avalanche of some 600 research studies on such healing design features as neonatal intensive care unit (NICU) lighting, sinks in rooms and infection control.

Conversely, there has not yet been true research conducted on the benefit of same-handed rooms, but it is a concept that is gaining popularity, based on the principles of EBD rather than RBD. The Center for Health Design stands in the forefront of the EBD movement through its multi-year research effort with other healthcare organisations interested in providing design that fosters optimum patient healing and safe environments. HDR is proud to have designed some of those organisations' healthcare facilities.

Cyndi McCullough
Senior vice president, HDR Architecture



Ten years ago we pondered, does the environment contribute to healing? Now, we ask, in a much more specific way, how do particular aspects of the design of the physical environment impact on patients' outcomes, experience and on organisational effectiveness? Research and EBD have helped us to get here.

The evidence base for design in healthcare has typically drawn on three approaches: scientific studies, like medical drug trials, isolating single variables to connect environmental features with specific outcomes; social science methods that seek to establish perceptions and levels of user satisfaction; and thirdly, design-led enquiry that has developed ideas about the therapeutic nature of the environment and, more recently, the ability to measure and rate the quality of design.

There is no doubt, from where I now sit, as chair of NHS Design Review, the quality of the design of healthcare environments has improved. This is not solely due to research activity. This kind of culture change requires huge effort on many fronts including government policy, design practice, procurement requirements and an informed client.

But what EBD and research can do is to inform the next generation of healthcare environments, by providing the ammunition needed to argue the case for investment in good quality design; better understand what really makes a difference; and create feedback from projects in use.

Susan Francis
Special advisor for health, Commission for Architecture and the Built Environment
(a personal view)

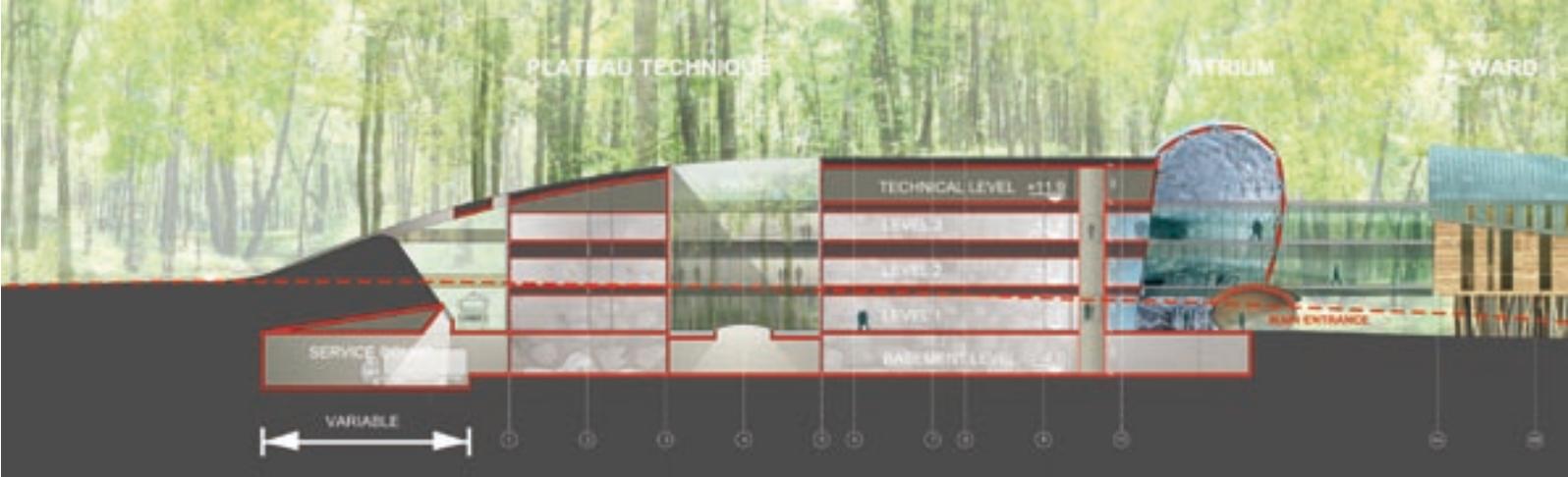


Carefully documented and fully verified research is the key foundation stone for EBD, enabling designed facilities to be used as test beds for further research. The inspirational dynamic of excellent creative design can provide the 'quantum leaps' in the evolving relationship between research and EBD. To capture this, post-project evaluation, which is rarely carried out systematically, needs to be properly funded and formally included

in private and public healthcare procurement processes.

The success of EBD is reliant on the quality and appropriateness of the evidence used. The evidence also has to be correctly interpreted for the specific design challenge. The research base for EBD needs to be constantly evolving to keep pace with social, medical and scientific advances and needs to fully address the huge design challenges caused by climate change and the differing circumstances of rich and poor. The ultimate prize is universally available current research that is constantly being enriched by fully evaluated completed projects.

Mike Nightingale
Founder, Nightingale Associates



The Enchanted Hospital

The natural forest habitat has been embraced in the concept for the new All Ukrainian Health Protection Centre for Mothers and Children in Kiev, which is intended to delight and inspire the imagination of its patient group, writes Neil Cadenhead.

Modern hospitals invest heavily in supporting clinical efficiency and patient comfort, meeting Vitruvius' standards of 'firmness' and 'commodity', but often come up short in 'delight' – the third of his prerequisites for good design. By employing the following design principles, the concept for the All Ukrainian Health Protection Centre for Mothers and Children in Kiev aims to not only deliver optimum levels of 'efficiency' and 'comfort' but also seeks to provide meaning, cultural relevance and to engage the imagination of children.

Anthropomorphic

Since the dawn of time, architecture has sought to express the form and proportions of the ideal human. This design extends this concept by taking the most humble of forest life – insects, leaves, sticks and rocks – to stimulate the child's imagination through the form of a building that sits naturally in its landscape, is reassuring and, at the same time, adventurous.

A response to the forest

Developed on a stunning site, the design aims to respect and work with the forest to preserve its unique atmosphere, rather than destroy it. By seeking to remove as few trees as possible and develop a landscape design that uses the natural forest floor rather than grass as its base, the architecture harmonises with the forms, feeling and colours of the forest. By also employing natural ventilation during spring and autumn, which allows windows to be open and the smell of fresh air and the sound of birdsong to penetrate, the natural habitat is maintained and a more powerful cultivation of the healing environment is made possible.

Local context

The adoption of a uniquely Ukrainian approach to the architecture embeds the design in local culture, thereby avoiding the normal 'clothing' worn by so-called international designs – aluminium, curtain glazing and simple rectangular forms. The design seeks instead to give a modern reinterpretation of the precedents, expression and form of the Ukrainian landscape, its people, its vernacular buildings and the forest itself.

A place for children

Reassuring and accessible for children, the design is also suggestive in its response to the joy of childhood, in particular to play, fantasy and another world full of mythical beasts, fairies, and magic. But children are seldom alone in hospital. Recognising that a parent or guardian accompanies them during their stay, bedrooms are 'family' rooms, and the building offers positive distraction to worried carers. All bedrooms are single occupancy, but with additional space for a reclining chair or folding bed for relatives.



Above: the building will be partially built into the landscape

Right: the transparent design creates the feeling of being in amongst the trees



Young children have difficulty comprehending the idea of illness. Treatment is often observed by children to be 'scary' and associated with pain. By separating areas of treatment and diagnosis, physically and visibly, the design aims to disconnect the children from negative associations and memories with the rooms and spaces such as ward areas inhabited during recovery and rest.

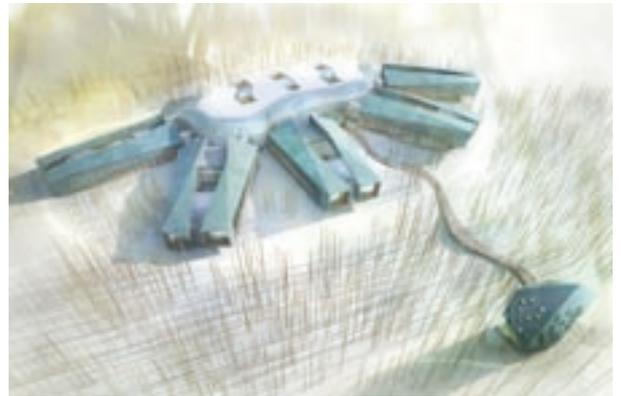
Design statement

In most hospitals, on arrival at the main entrance, patients are led through treatment and diagnostic areas in a celebration of its functional purpose.

In the architecture of this hospital, the 'technical platform' has been 'lost' in the landscape, allowing the patient to approach the building from the aspect of the bedroom, thereby providing reassurance about their lodgings and habitat.

There is also considerable research to show that positive distraction from illness and pain aids the speed of recovery by lowering the patient's perception of pain. The aim of this design, therefore, is to make the internal environment of the ward blocks reassuring and homely.

But comfort has both a physical and psychological perspective. The criteria for physical comfort in all patient groups include correct temperature, relief from strong sunlight penetration of the building, and quiet. But children, in particular, are psychologically sensitive to the environment and require opportunities for intellectual stimulation, play and learning that are typically available outside and need to be replicated in the hospital setting.



Top: the connection with nature is integral to the design

Above: the shape of the building reflects the fantastical environment

Left: the forest setting creates a welcoming approach for patients and visitors

The child's needs in hospital go beyond the need for physical and psychological comfort, embracing the whole of Maslow's hierarchy of needs: safety, belonging, esteem and self-actualisation. The design response, to plan for 100% single bedrooms, enables the bedroom to become a refuge and a home for the duration of the child's stay.

The connection between the hospital interior and the forest is critical too, ensuring the building affords a transparent view to the outside world, so that patients enjoy a feeling of being 'among the trees', with all the associations of comfort and safety inherent

in nature. Spiritually the buildings define a 'clearing in the trees', thereby creating a welcoming space for visitors and patients on arrival. From this space, paths lead to the hospital's main entrance and beyond to the other two hospitals on the campus. The system of walks in and around the children's hospital becomes part of the existing system of forest walks to be enjoyed by the patients from all three hospitals.

The principal space of the hospital is a long sinuous atrium space, which encloses all the main public areas and circulation routes of the hospital. It is roofed with ETFE bubbles, and framed by a hexagonal structure, to create a form redolent of an insect's eye. This form of roof is transparent yet highly insulated, easily maintained, inexpensive and easy to construct. The atrium wraps around the technical platform to provide easy access to all treatment, diagnostic and consulting spaces.



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The clinical corridors are not shared by the public and are formed of fritted glass tubes which leave the technical platform and punch out through the atrium wall to link to the ward blocks. The pattern of corridors is dendritic in character, so that each of the wards is at the end of a finger, 'sheltered' from passing traffic.

The building has a main entrance expressed as a golden shell and secondary, more functional entrances, including an emergency entrance to the side of the building, with a dedicated approach road for ambulances; a helicopter pad located at the rear of the technical platform, providing rapid access to the theatres and critical care units; and a stores and supplies entrance, concealed from view at the rear of the facility.

Sustainability

The Kiev climate is cold and dry in the winter, with conditions of -25°C @ 90% relative humidity (RH) and hot and dry in the summer with conditions of 35°C with 75%RH in the morning and 55%RH in the afternoon. People in naturally ventilated spaces are comfortable in a greater range of temperatures than in fully air-conditioned spaces – which in itself is an energy-saving measure. This psychological phenomenon also applies where people can control their own environmental conditions. The result is that the developed world is moving away from fully air-conditioned hospitals in favour of passive, as opposed to active, buildings that naturally maintain comfortable conditions.

This approach is adopted in the design which incorporates features such as: a high thermal mass of the technical platform; and by contrast ventilated bedroom pods; with ward windows shaded from the sun for summer; and an atrium 'winter garden'.

These initiatives are intended to produce a more natural type of comfort in the building as part of a strategy to save energy and limit CO_2 emissions with an objective to reduce the annual energy consumption.

In Kiev, as in the rest of the world there is a need to address long term shortages in energy supply and to try to arrest climate

A uniquely Ukrainian approach to the architecture embeds the design in local culture

change. To achieve this, our strategy is to minimise the building's energy demand and to incorporate energy saving and low carbon renewable technologies. The building's use of energy will be minimised by the following conservation and renewable energy proposals:

- The engineering service strategy has been developed with a view to achieving exemplary status in terms of carbon emissions. Natural gas tri-generation system incorporating dual fuel boilers (complete with condensing option), combined heat and power and absorption chillers will be provided as the primary source of electrical and thermal energy.
- Chilled beams have been selected as the primary means of space cooling, with the potential for linking to a ground loop. The project will also feature solar thermal panels for hot water. Grey water recycling will be used for toilet flushing.

Only a research-based evaluation over time of the design of the All Ukrainian Health Protection Centre for Mothers and Children in Kiev will establish whether it has been a success or failure. What is without doubt is that the design attempts to raise the game in terms of design quality standards. It poses the challenge that, in the future, just prioritising functional efficiency and patient comfort will not suffice. Healthcare environments should entertain the imagination, be of their place and time and, ultimately, offer delight.

Neil Cadenhead is a director of bdpgrupe6

Below: paths lead to the hospital's main entrance and to the two other hospitals on the campus



From its inception, the Private Financial Initiative (PFI) for developing healthcare facilities has been controversial. Its advocates claim that many of the 200 projects completed over the last decade in the UK would not have been implemented without PFI. They say the private sector has contributed strong management, a high level of cost and schedule certainty, along with the assumption of risk and the investment of private capital in needed public works.

They contend that the range of private-sector experience assembled for PFI work brought international best practice to what had become an inward-looking and tired NHS approach to the planning and design of healthcare facilities.

Others argue that the product of the decade-long PFI effort has fallen short of its potential to deliver world-leading healthcare facilities, claiming that PFI has delivered facilities that are “fit-for-purpose and offer value for money” only by the most generous interpretation.

Exhibit 3 confirms that these weaknesses are widely recognised, even by its government sponsors. Layer upon layer of remedies for the shortcomings of the PFI programme have been proposed. Each year brings forth a new approach, such as the recently adopted use of design exemplars and competitive dialogue.

The Royal Institute of British Architects (RIBA) and the UK government’s design watchdog, the Commission for Architecture and the Built Environment (CABE),

Smarter PFI

Ken Schwarz describes how North Bristol NHS Trust adopted a new affordable and effective way to provide clear design guidance to PFI bidders on the redevelopment of the Southmead Hospital.

have entered the fray, convinced that the answer is to separate the designer’s work from the bidding for management, finance, construction and operational aspects of project development – thereby reaffirming the client/architect relationship that is at the core of most successful design efforts and is often lost in PFI.

They cite the efforts of John Cole, director of the Health Estates Agency for Northern Ireland, where he has commissioned skilled planning and design teams to work directly with hospital trusts to create well-developed design exemplars that serve as the basis for subsequent bidding by PFI consortia. In the UK this method is championed as a ‘Smart PFI’.

Our experience at Bristol

Approximately a year ago, NBBJ, as part of a larger technical team led by Integrated Building Services, was engaged to advise the North Bristol NHS Trust in the rebuilding of the £400+m Southmead Hospital site via PFI. The trust had high aspirations to achieve efficiencies by consolidating the services of two hospitals onto one site – as well as achieving a high quality facility and environment for care. The trust hired David Powell to lead the development team – a veteran of successful PFI projects who brought an additional thrust for excellence.

Powell assembled a knowledgeable and energetic project team, including directors of the medical and nursing staff along with experts in management, finance, estate and contracts. Importantly, Sonia Mills, chair of the trust, volunteered to be design champion, thereby reinforcing the trust’s ambition. This quest was further

reflected in the selection of technical advisors from the private sector and design advisors from CABE, the Department of Health Design Review Panel and Bristol City town planners. This formidable array of talent and resource not only strengthened the trust’s team, but also signaled that for this PFI “design and quality mattered”.

The protocols and guidance from the government’s Private Finance Unit (PFU) left the trust team latitude as to which process it would follow to achieve its objectives. These ranged from defining the project requirements in terms of performance outcomes “to elicit the maximum range of response and innovation from the private-sector bidders”, to the more prescriptive design exemplar approach.

The project team discarded the former method, given its history of being difficult to assess – and often producing results that favoured consortia interests

Exhibit 1: Model summarising features of the Long Range Development Plan



rather than trust needs. Although the design exemplar method looked promising, produced good results in Northern Ireland and received support from design-orientated groups, it faced major obstacles to use at Bristol – the cost of developing the exemplar was prohibitive and, unlike in Northern Ireland, would not be reimbursed by the government; and a survey of potential bidders revealed that they uniformly opposed the approach, claiming that it would limit the innovation and unique selling points they could bring to their bids.

Therefore, the project team chose a third path for the Bristol PFI, which was less proscriptive and expensive to develop than a full design exemplar, but sufficiently descriptive to clearly set forth the trust's quantitative and qualitative objectives. In particular, the body of information made available to bidders would be enhanced to describe the more elusive aspects of the trust's aspirations – those that define design excellence and high quality.

Part of this guidance was presented in a summary of the project team's observations of existing healthcare and other environments titled, *What the trust likes, and doesn't like*. Part of this guidance was more formally summarised by the design advisors through close working with the project team. The result is an affordable and effective way to provide clear design guidance to PFI bidders. Dubbed "Smarter PFI" by the trade press, the following summarises key elements of this guidance.

Long Range Development Plan (1:1250) The LRDP established a framework to guide the future development of the 27-hectare Southmead Hospital Campus. The plan indicated zoning, type and scale of development, roads and parking and best use of valued existing buildings and landscape. It also embodied urban design principles related to place making, public and private space, consideration of historic patterns of development, and neighbourhood interface and regeneration. This plan was developed in close working with the Bristol City town planners. (Exhibit 1 and 2)

Development Control Plan (1:1250) The principles of the LRDP were more fully tested in the specific 10-hectare zone established within the campus for the PFI project. The DCP also described the measures required to prepare the site for the project, which resulted in £50m of enabling works being carried out in advance.

Public Sector Comparator In the manner that the LRDP and DCP defined and tested objectives for site development, the Public Sector Comparator did so for the proposed buildings. The PSC resulted from the studies described below. Taken together, they embody the trust's quantitative and qualitative requirements for the project.

Building Concept Diagram The sketch diagram, embodies three important design concepts that underpin the PSC: the separation of high-tech, process-driven functions (diagnostics and treatment) from the low-tech, patient-focused functions (wards) – thereby enabling each to respond most efficiently to its functional requirements, whilst ensuring easy flow between them; the creation of a low-rise hospital complex, interspersed with green spaces, thereby maximising the contribution of natural features to healing environments; and the use of a simple day-lit pattern of circulation that provides distinct pathways for varied flows, whilst facilitating easy way-finding. All of the above also contribute to sustainable building design.

Functional Relationship Diagrams (1:500) Functional areas of the hospital are arranged in block form at each level, and stacked in 3-D, to indicate how required departmental size and key adjacencies can be achieved – in particular Emergency/Imaging, Emergency Assessment, Outpatient/Diagnostics, Community Hospital/Diagnostics, Theatres/ICU, Theatres, Surgical Wards and Day Care. (Exhibit 4)

Departmental Layouts (1:200) Departmental, room-by-room layouts are presented for key functional areas, including theatres, imaging, emergency, nursing units and outpatient clinics. This enables the trust to consider key features of the layouts and present the findings to bidders.

Loaded, Generic Rooms (1:50) Twenty rooms, which together comprise 75% of all rooms in the project are presented in detail, including room data sheets that specify dimensions, environmental characteristics, materials and equipment; and loaded plans



Exhibit 2: Long Range Development Plan: Site Zoning

**Exhibit 3:
PFI shortcomings - A history of remedies**

- Guidance to inform the trust team
- Design champion
- CABE enabler
- DoH & CABE design reviews
- AEDET evaluation
- PITN, FITN, BAFO and LAFO
- Competitive dialogue
- 6 – 3 – 1; 4 – 3 – 1; 3 – 2 – 1
- Health expert & generalist architect
- Public Sector Comparator
- Separating design process from BFO bid
- Exemplars, Smart PFI
- Smarter PFI?

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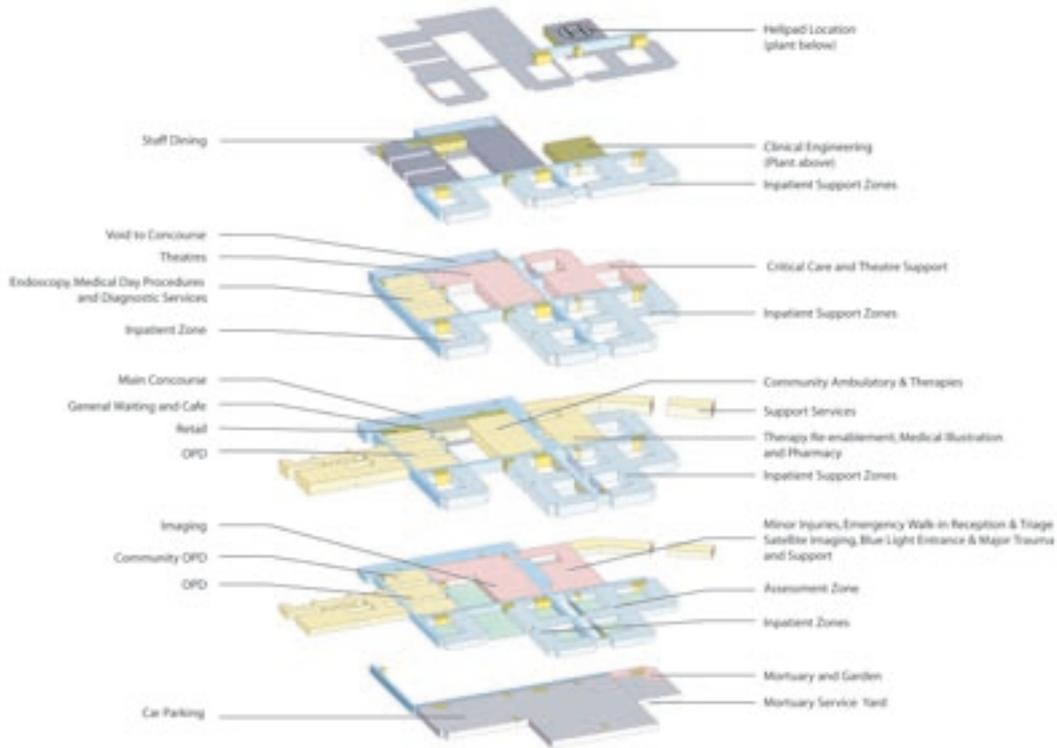


Exhibit 4:
Functional
Stacking Diagram

that show the position of the above in the context of the room.

Kit-Of-Parts For Interior Fitout (1:50 And 1:20) Aside from key public areas which may be bespoke-designed, and clinical areas, such as theatres, which are driven by specialist functional needs, more than 80% of the remaining fit-out of hospital interiors can be accomplished from a standardised 'kit-of-parts', which was developed for the Bristol project to embody the trust's objectives regarding performance, materials, details, aesthetics and consideration of off-site production. This demonstrates that such material could be developed for trust review in parallel with the overall project design – thus subject to trust scrutiny during the bidding period.

Experiential Aspects (1:1250 model and sketches) Massing, scale, urban design features and relationships to the surrounding neighbourhood are described in a physical model. Key external and internal features are described in simple perspective sketches. These show the interface of the building and main entrance plaza; incorporation of historic structures; a day-lit, multi-level entrance hall that enables way-finding; a public café overlooking an internal garden; a staff restaurant with favourable long views and inpatient rooms overlooking a well-proportioned, landscaped courtyard; and other key experiential objectives. (Exhibit 5).

Competitive dialogue

All of the above planning and design materials, together with accompanying specifications for civil, structural, mechanical, electrical and communications systems, enabled the achievement of robust cost estimating, outline planning consent, business case approval and permission to launch the invitation to bidders to participate.

The process for Bristol leading to selection of preferred bidder is scheduled to take 14 months. Nine months of this is devoted to competitive dialogue in which bidders develop their own proposals, guided by the principles embodied in the materials described above, and by close working with the trust and its advisors.

Whether or not this process will achieve the level of design quality that the trust seeks will only be assured at the end of the bid period – and ultimately only upon completion of the project. We can report, however, that mid-way through bidding, all participants are demonstrating a sound understanding of the trust's objectives and a commitment of substantial resources to achieving them. To date "Smarter PFI" seems to be working.

Ken Schwarz is a principal of NBBJ Architects



Exhibit 5: Sketch showing
interface of new and retained
historical buildings



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Over the last 10 years, researchers in both universities and industry have been exploring the expanse of international research into optimum healing environments from Japan to Scandinavia, the US and even NASA. At the same time, rapid advances in technology have been harnessed to support an increasingly persuasive evidence base that in itself supports the development of optimum healing environments specific to varied illnesses and age groups.

Studies clearly show that certain elements – lighting, colour, aroma, views, art, modulation of space and form, manipulation of scale, proportion and rhythm, sound, texture and materials, ease and flow of movement through space and time, indoor and outdoor plantscaping – can have a powerful healing and therapeutic benefit on patients.

Essentially the environment is perceived through the main sensory receptors. According to recent research, there are a minimum of 21 senses. Understanding the true dimensions and limitations of the

A sense of place

Richard Mazuch describes how the ground breaking hPod project could soon lead to the creation of the optimum healing environment.

sensory receptors not only increases the skill of the designer but also enables the creation of a truly responsive environment.

The hPod Project will fine-tune and choreograph research, new technology and products to deliver optimum healing environments for patients, using purposed-developed tools including an emotional mapping design tool, which enables design teams to create truly de-stressing, healing, patient-focused and therapeutic environments. Predominant emotions are identified as colours on plans in each and every space of the individual patient groups. Clinicians and designers can navigate through the emotions, feelings, sentiments and sensations of patients with more skill and sensitivity, within varied healthcare environments.

In addition, Nightingale Associates is systematically developing 'prescription spreadsheets' to help define precise and optimum conditions for healing processes within individual departments, single rooms, and specific to individual patients and their relative illnesses. With the 'design prescription', it is envisaged that smart cards, used to access single rooms, will link to building management systems which will deliver optimum healing environments to individual patients – attenuating light intensity, colour and temperature.

Interdisciplinary approach

The project, which commenced in December 2006, has been backed by a strong team of engineers, university researchers and product designers, architects, interior designers, furniture designers, clinicians, patients, contractors – and bespoke manufacturers. In total, 16 healing pods are being developed, each delivering optimum healing environments to specific patient groups – neonatal; labour; breastfeeding; MRI/CAT; cardiac; burns unit/palliative care; SAD (seasonal affective disorder); bipolar depression; headache; dementia; oncology; chemotherapy; phlebotomy; intensive therapy; energising; and calming. The neonate pod will deliver an optimum neonatal intensive care unit environment, based on extensive research from the US, which shows that this environment needs to mimic that of a uterus or womb in terms of temperature, light and other key elements.

For breastfeeding, paediatricians in neonatal intensive care units (NICUs) and special care baby units (SCBUs) in France and Belgium encourage mothers to wear orange jumpers which help them to lactate. Inga Warren from the Winnicott Baby Unit at St Mary's Hospital in London has also discovered that pre-term babies and neonates feed more readily when exposed to the smell of vanilla. Seasonal affective disorder lamps produced by Philips have also been developed in the design of the SAD pod to alleviate winter depression which can cause lethargy, sleep problems, anxiety and overeating.

The calming pod will deliver images of woodland and landscapes scenes, which have been shown to lower respiration rates, blood pressure and heart rates within three minutes. Ambient colour, temperature and sounds will be key to the choreography of this space. In the burns pod, we hope to demonstrate how burns victims can obtain extraordinary relief from pain by entering a virtual-reality landscape full of soothing snowscapes, cool colours and reduced temperatures and smells emotive of cold climates.

It is envisaged that, eventually, the hPod will develop into individual spaces within a healthcare setting. So, from hPods to rooms to departments – ultimately it is hoped that a prototype hospital will be built using this data.

Richard Mazuch is research director of Nightingale Associates



A class apart

Singapore is ranked by the World Health Organization as having the best healthcare system in Asia, with a multitude of specialised, expert treatments in oncology, gynaecology, cardiology, ophthalmology and many other specialities.

In fact, according to consultants, Watson Wyatt Worldwide, Singapore is acknowledged as having one of the most successful healthcare systems in the world, both in respect of financial efficiency and community health outcomes. Evidence of this achievement are the nation's 11 Joint Commission International (JCI) accredited hospitals and treatment centres, which is one-third of all the JCI-accredited facilities in Asia.

Singapore's healthcare facilities are world-class, reflecting its reputation for clinical excellence, reports *Ruby Lai-Chuah*.

Market structure

Healthcare design in Singapore has progressed dramatically in the last two decades, with the Ministry of Health embarking on an ambitious task of redeveloping all the old government hospitals and creating new facilities to meet the ever-increasing healthcare needs of the nation. Public hospitals deliver 80% of care in the acute sector, with the remaining 20% provided by private hospital care.

There are currently seven public hospitals, with the eighth under construction in the north, and plans are being made for a ninth hospital in the west. There are also six national specialty centres for cancer, cardiac, eye, skin, neuroscience and dental care.

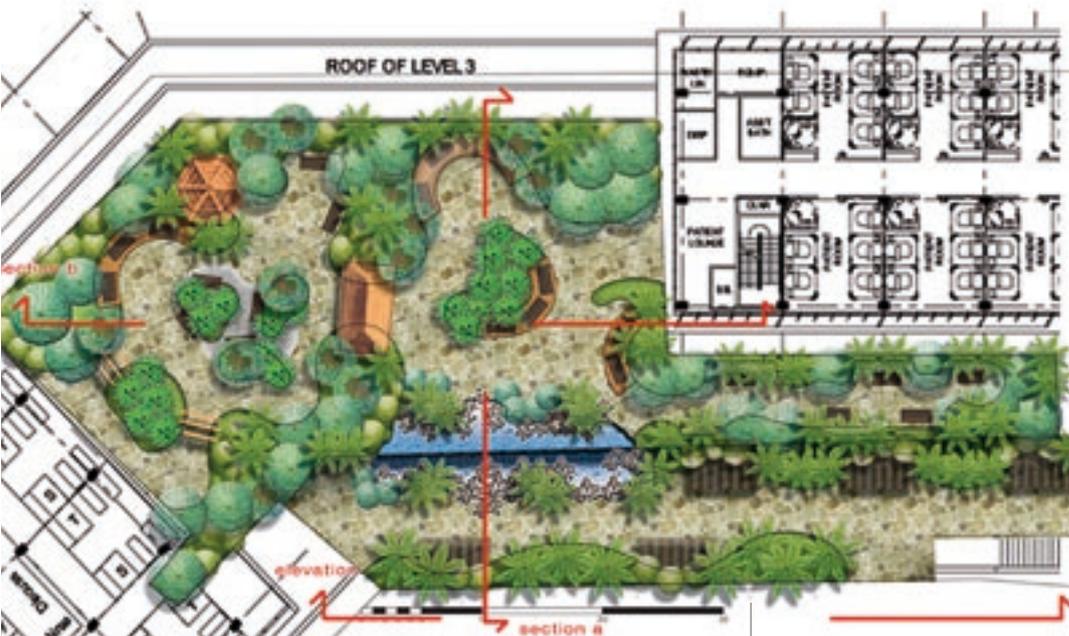
Public healthcare facilities fall under two broad clusters: the National Healthcare Group (NHG) and Singapore Health Services (SingHealth).

Each cluster provides a full range of acute services ranging from primary care at the 18 polyclinics, to secondary and tertiary care at the regional and tertiary hospitals and national centres.

Private practitioners provide 80% of primary healthcare services while government polyclinics provide the remaining 20%. The doctors either work in their clinics located in the housing estates spread throughout the island, in commercial buildings and medical centres, or within private hospitals. There are six private hospitals, and several specialist centres providing specialist healthcare services for private patients.

There is also a comprehensive range of residential and community-based healthcare services that cater to the long-term healthcare needs of Singaporeans, comprising community hospitals, hospitals for the chronically ill, nursing homes, sheltered homes for the formerly-mentally ill, inpatient hospice institutions, home medical, home nursing and home hospice care services, day rehabilitation centres, dementia day care centres, psychiatric day care centres and psychiatric rehabilitation homes.

In 2005, Singapore welcomed 374,000 visitors specifically for healthcare,



Khoo Teck Puat Hospital (above)

The design of this 550-bed hospital, which is currently under construction, comprises an 8-storey block for private wards, a 10-storey block for subsidised wards and a 6-storey block for specialist outpatient clinics. The emergency department and the diagnostic and treatment department are on the lower three floors, below the wards. The hospital has one main entrance which is designed for easy access to the emergency department and specialist outpatient clinics, with visitor lift cores to the wards nearby. Wayfinding is thus very clear.

Pockets of green distributed throughout the hospital bring healing landscape to the patients. The hospital opens out towards a nearby pond which will be specially developed for the needs of the patients and visitors.

The interior design is warm and homely, using natural materials to create a relaxed and comfortable feel for patients and visitors. Artistic displays will be used to conjure joyful and peaceful feelings.

Kho Teck Puat Hospital (right)

Project completion date: 2010
Contract form: Public Service Conditions of Contract (PSSCOC)
Client: Alexandra Hospital
Architect: CPG Consultants (in collaboration with RMJM Hillier)
Structural engineer: CPG Consultants
Services and Environmental engineer: CPG Consultants
Quantity surveyor and planning supervisor: CPG Consultants
Main contractor: Hyundai Engineering & Construction



and in 2006, there were over 410,000 international patients. This number is expected to increase steadily, with the encouragement of the government. SingaporeMedicine, a multi-agency government initiative aimed at developing Singapore into one of Asia's leading destinations for healthcare services, was set up in 2003. The public and private hospitals are well-positioned to serve the 'medical travellers', by providing 'essential' healthcare, 'affordable' healthcare and 'premium' healthcare to patients from the region and from as far away as the Middle East.

Hospital design – the Singapore style

Hospitals in Singapore are designed to meet international standards geared towards Western medical science, but are customised to the local climate and cultures. The design principles adopted in Singapore are:

- Patient and visitor-focused design
- High technology to improve efficiency and quality of care
- Clean and green design
- Promotion of medical wellness
- Design in the urban context

Patient- and visitor-focused design

Asian society is highly family-orientated. When patients come to the hospital, they are often accompanied by family members. Therefore, waiting areas need to be large enough to cater for the numbers. When patients are hospitalised, their visitors come in throngs, and often a caregiver will stay overnight. It is important to cater for this need by providing space and facilities for the visitors.

An important aspect of this is clear wayfinding to ensure that visitors do not get lost. This is accomplished by intuitive wayfinding with clear access to important landmarks (emergency department entrance, visitor lifts to wards, escalators to clinics, etc) as well as clear signage using international icons. As many visitors remain in the hospital for the whole day, facilities are provided to ease their stay. These may include a cafeteria, banking facilities, bookshops, a commercial pharmacy, and gift and flower shops.

High technology

Singapore hospitals are designed with excellent medical infrastructure. Many physicians received their speciality training from respected international hospitals and demand similar facilities in the local hospitals. The high level of training of support staff ensures that patients get the best medical care.

Integrated information systems are used in the hospitals, combining patient records, prescriptions and billing into one seamless system. Physicians can log on to wireless computers to access x-ray records, update patient symptoms and get all the required information at the touch of a button. They can note down the diagnosis

Tan Tock Seng Hospital (below)

Singapore's second largest acute care general hospital with 1,400 beds, this hospital has a unique ward floor plate comprising two triangles with visitors' lifts and waiting areas located where their apexes meet. The shape allows thorough ventilation for non air-conditioned wards, and the central nurse station has an excellent view of all patient rooms.

Specialist outpatient clinics, at one end, and wards, at the other, are situated above a podium which houses the diagnostic and treatment and support areas. There is also a helicopter landing on the tower block roof-top. The hospital received the American Institute of Architects Modern Healthcare Design Excellence Award.



Market Report: Singapore

KK Women's & Children's Hospital

Project completion date: 1998
Contract form: Form 24A
Client: Ministry of Health
Architect: CPG Consultants (in collaboration with McConnel Smith and Johnson / Arkitek Tenggara)
Structural engineer: CPG Consultants
Services and environmental engineer: CPG Consultants
Quantity surveyor and planning supervisor: CPG Consultants
Main contractor: Ssang Yong Engineering & Construction

and recommended treatment into the case sheet electronically, and enter the prescription.

The pharmacist receives the prescription electronically and can start preparing the medicine immediately so that when the patient goes to the pharmacy, the medicine is ready for collection. In addition, telemedicine is becoming popular in some of the hospitals, enabling doctors in Singapore to listen to the heartbeat of their patients in Jakarta and see them through teleconferencing screens.

In addition, in order to cut down on expensive manpower, automation is used in public hospitals – including technology such as the automated guided vehicle system for transporting linen, food and medicine; a pneumatic tube system to transport samples and case sheets; and pneumatic chute systems for transporting dirty linen and waste.

Clean and green design

Singapore is an equatorial country with high temperatures, high humidity and heavy rainfall. Energy is expensive as the country does not have any natural resources. The public hospitals are designed to keep energy usage down.

Natural ventilation is used wherever possible. For public hospitals, 65% of the wards are naturally ventilated, with only the private wards fully air-conditioned. This has an important impact on the ward design. The triangular ward form of the Tan Tock Seng Hospital was found to have good thorough-ventilation for the wards. Where rectangular wards are used, the depth of the floor plate has to be kept fairly narrow and a single corridor system is preferred, instead of a race-track-style system with rooms in the middle.

Wards are designed with large windows to give the patients a good external view. Building orientation is analysed and sunshades designed to ward off the strong afternoon sun. Naturally ventilated wards are provided with ceiling fans individually controlled by the patient.

Finishes are designed with ease of maintenance in mind. Good quality vinyl sheet with seamless joints and covered-up skirting are used in most medical areas. These are easy to clean and are good in terms of sound absorption and comfortable



on which to walk and wheel. Walls are finished with easily cleaned paint, and wall-guards installed to protect against damage by trolleys.

Promoting medical wellness

The key to Singapore's efficient healthcare system is the emphasis on the individual to assume personal responsibility for their own health and health expenditure. The government places an emphasis on encouraging self-reliance, keeping healthcare affordable and promoting a healthy lifestyle.

Hospitals also play an important role in promoting health education. Many public talks and exhibitions are held in public hospitals' auditoriums and public spaces, encouraging people to incorporate physical activity into their daily life, teaching them how to read food labels and select healthier food. Public screening programmes are provided in the public clinics for early detection of diseases such as hypertension, diabetes and heart diseases.

Designing in the urban context

Land is very scarce in Singapore. Hospitals have to be built with a high plot ratio. Tan Tock Seng Hospital, for example, is 14 stories high, and the new Khoo Teck Puat Hospital is 10 stories high. Greater reliance has to be placed on vertical transportation using lifts, and building designs have to provide areas of refuge to which patients can be transferred in the case of fire evacuation.

Separate banks of lifts are provided for staff use, for transferring patients from wards to diagnostic and treatments areas, providing patients with privacy from visitors using the lifts.

As there is limited ground, podium roofs are landscaped to allow patients garden space in which to relax and recuperate. Where possible, sky gardens are provided.

Emerging trends

Healthcare treatment is continuously changing, and hospital design has to keep pace with the



Tan Tock Seng Hospital (above)

Project completion date: 1999
Contract form: Form 24A
Client: Ministry of Health
Architect: CPG Consultants (in collaboration with Ellerbe Beckett, USA)
Structural engineer: CPG Consultants
Services and environmental engineer: CPG Consultants
Quantity surveyor and planning supervisor: CPG Consultants
Main contractor: SsangYong-Guan Ho Joint Venture

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Khoo Teck Puat Hospital (above)

Purpose built spaces at the new hospital with views of nature and natural light created with courtyard garden settings will provide opportunities for repose and retreat

changing medical and social demands. With the growing sophistication of surgical skills, operations which in the past required patients to be hospitalised can now be conducted as day surgeries, with the patient going home within a few hours of the operation. This has reduced the demand of beds in the wards, but increased the demand on day surgical facilities.

Thus, the new Khoo Teck Puat Hospital, designed by CPG Consultants, has fewer beds than the Changi General Hospital even though it serves the same catchment size, but has a larger area for its diagnostic and treatment department.

SARS has had a great impact on the healthcare scene in Singapore. Learning from the incident, hospitals are now geared towards providing more isolation rooms, and their emergency departments are designed to segregate the 'suspected infectious' from the other patients. Khoo Teck Puat Hospital has an isolation ward, and many of the other existing hospitals have been refurbished to convert some wards into isolation wards. A new Communicable Disease Centre is being designed to cater for infectious diseases.

Another trend in Singapore is the growth of the private sector. The government has recently offered new sites for

private hospital development, which will result in many new and interesting healthcare projects in the next few years. With greater commercial input, we may see private clinics in medical centres, shopping centres located next to a general hospital, hotels built within the same medical complex to provide lodging for families of foreign patients and possibly to act as step-down nursing rooms for patients recovering from treatment. The permutations are myriad and will prove interesting.

Reputation for excellence

Singapore is a world-class healthcare destination, well known for its excellent healthcare facilities, skilled medical professionals and the latest medical technologies. Patients enjoy a wide range of clinical services, from basic health screening to complex medical care, at Singapore's public and private hospitals, as well as national speciality centres. Patients also benefit from the clinical research carried out by public and national speciality centres and the many thriving pharmaceutical, biotechnology and medical technology industry. And Singapore doctors are kept abreast of the latest medical know-how through continuous professional training and seminars.

Singapore has gained a reputation of having a trustworthy healthcare system which allows patients faster access to safe, new healthcare products and services in technically advanced and comfortable facilities with the best of medical technology customised for the patients.

Land is very scarce in Singapore, so hospitals are built with a high plot ratio



Making places, healing spaces

Sean Stanwick describes how Canada's regional responses to healthcare design are rooted in the life-affirming connection between humanity and nature.

unique cultural values. "Since the 1940s, a uniquely Canadian architecture has developed," writes Lisa Rochon in *Up North: Where Canada's Architecture Meets the Land*. "Rooted in the principles of human scale, material warmth, and deep connections to site" [ours is an architecture that] "resonates with the humanity of this country."¹

By and large, Canadians understand that a hospital is a highly emotional place and recognise the negative implications of creating a generic, corporate-like office building with beds. Therefore, materials such as wood and stone are used generously to create places of quiet refuge and bring something familiar and comforting from everyday life. Light is embraced as an essential life-affirming force, often giving a spiritual dimension to the care experience. Natural features such as running water; fish and live foliage also serve to complement the care environment. In one northern Ontario hospital, a 'seasonal river' terrazzo floor pattern composed of fish and other natural forms flows through the multi-storey wooden concourse.² In short, the best Canadian hospitals rarely function as a drive-by experience, but instead they allow us to slow down, breathe and heal.

There are several noteworthy examples that illustrate this shared desire to celebrate what is special about the land and local culture. A case in point is the new Peel Regional Cancer Centre at the Credit Valley Hospital (CVH) in Mississauga, designed by my own firm, Farrow Partnership Architects. Senior partner Tye Farrow has followed the tradition of noted Toronto architect Eberhard Zeidler, who first championed the case for human-centred healing facilities at the Hospital for Sick Children in Toronto, by challenging accepted healthcare norms through

The Canadian healthcare system has enjoyed a longstanding reputation for being one of the best in the world. Part of this recognition is based on the fact that pre-eminent Canadian hospitals intentionally draw on regional or natural themes to create meaningful and relevant designs. As a result, several examples have risen to international attention by addressing both the innate human desire to connect with natural surroundings and the necessity to deliver technologically advanced medical infrastructure.

Making places

Canadian architects have a tradition of treading lightly on the land they occupy and also seeking to honour the origins and influences of the building site. Such efforts often include references to local geography, environmental sensitivities or



Providence Legacy Project (right)

Project completion date: 2014 (pending formal project approval)

Contract form: P3

Cost: C\$1.5 billion (est)

Client: Providence Health Care

Architect: Farrow Partnership Architects; Busby Perkins + Will Architects



the creation of a much-needed communal gathering place in a sprawling suburban community.

Initially, cancer patients at the hospital were asked about their priorities for the new facility. "Our spaces should give us hope," they responded. When asked what would give them hope, they replied: "Something that is alive."

Faced with a devastating illness, this response emphasises the importance of fostering strong civic and social connections. In the Toronto suburb of Mississauga, the quest to create a unique gathering point called for a solution far beyond such standard elements as a canopy and a coffee kiosk in the lobby. Dramatic use of wood in the entry atrium, flooded with natural light, serves to acknowledge the necessity for a memorable place to congregate and interact. Clearly visible from the street, the sheltering tree-shaped forms combine with natural materials to give a spiritual dimension to the experience.

"There is nothing timid about this design," says Farrow. "The goal was to provide a place that would contribute to the economic vitality of the city, but also incite a spiritual reaction from the users."

While the design team is a key contributor, it is by no means a singular effort. Confronted with pressure to conform to conventional design standards, president and CEO Wayne Fyffe also seized the unique opportunity to raise the bar for health care delivery internationally. "The bold design was embraced immediately as a logical extension of our vision and values," says Fyffe. "The board got it and key staff members instantly saw that this was the right thing to do. An anonymous, steel-columned box would contradict our values and turn our vision into empty words."

Clearly there is a powerful attraction to this design that draws patients, staff and visitors who gather to talk through emotional issues or to simply share their thoughts. Its function goes far beyond the standard requirement for circulation and waiting. Conveying in every respect the message that "you are in good hands", a reassuring sense of community and animation now infuse the suburban block. "It's uplifting," says Corinne Stafford, a visitor to the centre. "It's almost like not being in a hospital."

The commitment of the design and management team has not gone unnoticed by the international community as well. An expert panel chosen by the UK's leading advocate for high quality design, the Commission for Architecture and the Built Environment (CABE) selected the project as its Best International Design at the ninth Building Better Healthcare Awards (see p40). The award recognises, "an outstanding project that contributes to new thinking and influences the UK's future experience of delivering healthcare in the 21st century."

Close to home

Passive, disconnected hospitals will have a limited future, while those that take an active role in the health of their constituents will maintain their relevance well into the future. Through what some critics have hailed as one of the finest examples of modern architecture in the city, the Bloorview Kids Rehab in north Toronto makes a strong statement about the value in creating inroads into the community.

Designed by Toronto architects Montgomery Sisam in a joint venture with Stantec Architecture, the new six-floor 358,000 square-foot 'home away from home' for children coping with disabling injuries and illnesses offers a welcoming alternative to the typical hospital.

Situated in the heart of a residential neighbourhood, at the edge of a wooded Toronto ravine, Bloorview executed the role of good neighbour perfectly. City planners, local

Bloorview Kids Rehab (above left and right)

Project completion date: June 2006
 Contract form: Stipulated Sum
 Cost: C\$80m (construction cost)
 Client: Bloorview Kids Rehab
 Architect: Montgomery Sisam Architects |
 Stantec Architecture In Joint Venture
 Structural engineer: Yolles Partnership
 Mechanical and electrical engineer: H.H.
 Angus and Associates
 Quantity surveyor: Curran McCabe
 Ravindran Ross
 Main contractor: EllisDon Corporation



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- Provision of health planning advice to NHS Greater Glasgow for the development of the **New Beatson, West of Scotland Cancer Centre**
- Supporting several **P21 contractors and 9 LIFTCos** on the development of mental health, learning disability, community hospital and primary care facilities
- Supporting HBG on development of several health building developments as part of the **Design for Life, Building for Wales** framework
- Developing a comprehensive Clinical Services Plan for the **Hamad Medical Corporation** – the public health service provider in the State of Qatar.



residents, as well as neighbouring institutions were all consulted to help shape the building. The resulting site design incorporated greenspaces, strong linkages between the neighbourhood to the south and the ravine to the north, as well as a dedicated public pedestrian walkway across the top of the ravine.

The design intentionally respects the look and feel of the adjacent residences. On the outside of the wedge-shaped west wing, which rises from two storeys to six, the designers created an earth-tone brick base and used warm-grey zinc patterned to mimic the weathered wooden shingles prevalent in the neighbourhood.

Along its sloped edge, the metal roof cuts itself away to expose several outdoor terraces – a gesture, in part, to the adjacent residential condominiums. Anticipating light, wind and rain to penetrate through the filigree of wooden trellises and ivy, the terraces reinforce the concept of the hospital as a living, breathing building.

Bloorview also gives back to the community with new urban infrastructure. “We created a new street with a direct link to a widened walkway along the edge of the ravine,” says architect Terry Montgomery. “All of these moves create a multi-layered sense of place for both hospital and neighbourhood.”

Bloorview actually functions more like a community centre than a hospital, as a variety of therapeutic and social spaces are offered for daily use by local residents. For children, this connection with their family rhythms, rather than being insulated from the outside world, is a vital aspect in their healing process.

“In most hospitals, children experience such disconnection from the normal rhythms of life,” says lead interior designer Anne Carlyle. “Because this site bridges the cityscape and the natural environment of a ravine – with extraordinary views of both – we had the opportunity to reinforce that connection.”

The heart of the scheme is the double-height family resource centre, created as the place where the city and the ravine come together: Providing a comfortable setting for first-time visitors to congregate and orient themselves, the centre is also a good vantage point for those already familiar with the layout to observe the daily comings and goings. Generous use of glass and natural materials such as warm cherry woods and limestone floors soften the feel and yield warmth underfoot.

The benefits of art are also well considered. Drawing on themes from nature, transformation and history, the installations are intentionally abstract and whimsical. In the main lobby, artist Jan MacKie created *Whispered Invitation*, a curtain of over 5,000 coloured glass beads. Triggered by the motion of children, wisps of cosmological light dance across the walls and emulate the great northern lights.

But the most emotional installation is also the least technical. Created by children, a tactile mosaic of hand-patterned ceramic tiles featuring elaborate birds or just simple dents and wiggles gives children an opportunity to make their own mark on their home away from home.

An urban village

The human connection between nature and building is an intuitive and deeply emotional one. Harvard biologist EO Wilson wrote in *The Biophilia Hypothesis* of our deeper attachment to nature that includes a broad range of intellectual, physical and emotional needs. Wilson infers that it is impossible to detach from nature without also compromising our spiritual existence.³

As a paradigm for healthcare, Vancouver architect and award-winning leader in green design Peter Busby agrees. His firm, Busby Perkins + Will, and Farrow Partnership are currently laying the groundwork for a new green standard at the Providence Legacy Project in Vancouver, British Columbia.

Providence Health Care (PHC) is the largest Roman Catholic, non-profit healthcare organisation in Canada. The Legacy Project will establish a new 418-bed hospital, research, and teaching facility in the city's Downtown Eastside, a gritty neighbourhood experiencing gentrification. Though still on the drawing board, the first impression is of a verdant wellness campus, rather than a place for processing the sick.



Peel Regional Cancer Centre (above)

Project completion date: May 2005

Contract form: Stipulated Sum

Cost: C\$83m

Client: Credit Valley Hospital

Architect: Farrow Partnership Architects

Structural engineer: Halsall & Associates

Services and environmental engineer: Rybka Smith and Ginsler (mechanical electrical engineers)

Quantity surveyor and planning supervisor: Altus

Helyar Cost Consulting

Main contractor: PCL Constructors

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Conceived as an interconnected urban village, the hospital will integrate mixed-use functions including healing programmes, residential, research, retail, and a village green. The same gesture for place-making seen at Farrow's Credit Valley Hospital extends to Legacy in the form of the Patient Intake Centre (PIC), a central hub that functions as main circulation atrium and community gathering space. Flanked by retail and residential, the PIC and the pedestrian-only forecourt will be animated by fluid and casual movement between campus and city buildings.

Momentum for the ambitious project comes both from an accelerated trend towards ambulatory care and short-stay treatments, as well as a growing belief that green design and healthcare are not mutually exclusive states. This is particularly relevant in British Columbia, where personal health is so closely linked to the outdoors.

The project is aiming to be the greenest in Canada, achieving a minimum LEED-Canada gold certification. "We'll be pushing the envelope to make things better and be sustainable," says Neil MacConnell, Providence vice-president responsible for Providence Legacy Projects. "We would expect our building to be, at minimum, gold and hopefully platinum."

Renewed interest in 'what's out there'

Increasing emphasis placed by healthcare organisations on the implementation of evidence-based design principles in their capital projects supports architects' long-standing efforts to deliver integrated 'indoor-outdoor' designs.

Most Prime Consultant RFPs (Requests for Proposal) for significant healthcare developments now allude to these principles, and require a commitment to patient-centered design respectful of the theories of Dr Roger Ulrich and similar studies. While often difficult to quantify, as the number of variables abound in the healthcare setting, ample anecdotal evidence suggests a relationship between a serene, empowering, daylight-filled therapeutic setting and the speed or efficacy of the healing process.

The University of Alberta's ground-breaking 1100-bed Walter C. Mackenzie Health Sciences Centre, designed by the Zeidler Partnership in the 1980s, gave support to this theory. A Zeidler innovation in the healthcare setting, the atrium concept succeeded in bringing the outdoors in by delivering a light-filled, temperate, tree-lined space which was now usable 24/7. By virtue of these attributes, most well-designed atria evolve to become the animated hub of the hospitals they serve. Zeidler's successful atrium at Toronto's Hospital for Sick Children reinforces this pattern.

More recently, healthcare organisations have recognised the value of a sensitive and sustainable landscape design. Not content to limit 'greening' to interior spaces, St. Joseph's Healthcare (Hamilton) has championed the value-added contribution of a world-class landscape architect (Andropogon

Through careful consideration of passive design strategies, buildings have been oriented to correspond with the sun's path, allowing maximum sunlight penetration deep into courtyards, green terraces, and light wells. Additionally, higher structures located on the north will give patients unobstructed views to the False Creek waterfront. Photovoltaic panels have also been incorporated for renewable energy production, while natural ventilation in all patient rooms will help balance mechanical and electrical loads.

When complete, Legacy will provide a new value proposition for the future of healthcare. "Hospitals are the unhealthiest buildings going," says Busby. "Providence wants a green building with fresh air and sunshine; these are extremely important for the health of both patients and employees."

In *41° to 66°, Regional Responses to Sustainable Architecture in Canada*, architects Marco Polo and John McMinn wrote: "The enduring presence of regionalism in Canadian architecture...addresses both environmental conditions and material traditions."⁴ More akin to portraits of the landscape around them, Canada's exemplary hospitals intentionally support conscious decisions regarding the oft-neglected contextual dimension – and in doing so, find the common ground between sustainability, functionality and civic pride.

Sean Stanwick is an associate of Farrow Partnership Architects

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Associates of Pennsylvania) as part of the redevelopment of its mountain campus. Zeidler has positioned Andropogon as an equal design partner through all stages of building and site planning to ensure not only the ubiquitous "seamless integration of indoor and outdoor spaces" but also the creation of meaningful outdoor therapeutic spaces.

In Victoria BC, the Vancouver Island Health Authority has designated as 'Pacific Green' an initiative to reclaim and protect its site throughout the development of a new 500-bed patient care centre. This concept is one of three fundamental principles which underscore its vision. Programme spaces were mandated for distinct patient, staff and visitor populations. Staff considerations include meaningful and quality views of these spaces from above in addition to a tactile experience *in situ*. Patient access to spectacular mountain views has been upheld as inherent in enhancing the patient experience.

Informed healthcare organisations, the 'early adopters' of evidence-based design theories, now encourage not only the implementation of basic principles, but also the exploration of opportunities on and around their sites.

Ron Nemeth, B.Arch. OAQ, OAA, AAA is a partner at Zeidler Partnership Architects





The healthcare system is one of the most complex and rapidly changing organisational and technical environments in advanced economies. In most countries many stakeholders from the public, private and voluntary sectors are involved. The mechanisms for funding, payment and reimbursement for services are often convoluted. The policy context may be dynamic, with governments regularly introducing new targets and objectives. And all this is taking place against a backdrop of evolving patterns of demand associated with shifts in demography and morbidity.

Modernising the health and social care system to address the emerging demands is a priority for many governments. In the UK, wide-ranging organisational and funding reforms are being put in place and an unprecedented investment to renew the built and technical infrastructure for healthcare is underway. Many new hospitals and primary care facilities are being built, and a national programme to introduce new information

and communication technology to support health services is being implemented.

Planning, delivering and operating infrastructure that will meet future healthcare needs poses significant challenges, not least because the lifecycles of the various elements of the health system – the built and technological environment, service delivery practices and policies – are mismatched.

The infrastructure challenge

These mismatched lifecycles of the healthcare infrastructure system's elements, coupled with the multiple stakeholder needs and differing institutional and funding arrangements which have to be reconciled, lie at the heart of the 'infrastructure challenge'. In the UK, this is compounded by a historic legacy of outdated buildings and cultures within the healthcare system.

Because of their durability and impact across

society, how to cope with future uncertainties has long been seen as a key problem for planning, designing and managing complex engineered systems. Over the lengthy delivery and operational contracts, typical of much complex infrastructure, there is likely to be a high degree of future uncertainty and risk. This arises from changing patterns of demand, which may not match the levels projected at the time of initial project planning. And while demographic or morbidity trends can be relatively predictable, unanticipated legislative or policy changes may substantially reduce demand or increase costs. Technological advances over a lengthy procurement, delivery and operational period may also mean that infrastructure designed in 2008 is obsolete by 2028.

Healthcare infrastructure is a prime example of a complex engineered system facing such uncertainties. It consists of many functional and operationally interconnected built and technical elements which interact with non-built systems such as organisational and financial structures. Both the healthcare infrastructure and service systems are subject to continuously evolving demand. Furthermore, the relationships between innovation in the technologies, infrastructure and services associated with healthcare are themselves complex. Cycle times for changes in these elements vary considerably between long-lasting fixed capital infrastructures, more rapidly changing technologies and services, and



Innovation frontier

James Barlow describes the planning, delivery and operational challenges of creating effective healthcare infrastructure systems in a period of rapid social and technological change.

How do innovative technologies, such as Maquet's PowerLED light (above) and Satellite ceiling suspension system (right) relate to the physical environment?

a frequently unstable policy context. In the UK, the current programme for building and operating new hospitals involves privately financed contracts for 30 years or more, but incorporates technologies which may have five-year life cycles. These are helping to deliver diagnostics and therapies, which are undergoing rapid evolutionary change.

Even though a project to design and build a new hospital may not be inherently complex, it will almost certainly be taking place within an environment where there is considerable market and technological uncertainty. High switching costs – in terms of time, money and disruption associated with adapting infrastructure to changes in services and demand – make it especially important to carefully plan healthcare built assets either for future adaptation or closure. In the UK, for example, a fragmented system for planning and delivering healthcare infrastructure is becoming increasingly exposed at a time when the context for care services is undergoing rapid change.

Modern healthcare systems around the world are faced with similar dilemmas. Two core areas that need to be addressed are: integrating services and infrastructure planning and delivery, and how to stimulate and sustain innovation in infrastructure provision.

Technological advances may mean that infrastructure procured and designed in 2008 is obsolete by 2028

Integrating services and infrastructure planning

As previously noted, increasing the flexibility of healthcare infrastructure to meet rapidly changing services and practices usually involves high switching costs. A more sophisticated and holistic approach to planning infrastructure and services is needed. However, this poses some interesting questions which require investigation. These include what form should new approaches to planning take, at what spatial scale, over what time period, and how coordination can be achieved when healthcare service organisations are becoming increasingly diverse and independent.

One area where improvement might be made is through integrating existing tools for modelling, simulating and visualising the potential impact of alternative infrastructure design decisions on care services and pathways. Another is the development of a better understanding of the 'value' of innovative investment in healthcare infrastructure in order to aid decision-making. This requires research on how different stakeholders perceive value and evidence-based benefits, and improved modelling of performance and costs and benefits.

Health and Care Infrastructure Research and Innovation Centre (HaCIRIC)

HaCIRIC is a collaborative venture between four UK universities – Imperial College London and the universities of Loughborough, Reading and Salford. Additional partners from other universities, industry and the healthcare system are involved in specific research projects. The centre is funded for an initial five years by the UK's Engineering and Physical Science Research Council.

HaCIRIC's focus is on understanding the interactions between innovations in healthcare technologies, services and infrastructure. Improving the way infrastructure is planned, delivered and managed is at the core of HaCIRIC's activities. Its research programme has been developed in partnership with key stakeholders from the healthcare system, including the UK's Department of Health, the National Health Service, and the supply industries.

Seven research themes underpin HaCIRIC's research projects, around a dozen of which are currently underway:

- Managing innovation in a context of technological change
- Procurement for innovation
- Innovative design and construction
- Care delivery practices
- Delivering improved performance through operations management
- Knowledge management in complex systems
- Design and evaluation of integrated systems

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Stimulating effective innovation

Stimulating innovation in infrastructure development embraces questions of risk and reward allocation; how incentives, procurement models and government policy targets can be more effectively used; and the concept of 'demand-driven innovation', where new approaches to procurement are designed to deliver innovation.

It is well known that distributing project risks and incentives across supply chains can help to motivate innovation. In current approaches to financing and procuring healthcare infrastructure this is often not the case. For example, the attitude towards risk within private finance schemes in the UK is generally cautious because of the way risk is shared and its nature as a long-term loan vehicle. Existing research on the relationship between financing and procurement processes and innovation needs to be extended and deepened through studies of live schemes. One area of HaCIRIC's work will be to develop this research base through the evaluation of a major new all single-bed hospital in the UK, and the redesign of primary care services and associated healthcare infrastructure.

There are significant challenges in planning and delivering built and technical infrastructure to meet emerging healthcare needs. These arise from the complex dynamics linking changes in healthcare services, technologies and infrastructures.

The pace of change in healthcare is speeding up, making it increasingly necessary that there is innovative thinking in planning, design and construction approaches, and an understanding of how infrastructure can enhance future health services.

Prof James Barlow is a director of the Health and Care Infrastructure Research and Innovation Centre at Imperial College London.





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For many years the Healthcare Estates Conference & Exhibition has been at the forefront of delivering essential information and products that affect the delivery of modern healthcare facilities in the UK.

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is Europe's largest exhibition dedicated to showcasing the latest healthcare facility products and services available.

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For conference information visit www.iheem.org.uk or for full details of the exhibition and exhibitor profiles visit www.healthcare-estates.com

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Wise move

How do you get plans for a health and social care facility off the ground when you've no experience of building projects? **Richard Brindley** describes how a new international architects' service is helping to deliver client visions.

Healthcare buildings, wherever they are in the world, bring more than their share of challenges. They have to be well designed, functional, constructed to high standards and delivered to strict timeframes. And, of course, they must offer value for money. But, faced with increasingly complex procurement methods, healthcare bodies can often find themselves in need of expert guidance. The answer could come in the shape of the 'client design advisor' – an innovative role created by the Royal Institute of British Architects (RIBA) to bridge this knowledge gap, and available to clients worldwide. Your own personal expert, a CDA understands your vision, advises you on everything from decision-making to setting budgets, and does their utmost to guide you through any obstacles standing in the way. As Southwark Health and Social Care discovered, it is support that could prove invaluable.

Case study: Aylesbury Resource Centre, Southwark, London

Project manager Catherine Searle was tasked with delivering a new day centre for adults with physical, neurological and sensory disabilities. A new building was required to modernise provision of adult education, independent living skills training, health and therapy services, employment support and other voluntary services. The centre was to be part of the regeneration project on the Aylesbury estate in Walworth, South London, managed by the council's regeneration department and Aylesbury New Deal for Communities.

The end users of the building – hundreds of people with a wide range of mobility, cognitive and visual disabilities – necessitated a unique set of design requirements. Special attention had to be paid to layout, materials, colours, finishes, fittings and equipment – all considerations that aren't sufficiently addressed in the UK's Disability Discrimination Act, hospital building notes or similar design guidelines. As the project was managed by the local authority, it didn't benefit from the expertise available within the strategic health authority. The local authority had no experience of building new social care facilities, and the architects had been chosen for their housing expertise. To add even more pressure, a previous design had failed due to the difficulty of safely evacuating the high number of disabled users in case of fire. A one-year delay followed, and since the centre was part of a high-profile, politically sensitive redevelopment project, getting the design right the second time around was imperative.

"As project manager for the modernisation of the day services, I sought all the help I could get," says Searle. "A capital programme manager in the NHS recommended the CDA service, and I got in touch with the RIBA." From there, Searle was put in contact with architect Wendy de Silva, whose own experience and interests were closely aligned with the project. De Silva helped develop the brief, identified the appropriate policies and directives and made sure the architects met all relevant health design standards.

Her input was immense. "When the first design failed, I worried that we'd only learn our design mistakes through serious health and safety incidents," Searle says. "With Wendy on board, I was confident I'd no longer have to live with the uncertainty of whether I'd neglected important details. With my vision and my client design advisor's expertise we became a formidable team."

"I would strongly advise any international organisation looking for support with a unique building project to take advantage of the RIBA's service. The minimal cost is far outweighed by the benefits the CDA brings and the contribution they make to the success of the project." Construction work on the £6 million project is due to begin in September this year, with plans to open in 2010.

With my vision and my client design advisor's expertise, we became a formidable team

**Catherine Searle,
Project Manager,
Aylesbury Resource Centre**



Richard Brindley is executive director of the RIBA Professional Services

How client design advisors work

The RIBA has a register of international CDAs, all of whom are senior architects and other professionals who have successfully completed a rigorous accreditation process. De Silva is keen to stress that CDAs work in a supporting role, enabling you to get the most value from, and take control of, your project. "This expertise is most valuable at the crucial inception stages of your project. CDAs help you get the brief right for all your stakeholders, manage the business case, and oversee the design and procurement processes, as well as helping you to see your project through to deliver your objectives," she adds.

For more information, contact: The RIBA's Client Design Advisor service at www.architecture.com/clientdesignadvisor or call: +44 (0)20 7307 3700.



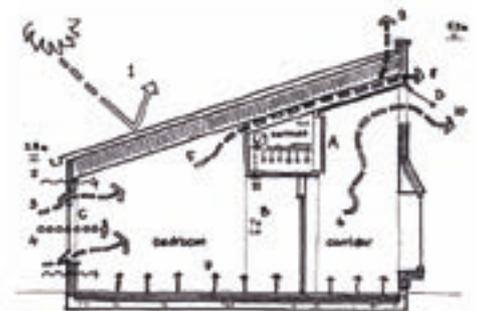
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Roseberry Park

Design & Health Scientific Review

The challenge of complexity



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 Hearststone Alzheimer Care

Human health is significantly related to the designed environment. The research activities promoted by the International Academy for Design & Health are founded on this assumption.

Our mission is to spread this awareness and promote health through well designed environments. As members of the Design & Health Scientific Committee, we want to emphasize the importance of integrating scientific research evidence in the design process, both in pre-design programming and in post-occupancy evaluation.

The integration of the disciplines of architecture, design, psychology, sociology, health sciences and economics provide global opportunities for researcher and practitioner exchange. We are committed to upholding high standards in this area to promote the practical as well as the theoretical importance of design in health promotion and innovation.

A healthy discipline and healing environments continually reinvent themselves. Where does such innovation originate? What tools generate transformation? Complexity theorists suggest that innovation emerges from an unfolding process of unpredictable 'jumps'. Process theorists argue that such innovative 'jumps' emerge from the confrontation of imagination and empirical evidence through an ongoing iterative design spiral.

New design principles are needed to respond to a new world of rapid change. There is little doubt, however, that the *machine-aesthetic* and the *homme-machine* are the remnants of a dated view of architecture and design waiting to be updated by contemporary research.

While design innovation manifests itself in non-linear dynamics, so does research. Research acts as a seismograph of the state of the art and a reflector of historical change. Scientific research is an indispensable component in an historic continuity allowing innovation to explode into unexpected directions.

The history of healthcare architecture, for example, is characterised by long uneventful periods followed by great transformation. Today's cultural upheaval is stimulating and opening new grounds for innovation, heralding the much anticipated Third Millennium 'jump'.

Traditional healthcare culture addresses the 'illness', not the 'ill', and is based on unconditioned faith in the 'machine'. This approach has generated the metaphor of healthcare settings as machines for healing and determined the architectural debate since the post war years. Today's scientific research aims to change these principles, starting with adopting the base belief in 'human-centred' environments.

In a rapidly changing world, complexity must embrace humanisation, but what will the future of architecture look like? Uncertainty and constant change in demographic, economic and political conditions make design and health one of the great challenges of our time. Difficult as it may be to figure out the shape and form of future society, what we know for sure is that it must be reconsidered within the context of global, sustainable, interdisciplinary and holistic healing environments.



49-55

We shape our buildings, then they kill us: Why healthcare buildings contribute to the error pandemic

Kenneth N. Dickerman, ACHA, AIA, FHF, National Resource Architect, Leo A Daly Company; Paul Barach, MD, MPH, Associate Professor, University of South Florida

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The Affects of Colour and Light on Health: Trans-Disciplinary Research Results

Eve A. Edelstein, Ph.D., Steven Doctors, Robert Brandt, Barbara Denton, Galen Cranz, Ph.D., Robert Mangel, Ph.D., W. Mike Martin, Ph.D., Gordon H. Chong



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Palliative care unit design: Patient and family preferences

Diana Anderson, B.Sc.(Arch), M.Arch.



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We shape our buildings, then they kill us:

Why healthcare buildings contribute to the error pandemic

The physical environment is a key component of a systemic approach to meeting the cultural challenge of patient safety in modern healthcare design.

Ken Dickerman ACHA, AIA, FHFJ; Paul Barach, MD, MPH; Ray Pentecost III, DrPH, ACHA, AIA.

Hospitals are complex. The physical environment in which that complexity exists has a significant impact on health and safety. However, enhancing patient safety or improving quality has not been integrated into aspects of the design of hospital buildings. Despite recent discussions in architectural literature regarding design of 'patient-centred' healthcare facilities and 'evidence-based design', there has been little assessment of the impact of the built environment on patient outcomes. Studies have focused primarily on the effects of light, colour, views, and noise, yet there are many more considerations in facility planning that can influence the safety and quality of care¹.

Analysis of more than 400 research studies shows a direct link between quality of care, patient health, and the way a hospital is designed. Here are a few examples of how changes in design can improve the quality of care:

- Patient falls declined by 75% in the cardiac critical care unit at Methodist Hospital in Indianapolis, Indiana, which made better use of nursing staff by dispersing their stations and placing them in closer proximity to patients' rooms¹;
- The rate of hospital-acquired infections decreased 11% in new patient pavilions at Bronson Methodist Hospital in Kalamazoo,

Michigan which was attributed to a design that featured private rooms and specially located sinks¹;

- Medical errors fell 30% on two new inpatient units at the Barbara Ann Karmanos Cancer Institute in Detroit, Michigan, after it allocated more space for their medication rooms, re-organised medical supplies, and installed acoustical panels to decrease noise levels¹;

The evidence is impressive. The healthcare environment has substantial effects on patient health and safety, care efficiency, staff effectiveness and morale. The US spends approximately 17% of its gross national product on healthcare, much of which is provided in hospitals. Yet, despite this enormous expenditure and the available technological resources, today's hospital care frequently runs afoul of the cardinal rule of medicine – above all else, do no harm. Hospitals also create stress for patients, their families, and staff. The negative effects of stress are psychological, physiological, and behavioural, and include:

- Anxiety, depression, and anger (psychological);
- Increased blood pressure, elevated levels of the body's stress hormones, and reduced immune function (physiological); and,
- Sleeplessness, aggressive outbursts, patient refusal to follow doctor's instructions, staff inattention to detail, and drug or alcohol abuse (behavioural).

Poor design of the hospital environment contributes to all these problems. Poor air quality and ventilation, together with placing two or more patients in the same room, are major causes of hospital-acquired infection. Inadequate lighting is linked to patient depression as well as to medication errors. Lack of a strong nursing presence can result in patient falls.

Seldom does an opportunity emerge to build a new hospital; most hospitals are in a continuous cycle of remodelling and expanding their existing facilities to adapt to changing demands. The US is in the midst of the largest hospital construction boom in history with over 500 hospitals being built, with a staggering \$200 billion impact.

We would then ask ourselves several guiding questions:

- How and via what mechanisms does the physical environment participate in patient safety?
- How does the environment of the system affect the safety of patients?
- What characteristics are used to describe an environment?
- What process creates the physical environment?
- Is it possible to change either the creation process or the result to improve safety?

Healthcare building design history

Louis Sullivan's famous dictum, "form follows function", should be rewritten to say, "form follows function and then function follows form"¹², to express the essential relationship between buildings and the people who populate them. The act of making form follow function (or clinical process) is brief, fraught with difficulties and often incomplete. The opportunity or limitation placed by the form upon function is lasting, hidden and inelastic. And the lengthy process of 5-8 years from idea inception to facility construction exacerbates these challenges.

In 1976, John Thompson and Grace Goldin of Yale University wrote the most complete study on the history of hospital design, *A Social and Architectural History of the Hospital*. While this work principally deals with the development of nursing wards or units, it sheds light on other key aspects of hospital development. The historical aspect of the work can be summarised as follows: there is nothing new under the sun. The two essential problems of hospital design which architects

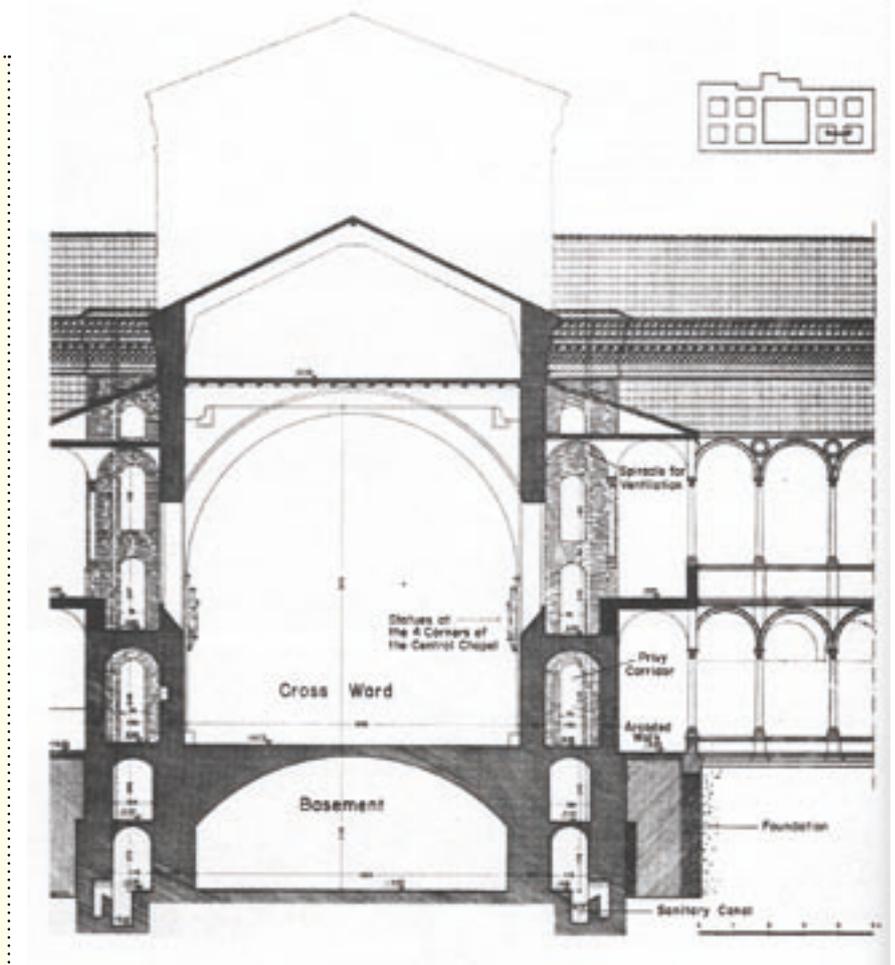


Figure 1: Ospedale Maggiore, Milan, section by Liliana Grassi

still face are: efficient and safe removal of human waste and creation of an environment that aids rather than hinders healing. Several examples will follow to demonstrate the slow pace of change in healthcare design.

Greek hospitals – Patient-focused

The first of these, though perhaps not the first hospital, is the Greek Asclepieion. These institutions were as much, if not more, temples than hospitals. Patients received the benefit of prayers and sacrificial offerings which were intended to influence the god of healing Asclepius. The relationship between god (healer) and patient with attendants as intermediaries was paramount.

Roman hospitals – Specialty hospitals

The Romans adopted the Asclepian model, but reformatted it to their own more practical purpose. Since soldiers, and later slaves, were the foundation of Roman civilization, it was natural that they should build *valetudinaria* to serve the legions. These might be complicated

fixed facilities where Roman rule was well established, or they might be small or movable structures to accommodate armies on the march.

As the expansion of the empire decreased, captured slaves became less common and Roman slaveholders were obliged to take better care of their property. One answer was to adopt the military approach and build *valetudinaria* for slaves. Better-heeled elements of Roman society had no such institutions available, since the belief structure held that illness was due to the anger of the gods and not natural causes.

The Middle Ages – Charity care

During the Middle Ages, as Christianity spread through Europe, the concept of caring for less fortunate members of society became more popular. In Islamic countries, value was even placed on the human body with the concomitant concept of caring for it, whereas Christianity looked at the body as a repository for the soul.

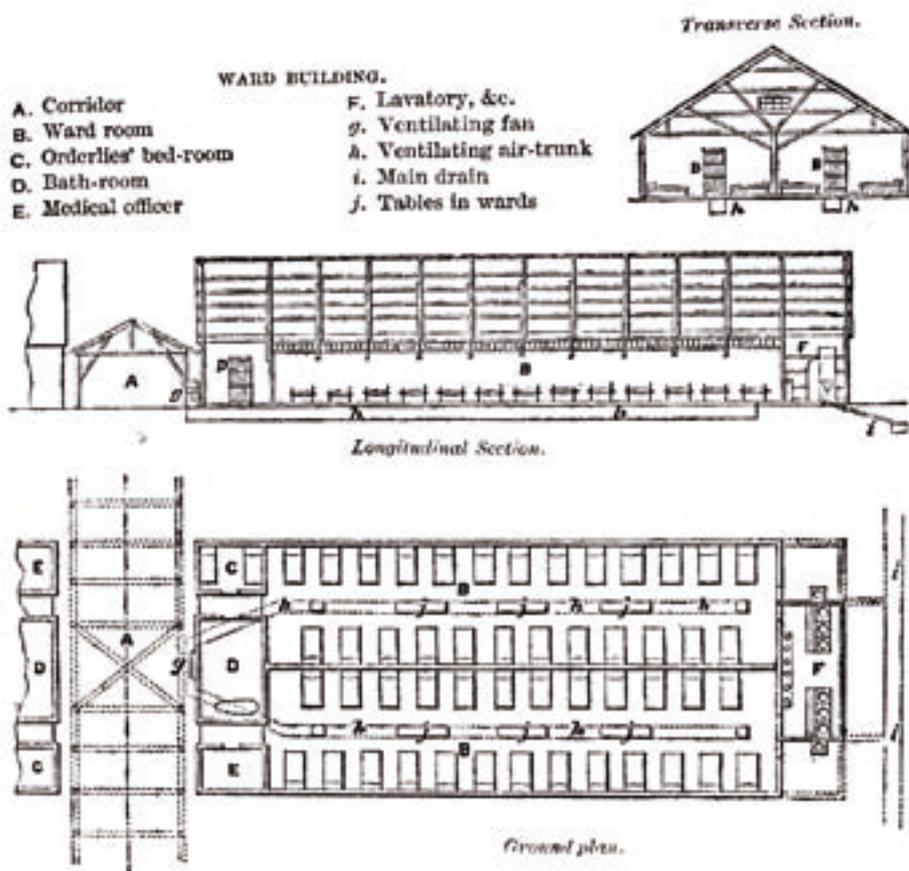


Figure 2: British army hospital, Renkioi, plan by Isambard Brunel, from Longmans Green

Great pilgrimages and the Crusades occasioned the development of centres to care for travellers. Located at monasteries such as Cluny in France, these developed from adjunct functions to purpose-built components of the monastery complex.

The technology of care in these institutions had not made great strides since the days of the Greeks, nor had there been great advances in the methods of removing waste or designing wards that aided healing. Clearly, however, there was a growing interest in health and public health, including creating the types of organisations and institutions that should be responsible for public welfare.

During the Renaissance, designers continued to struggle with the problems of waste removal and ward design. Some solutions, such as the hospital planned by Filarte in Milan (Figure 1), had a well-developed system of latrines near patient sleeping areas. Unfortunately, the waste, once removed, was discharged into the principal public waterway, which only relocated, rather than solved, the

problem. In Filarte's ward plan, the latrines were located adjacent to patient beds. Wards were also designed so that patients could see the altar of the patron saint.

The advent of scientific medicine

During the 16th, 17th and 18th centuries, the balance between religiously dominated belief systems and naturalistic-driven belief systems (science) underwent a pronounced change. As the bulk of scientific knowledge grew, there was greater interest in experimentation in health facility design. Human understanding of disease had changed and was forcing new concepts in care in areas such as antisepsis, surgical interventions and other drug developments. In many places, it was still common to have more than one patient per bed and care was more palliative than remedial. Mental health conditions were still misunderstood, and although there were some new models of mental healthcare, mental health conditions were felt to be due to demonic and/or satanical influences. War

and military conquests also helped to spur dramatic changes in care.

Florence Nightingale

Few stories are more significant in the history of healthcare than that of Florence Nightingale and her experience during the Crimean war. At the converted Turkish barracks at Scutari which the British army used as a hospital (Figure 6), the mortality rate in the hospital is said to have been 47% with infection killing many more soldiers than bullets.

The answer developed for Scutari was a modular hospital solution that could be constructed in England, disassembled, shipped to Turkey, and reassembled (Figure 2). In addition, it was cheap and made of materials which could be easily cleaned.

The patient wards, individual huts for about 50 men, had other unique features, including a ventilation system which forced 1,000 cubic feet of air per minute through two ducts underneath the floor. The air was discharged into the ward through grilles in the floor and travelled upward and out. The hospital was a combination of ward huts and special-purpose structures for cooking, cleaning, and other aspects of care and operation all organised in a grid-like layout which facilitated the placement of water supplies and drains.

An innovative ward plan, founded on a 30-foot wide unit and housing 30 patients, was derived from the Crimean experience, and came to be known as the 'Nightingale Ward' (Figure 3).

Modern hospital design process

Global performance, in terms of outcome, risk management, and safety, is influenced by local interactions and synchronisation of system components (e.g. providers, patients, technologies, information and material resources, physical and temporal constraints). As a result, adverse events and unintended consequences are impossible to understand in terms of simple rational rules.

To date, reductionist approaches towards hospital construction have failed to adequately control risk or reduce the number of adverse events. The conditions in which we work, with fatigue from 24-hour duty rotations, double shifts, high workloads, confusing labels, noisy environments, look-alike names, poor handwriting, poorly designed equipment, and healthcare buildings, can lead to errors. These are open or ill-posed problems best

understood through controlled observations, cases study, and modelling, with insights drawn from other complex adaptive systems, such as emerging economies and dynamic social systems. This complex system theory can arguably be used as the basis for a new principled approach to optimising hospital design, performance and outcomes, managing risk and guiding health policy.

The traditional hospital design process requires that architects be given programme objectives (function and programme), which are then translated in room requirements (a space programme) and followed by the creation of department adjacencies (block diagrams). Once this preliminary information has been provided, room-by-room adjacencies are developed and then a detailed design of each room is completed (schematic and design development).

Architects then convert room-by-room design to construction documents that represent how individuals, equipment and technology in hospitals will function together. Equipment and technology planning generally occurs in the later stages of the design process. Typically, discussions of patient safety or designing around adverse events are rare. This creates an opportunity to repeat latent conditions existing in current hospital designs that contribute to active failures (adverse events or sentinel events)³. Human factors, the interface and impact of equipment, technology, and facilities is also not typically discussed or explored early in the process.

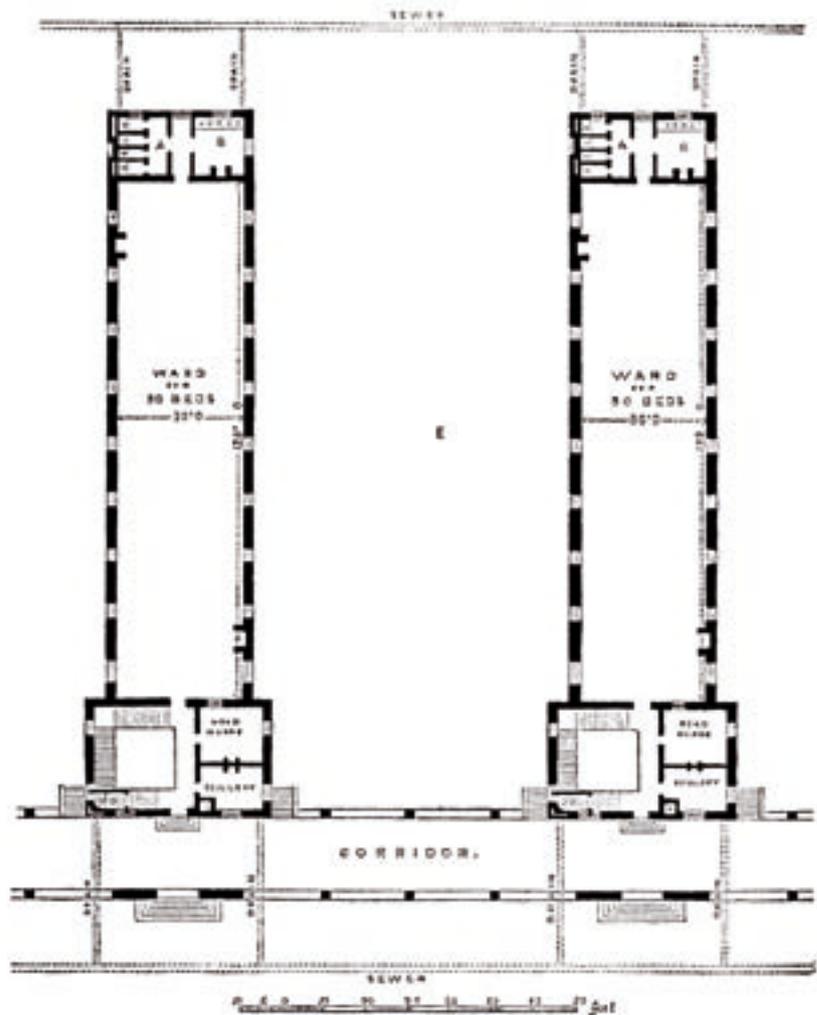
Patient safety challenge

In the early 1990s, researchers such as Leape and Brennan began to question the safety of healthcare institutions⁴. The Institute of Medicine report in 2000 posited that between 44,000 and 98,000 Americans die in US hospitals due to preventable errors.

There are two possible responses to this challenge – a personal or a systems approach. Our primary response to this epidemic has been to focus on the personal approach in which after an error or accident we search for the 'guilty parties'. The legal system is most willing to help in this 'righteous cause' as it rids the system of 'incompetent doctors' and punishes 'bad hospitals'.

The concept of 'systems' is important in the discussion of healthcare safety and health facility design. A system is a set of components, sometimes called subsystems or microsystems,

Figure 3: Example of a Nightingale ward, from Notes on Hospitals, F. Nightingale



which are related or a complex whole formed from related parts, or an organisation of people, tools, resources and environment⁵. This last term, 'environment', is the focus of this study – specifically the physical environment in which components are housed, as opposed to the cultural environment.

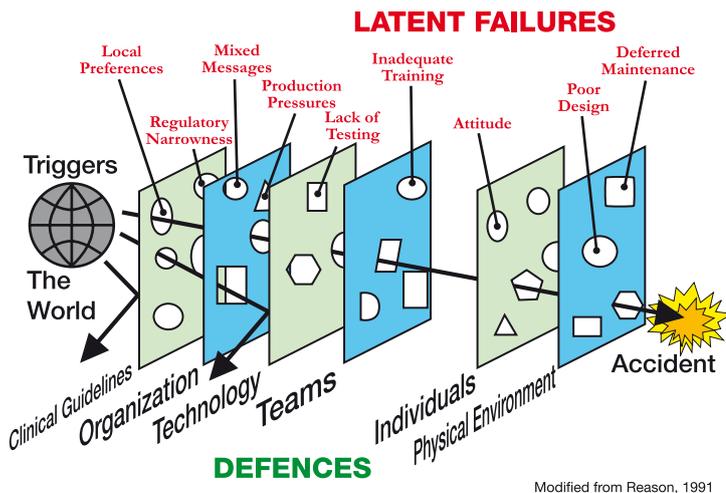
Characteristics of systems

A healthcare system includes several sub-component microsystems. The foremost are the medical or clinical processes undertaken. Another component is medical and nonmedical technology, including information systems, diagnostic systems, imaging systems and more mundane technologies such as floor cleaning equipment, supply ordering and distribution technologies. Next there is organisation, the administrative arrangement that includes policies, procedures, strategies and tactics, management tools and business

plans. Humans are another subsystem, which includes professional, technical, administrative, management, patient, public and government. Finally, the designed, built environment is a subcomponent. It possesses a large number of characteristics.

Charles Perrow undertook a study of major accidents and discovered that systems, rather than individuals, were often at fault⁶. Perrow and James Reason redefined how we should proceed to understand causes of accidents and fix problems. One of Perrow's contributions was to describe how the components of systems relate. He defined two scales – complexity and coupling – which explained how components of systems react (Figure 4).

Complexity can range from low complexity to high complexity. Making a sandwich is a low complexity undertaking. Flying a fighter jet off an aircraft carrier is highly complex. Coupling ranges from loose to tight. If an activity is



Modified from Reason, 1991

subsystem or component of the system.

When referring to Reason's diagram, note that the 'defence' against errors is made up of subsystems shown as layers⁹. In our review of medical literature to date, when the source, description, and causes of errors are given there is invariably a failure to consider the 'layer' representing the physical environment.

Systems and safety

It is essential that we accept the construct, which states that accidents are latent in systems and, therefore, safety is a component of systems as well as their subcomponents. Richard Cook proposed this concept in his paper, *A Tale of Two Stories*¹⁰. It follows that if safety is a component of the system, it might also be described as a part of the culture of the system. The IOM report, *To Err is Human*, describes safety as an emergent characteristic of systems¹¹. It emerges not because one subsystem is near perfect, but because the aggregation of subsystems embodies it as a whole.

We offer this additional consideration. The challenge is to change the traditional hospital design process to incorporate the safety-driven design principles and to create or enhance the culture of safety. In planning for the new facility, we approach the hospital design process with a blank sheet of paper; an appreciation of the evidence that there is ample opportunity to improve hospital patient safety. We believe that improving hospital facility design will not only increase patient safety directly but also indirectly promote a safety-oriented organisational culture.

The new foundation for understanding human error considers that healthcare providers make mistakes because the systems, tasks and processes they work in are poorly designed. Organisational accidents have multiple causes involving many people operating at different levels. This translates into failures at the point of service (e.g. a physician ordering an allergenic drug for an allergic patient). Based on this idea, exceptional design of healthcare institutions will provide an environment of patient safety as well as a safety-oriented organisational culture. It requires a focus on safety by hospital leadership, physicians and staff that is accomplished through a continuous cycle of evaluation and improvement of the facility, equipment, technology and processes.

The traditional design concepts can be

Figure 4 (right): Interdependence characteristics of systems (after Perrow⁶)

Figure 5 (above): Layers of defence systems breached through their latent failures (after Reason⁹)

		COMPLEXITY	
		LOW	HIGH
COUPLING	LOOSE	LOOSE LOW	LOOSE HIGH
	TIGHT	TIGHT LOW	TIGHT HIGH

not highly dependent on the exactness of preceding activities, it is loosely coupled. The steps of making a sandwich are loosely coupled. The steps in flying off the carrier are tightly coupled. Healthcare, for example, is a system that is highly complex and tightly interrelated, with many subcomponents, and some hidden characteristics, requiring 'operators' to use a great deal of short-term memory or computing power.

Healthcare systems are also tightly coupled in that there is no 'wobble room' in the connections. If one component fails, the adjoining components are immediately impacted, sometimes in unforeseen ways.

The illustration above shows the relationships between complexity and coupling.⁷

Reason's theory of human errors

Reason, in his work *Human Error*⁸, teaches that accidents are latent in systems. This idea

speaks to the imperfection of the design of systems as much as to the fallibility of the people who operate them. Reason describes a system as having a series of layers of defence (Figure 5). These might be procedures, training, teams, organisation and technical safeguards. These safeguards, however, are imperfect. They each have holes like a piece of Swiss cheese. The holes represent various types of shortcomings peculiar to each layer of defence. The location of the holes in each layer is dynamic as subsystems change over time. There are always 'triggering events' which penetrate some layers, but are generally stopped by others, until that fateful time when all of the defences are breached. This conceptual model helps us to see that the shortcomings in the defences exist without respect to whether or not there are accidents. They are a characteristic of the construction and operation of a particular

summarised as follows:

- The physical environment for healing is a shelter, but has little special interaction with the healing process or operation. The healing environment is separate, but not particularly special.

- The physical environment for healing is an 'edifice' or monument signifying the importance of an individual, a community or an institution.

- The physical environment for healing is an asset whose value is seen in terms of its real estate characteristics.

In contrast, we propose our concept as follows: the physical environment for healing is an integral subcomponent of the care delivery process. Like other tools and resources, its design, use and application either promote or hinder the attainment of the goals of care. These systems and subsystems or microsystems, need to be carefully designed and supported¹².

The characteristics of the physical environment interact with the care process through physiological and psychological pathways. The interactions may directly or indirectly affect caregivers, patients, support personnel, equipment and operational plans. Improving the physical environment 'layer' in Reason's 'Swiss cheese' lies in the process by which the physical environment is created. That process has evolved over time and it now includes several variants. Our review of the characteristics of the design process, leads us to conclude they should all be considered as a single process.

Can we change the design process?

If we accept the proposition that healthcare is a system and that the physical environment is a component of that system, we might then ask whether that part of the system could be improved. In other words, is there



Figure 6: Turkish barracks at Scutari, *Illustrated London News*, 16 December 1854

anything wrong with the healthcare physical environment and, if so, can this layer of cheese have some of the holes filled in?

There are many deficiencies in the design of healthcare environments that contribute to adverse events. One example relates to patient falls, which is sufficiently significant to have been placed on the national list of patient safety objectives¹³. The design of the environment has direct and indirect impacts on patient falls and yet has been mostly ignored by regulators. Hospitals have latitude in choosing which finish materials to use despite clear and dangerous consequences when using slippery surfaces.

Why do deficiencies in the designed physical environment occur? While there has been too little peer-reviewed study of this question, the design process does have a number of characteristics, which may be at fault. Design professionals, in the course of study for their profession, generally do not study ergonomics, human performance science, or the science of how human beings interact with their environment.

An unstated conclusion of Donald

Norman's book, *The Design of Everyday Things*, is that designers don't know much about everyday users³. Designers study design, not human beings. This deficiency manifests itself in the results of their work. Aside from not having a rudimentary understanding of human performance and its limitations, such as fatigue, stress and sensory degradation, designers are insulated from users. This happens because designers make assumptions about users based on their own, and not the users', experience.

Healthcare building design projects often begin with a set of assumptions, made by the owners, the designers or others. These assumptions are not tested before or during the design process. For example, a functional programme may be created by the owner and stipulated to the designer as a given. No opportunity exists to question or test the contents of this programme or to work with clinicians and others involved in care to find better methods.

The process of design commonly used in healthcare is linear. It starts with the

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architect working with the givens, proceeds to a greater definition of the floor plan and massing, then adds equipment, information technology, building systems, furnishings and other components. There is a natural and financial inclination not to loop back to look at evolving issues in a holistic light.

If the plan is done, the solution must be a different piece of equipment, a different furnishing or, even worse, a process change. Likewise, after the equipment and technology are selected, usually just before construction begins, there is resistance to changing any part of the design which has been determined before.

These characteristics of the process are exacerbated by the fact that it is generally led by a single component of the design team, most frequently the architect. In alternative scenarios, the team is led by a 'programme manager', a 'construction manager' or by an 'owner's representative'. The problem with this form of leadership is that it tends to focus on one aspect of the project, for example, the budget, the schedule or the 'design', to the detriment of others.

Our search is to find methods which avoid these pitfalls, so that the resulting physical and operational environment is as safe and effective as possible (see panel box). Rather than trying to improve a process, which has demonstrably yielded inadequate results, we suggest that a new process be created.

Design for patient safety

The design process for patient safety must include three goals:

- Reduce the risk of healthcare-associated (caused by treatment) injury to patients and healthcare providers.
- Remove or minimise hazards, which increase risk of healthcare-associated injury to patients.
- Educate the design team in the complexity of designing healthcare settings for safe outcomes.

The strategy advocated for achieving these goals incorporates the following concepts¹⁴:

- Treat the creation of safety as part of a process that addresses the safety and integration of all system components, as part of the culture.
- Involve users and stakeholders at all levels of the institution in the 'creation of safety process' involves.
- A complete array of disciplines and

Critical design factors in the physical environment

Infection Control

- Selection of surface materials
- Handwashing station provision
- Space for maintenance of sterile technique
- Ventilation design – filtration, air flow, temperature, humidity

Patient Identification

- Lighting intensity and quality
- Sound/noise – design for aural quality

Surgical technique

- Vibration
- Noise and acoustic quality
- Layout of room for:
 - Placement and movement of surgical systems, robots, imaging, etc.
 - Staff workflow
 - Access to supplies and emergency services
- Room environment control design

Staff Accommodation

- Minimise stress

Transfer

- Physical – provision for patient transfer system
- Information – environment for accurate, undistracted communication

Utility Systems

- Design for ease of maintenance and indication of failure
- Clarity of controls, displays and indicators
- Standardisation of systems (important in other areas as well)

Systems coordination

- Design of systems to eliminate confusing alarms and indicators
- Testing of systems in simulated surgeries to discover shortcomings

knowledge is necessary at the project start.

- Use of a wide range of tools. These include: failure modes effect analysis (FMEA), root cause analysis (RCA), mock-ups, simulation, testing, and data analysis.

- Create and require team education about the patient safety problem, about the process of building design, and about the process of collaboration with others to derive effective and efficient solutions.

- Gain appreciation that designing for safety is an iterative process.

These strategies apply to all areas of healthcare facilities. The first part of this task is to define the characteristics of the environment from the perspective of design. On top of the accommodation of new systems and procedures, patient safety teams must deal with the environments and processes surrounding those which are already in use. The building codes and regulations need to be modified to allow for these changes. Building design-related contributors to hospital-acquired infections can include: inadequate maintenance of filters; use of floor, wall or ceiling materials which are hard to clean; poor placement of hand-washing stations; insufficient space to maintain sterile separation.

Reiling wrote: "Creating a process to evaluate

the interplay between equipment, technology, and facility to create safety at the beginning of the design process was challenging."¹⁵ The process he used emphasised "focus and commitment to safety-driven design principles".

Cultural challenges

The healthcare design process needs to be radically changed to address patient safety issues. Creating an environment in which a culture of patient safety can flourish is, however, daunting and requires a willingness to think outside the constraints of convention, and to challenge the intellectual and cultural stagnation which characterises many of our professional and commercial institutions.

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From top left: Princess Margaret Hospital, Toronto / Miramar Trade Centre, Cuba / Asuta Medical Center, Tel-Aviv / Toronto Western Hospital - CCU / The Hospital for Sick Children, Toronto / Royal Jubilee Hospital, Victoria / Belleville Library, Belleville / Canadian Embassy, Seoul / Henderson General Hospital, Hamilton / Toronto Western Hospital - Centre for Spiritual Reflection

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The Effects of Colour and Light on Health: **Trans-disciplinary Research Results**

A Latrobe Fellowship research team explores the value of a collaborative approach to evidence-based design through a pilot study of the effect of colour and lighting on patient well-being.

Eve A. Edelstein, PhD; Steven Doctors; Robert Brandt; Barbara Denton; Galen Cranz, PhD; Robert Mangel, PhD; W. Mike Martin, PhD; Gordon H. Chong.

The College of Fellows of the American Institute of Architects (AIA) awarded the 2005-2007 Latrobe Fellowship to a consortium formed by Chong Partners Architecture, Kaiser Foundation Health Plan and the University of California, Berkeley, in order to further research of relevance to architecture within healthcare settings.

The premise of the research was to investigate the practice of evidence-based design (EBD), a term used by many designers, despite the lack of research about the human response to design that can be used to inform design decisions.

The Latrobe research team hypothesised that a collaborative approach would benefit EBD by integrating the architect's design experience, the academic researcher's rigorous

methodologies and the client's understanding of institutional decision-making. In addition, the team proposed that a transdisciplinary approach, using physiological, behavioural and economic measures, would increase the quality and applicability of research findings. The team committed to test this model through a pilot study of the effects of colour and lighting on patient wellness outcomes.

There were therefore two major goals of the research:

- To create knowledge that could be applied in hospital and other environments;
- To assess the approach itself in terms of its value as a model for research to be used in EBD.

The research plan developed included the following initiatives:

- A review of design and biomedical literature about colour, lighting and health outcomes (to inform the pilot study);
- A literature review on evidence-based practice (to add context to the research);

- Creation of a database that integrates patient medical records, facility (CAFM) data (including room design attributes), and patient surveys;

- A laboratory experiment, built on circadian rhythm research, that investigates the effects of lighting on psychological and physiological measures known to relate to health outcomes;

- Design interpretation of the various findings; and

- Disciplined assessment of the research model.

The database development is being led by Kaiser Permanente (KP) and is expected to include 100,000 patient stays. It will be used to assess the effects of design interventions on patient medical conditions, for example, healing and patient satisfaction with their hospital experience. It will also be used to correlate existing room design attributes with medical and satisfaction data. The laboratory experiments, referred to here, assess the influence of lighting on human responses and the implications on design interpretations.

Evidence-based practice

Evidence-based practice may be seen as consistent with tendencies in our information-based society toward the production of knowledge in a transdisciplinary, socially-relevant context. Its roots are widely acknowledged to be in the healthcare industry, where a strategy of standardisation known as 'evidence-based medicine', has emerged over the past two decades¹. A core principle of evidence-based medicine is "the conscientious, explicit, and judicious use of current best evidence in making decisions about the care of individual patients."² In evidence-based medicine, the skills and experience of the healthcare provider, the needs and concerns of the patient, and evidence grounded in rigorous scientific methodology stand as the three foundational elements of a model for decision-making.

This model has since migrated to other disciplines, including education, social work, information technology, environmental

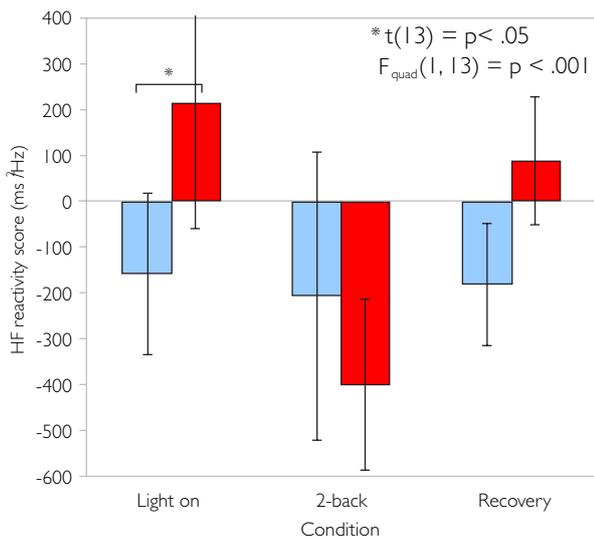


Concord lighting in the chapel at St Lukes Hospital, London:
The influence of light on health is relevant to all architectural environments

Edelstein et al. (2007)
 The Effects of Colour and Light on Health:
 Trans-Disciplinary Research Results.

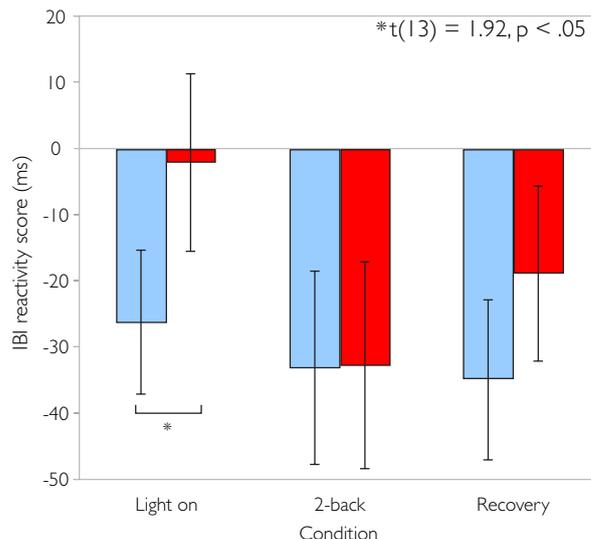
HF reactivity scores

Figure 1



IBI reactivity scores

Figure 2



management and architecture. While the extent of acceptance and implementation of evidence-based practice varies widely, a common motivation is the observation that current practices in these disciplines are unsystematic, overly reliant upon intuition, prone to undue political influence, or simply ill-suited to enhancing outcomes. That said, the underlying objective of evidence-based practice is the enhancement of outcomes by augmenting practitioner experience and skills with valid and reliable data.

What constitutes evidence and what are appropriate standards? The literature search conducted by the Latrobe team revealed that definitions of evidence and appropriate research standards vary across and within disciplines. A proponent for evidence-based practice in information technology, for instance, suggests balancing multiple types of evidence – tangible, testimonial, equivocal, missing and accepted facts – to construct arguments for decision-making and action³. By contrast, proponents of evidence-based practice in education place a specific emphasis on "rigorous, systematic, and objective methods" to generate evidence from randomised experiments⁴.

The Coalition for Evidence-based Policy, in

a user guide prepared for the US Department of Education, defines 'strong' evidence as well-designed and implemented randomised controlled trials held in two or more school settings⁵. In another approach, the definitions of evidence and rigour in librarianship move along a continuum from quantitative to qualitative methods subject to the nature and relevance of the research project⁶.

This variability in the definition of evidence is one challenge to the implementation of evidence-based practice. Other challenges identified by the Latrobe team in its literature search include lack of endorsement by researchers and/or practitioners in terms of applicability of the data in actual design decision-making; confidence that the research methodology used was well-designed; concerns about the role of professional judgement and experience; and fear that the architect's professional experience and judgement will be undervalued.

Challenges in executing an evidence-based approach include: the acquisition of expertise and resources to assess the value of the evidence; transparency of methodology; access repositories for the collection; assessment and dissemination of evidence; practitioner resistance to change; and variable

incentives for evidence-based practice.

The effort to infuse scientific principles into practice has historically characterised the rise and formation of many professions. The architectural profession has not been an exception to this pattern. Recent interest in linking scientific research to the design of the built environment dates to the late 1960s, exemplified by the environmental design movement. However, despite extensive research on the built environment, this material has for a variety of reasons failed to permeate professional practice, leaving architects reliant upon individual experience, intuition and readily available information rather than rigorously-formulated research.

There are indications of a shift toward the application of research and evidence-based practice in architecture, most often referred to as evidence-based design, though the focus thus far has been on the design of healthcare facilities. This attention to correlating the physical environment with patient outcomes, staff satisfaction and performance may be seen as a logical extension to the widespread acceptance of evidence-based medicine.

The influence of light

The Latrobe research team considered many

environmental factors thought to influence human outcomes, including colour, light, location and sound. Literature reviews provided the basis for focusing laboratory experiments on the exploration of the influence of light on health, which has an established research base of relevance to design.

The spectrum of light

Historically, significant attention has been given to the influence of colour on mood, function and its potential impact on healing. A recent review of 3,000 papers by Tofle *et al*⁷ found that "colour-mood associations exist, but that there is no evidence to suggest a one-to-one relationship between colour and emotion". They concluded that there were "no direct linkages between colour and health outcomes, with insufficient evidence in the literature to imply causal relationships between colour and inherent emotional triggers".

Re-examination of these findings in terms of brightness and contrast would be more consistent with visual scientists' concepts of colour, and might lead to further understanding about colour perception and preference. Indeed, Tofle *et al*⁷ concluded that brightness and contrast are more strongly related to colour perception than hue itself. Further, it should be noted that the internal state and conditions of each individual tested should be considered.

Medical or ophthalmic status is as important to colour perception, as are cultural and social factors. Methodological comparisons are also important in critical analysis and comparison of the existing body of literature. The conditions under which colour samples were tested varied widely across the studies reviewed. Responses to colour were tested with a range of conditions, from full-scale rooms to small pieces of mosaic tiles. Most studies used small sample sizes with insufficient power for statistical analyses. Finally, the perception of colour is directly related to the reflective and absorptive qualities of the surrounding environment, and the length of time observing the colour.

Chronobiology and rhythms

In contrast, a wealth of empirical research from the field of chronobiology demonstrates the influence of light on behavioural and physiological responses⁸. Solar cycles link daily (circadian) and annual (circannual) rhythms in almost all animals,

including humans. Many biological processes have diurnal patterns, such as cardiac, immune, endocrine, cellular regeneration and brain processes including learning⁹.

Behavioural patterns are similarly related including sleep, activity, feeding and mating. Short-term absence of diurnal lighting has been associated with altered levels of fatigue, disorientation and sleep. Longer-term absence of natural diurnal stimuli has been associated with seasonal affective disorders, depression and psychiatric disorders¹⁰. Patients, visitors and medical staff report the positive experience derived from light, as well as the detrimental disorientation and influence on cognitive function that occurs in the absence of natural lighting patterns^{11,12,13}.

Circadian cycles can be modulated by a variety of external cues, but light is the primary variable that aligns (or entrains) humans to diurnal and nocturnal rhythms. Although decades of research have examined the influence of electrical lighting on circadian entrainment, it was not until 2001 that a new class of cells was discovered in the retina of the eye, thought to be 'circadian' rather than visual receptors. This discovery renewed research that explored the spectrum, intensity and duration of light that influences biological responses.

Numerous studies have led to the development of 'dose response curves' to electrical light that reveal peak sensitivity in the blue wavelength (approximately 420-440nm) for modulations of melatonin suppression that regulates sleepiness. Bright white light has also been demonstrated to be effective in modulating mood, sleep and activity cycles¹⁴.

The range of spectra that influence the multiple circadian systems is yet to be explored. Complexities exist such that when a singular (monochromatic) light source is presented along with other (polychromatic) light, interaction effects occur, and a spectrum may become less effective at stimulating circadian responses than when presented alone. Thus, Figueiro *et al*¹⁵ demonstrated that melatonin suppression was influenced by polychromatic light, even when the irradiance in the short wavelength (436nm) was equal to monochromatic light of the same wavelength.

Lighting and health

In addition to the spectrum of light, research

demonstrates the importance of light intensity. It has been suggested that typical interior light levels are barely sufficient to stimulate circadian responses, and that the constant, dim, retinal illumination typical in many facilities and urban environments may be insufficient to stimulate circadian responses, leading to significant disruption of biological rhythms and sleep/activity cycles¹⁶.

Recent epidemiological studies suggest that increased cancer rates in night nurses may be related to the lack of light-dark cycles and the almost constant light exposure that they experience at work and at home^{17,18,19}. Studies that demonstrate the relationship between immune function, sleep and healing support the value of further research into lighting and health.

Many studies show that stress also changes rhythmically with diurnal modulation, modulating cardiac and neuroendocrine responses, which are likely to be responsible for the higher levels of cardiovascular disease found in chronically stressed individuals²⁰. Further, cardiovascular function is an underlying mechanism associated with attention and memory.

Thus Porges and Raskin²¹ demonstrated that heart rate was significantly modulated during sustained attention. With the increased interest in the role that stress plays in the development of cardiovascular disease, the influence of built features in architectural environments may have direct relevance to health, performance and well-being. Accordingly, Thayer and colleagues recently demonstrated that physical features of workplace environments, including electrical and day lighting changes, were associated with modulation of day/night differences in cardiac responses, an important indicator of stress and health risk²².

The Latrobe Experiment

The need for additional research that defines the relationship between lighting and health remains – and it formed the basis for design of the Latrobe Experiment. A multi-centre study was conducted, utilising an empirical approach to investigate the physiological and psychological responses to controlled light conditions in both morning and night conditions. The Latrobe study sought to determine the influence of brief light showers presented during the day. The objective of the study was to assess transient alerting and

activating effects of light that might be used for modulating psycho-physiological responses inside of built environments. The specific objective of the study at the Department of Psychology, Ohio State University, was to consider the influence of light on heart rate variability, an important indicator of health risk and stress level²³.

A parallel study was conducted at the Swartz Center for Computational Neuroscience at the University of California San Diego to assess the influence of the same lighting protocol on cognitive responses measured via electroencephalography (EEG) and independent component analysis of the brain waves²⁴. Initial results from the EEG study indicated an increased response in the theta band of brain waves from one subject during red light relative to white light, despite the lack of fatigue; however, additional recordings are required in order to confirm these results²⁵.

Statistically significant differences in heart rate reactivity were observed in bright white light versus red light conditions. Following baseline measures in fluorescent lighting, 14 subjects were exposed to 15-minute periods in darkness followed by light exposure to bright white light with a peak in the blue spectrum, and red light produced by LED panels.

Memory was tested using a 2-back working memory task six minutes after light condition change, while electrocardiography was recorded throughout the experiment. Red light exposure was associated with a significant decrease in heart rate [$p < 0.05$], and a significant increase in high-frequency heart rate reactivity (HF-HRV) (t test, $n = 14$, $p < .05$), that was confirmed in analysis of inter-beat-intervals. Consistent with studies that show a relationship between memory and

heart rate, there was a significant decrease in high frequency reactivity [F test quadratic, $n = 14$, $p < .001$] during the working memory task, relative to initial baseline and recovery periods, which did not alter significantly. In contrast, heart rate reactivity did not differ significantly during bright white light exposures, using both F and t-tests²⁶.

Implications

The heart rate variability findings provide important evidence that brief exposure to light, even during the day, may influence cardiac responses. They confirm the influence of short-wavelength blue light that has been intensively studied in relation to melatonin responses, and reveal additional information about the influence of light in the red range. Testing of red light is uncommon, and many researchers have assumed that there is little to no effect of red light on the neuroendocrine or circadian systems. However, Hanifin and colleagues²⁷ found that normal healthy humans exposed to 630 nm and 700 nm elicited small reductions of plasma melatonin levels. These findings are consistent with other studies that reveal the influence of a long-wavelength light on cardiac responses²⁸.

Designing for light and sight

The design implications of the original Latrobe research, in addition to the body of existing studies, could change lighting concepts in healthcare environments. These recent findings suggest that provision for brief light exposure (either solar or electrical) could be used to influence health and possibly cognitive outcomes. For example, red light sources in relatively inactive zones might provide conditions that suit patient



monitoring, without causing disruption from bright light likely to disturb nearby patient or respite zones. Brief exposure to bright light might better serve areas where activation and visibility is required. The use of narrow-band blue light could serve circadian modulation at lower intensities (approximately 30lux).

Since biological systems and disease states have different responses to light, we should not naively assume that a single light condition would serve all diseases, disabilities or the consequence of ageing. Whereas it might appear obvious to provide the same sequence of circadian lighting to all patients, each patient's medical condition and length of stay, let alone their individual circadian and social patterns will dictate their circadian needs. Further, day and night

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Solution providers, such as Concord, are increasingly taking the evidence base into account in their lighting designs

staff have conflicting needs from patients. It is therefore suggested that circadian lighting design incorporate a selection of spectral, intensity and timing patterns defined from the literature, but also include controls to account for individual needs.

The interaction between architectural and electrical sources of light should directly inform design decisions that influence the size, geometry, and layout of rooms and materials. Thus, field studies conducted for the Latrobe project showed that borrowed light at distributed and central nurse stations was limited when patient privacy screens and window coverings were closed. As a result, staff relied on overhead lights that were routinely

switched on during the day and night shift.

This varied greatly from the pre-occupancy site of similar design, which provided both adequate levels of light and a view of diurnal light from nursing station areas. The level of external circadian light is of course reliant on compass orientation, but also showed great differences dependent on the use of materials and distance from the window²⁹.

Value assessment

These design hypotheses must be verified in working healthcare settings, and can be readily tested using the mobile cardiac and mental function tasks demonstrated in the Latrobe study. Manufacturers and researchers are currently exploring the production of lamps that take this evidence-base into account, and ongoing research is being pursued to validate the influence of potential design solutions in operational environments. Using evidence from laboratory and post-occupancy evaluations, a human decision hierarchy can be applied to prioritise design options³⁰. Cost analysis of materials, installation, maintenance and energy use can be factored along with health, satisfaction and performance measures to assign value to each design option.

The ultimate goal

Although further research is required, the pervasive influence of light on many human functions underpins the value of architectural and electrical lighting strategies that support both visual and circadian needs. A greater understanding of the influence of light on health is relevant to all environments where architects play a role, but of most impact in healthcare environments where patients, visitors and staff present the broadest range

of conditions and needs.

The advent of wearable technologies now provides the means to study the influence of a variety design solutions in functioning healthcare settings without impeding the provision of care. The addition of rigorous findings from both laboratory and on-site studies enhances the range of evidence to be considered in a decision hierarchy that balances safety, security, health, performance, emotional, social and economic needs. The ultimate goal of the evidence-based approach that includes literature reviews, epidemiological studies and laboratory experiments is to assist in development of design strategies that support health, performance, emotional and social needs of all users.

Acknowledgements

The Latrobe Experiment Research was supported by the American Institute of Architects College of Fellows 2005 Latrobe Fellowship. We are grateful to the many scientists who conducted research and contributed to discussions including Robert Ellis, Dr John Sollers III, Dr Julian Thayer, and students at Ohio State University; Dr Ruey-Song Huang, and Dr Tzyy-Ping Jung, and Dr Scott Makeig from the University of California, San Diego. We are grateful for discussions and scientific advice from Dr Sonia Ancoli-Israel, Dr Esther Sternberg, Dr Mark Rae, Dr Mariana Figueiro, Dr Andrew Bierman, and Terry Klein. We also acknowledge contributions and discussions with the many members of Kaiser Permanente including John Kouletsis, Dr David Newhouse and the clinical team, and Duc Manh Tran of the Chong / SmithGroup template projects.

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Palliative Care Unit Design: Patient and family preferences

Diana Anderson's qualitative study reveals that a desire to choose levels of privacy and control their environment characterises patient and family preferences in the design of palliative care units.

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Healthcare design is a growing field of study and practice, with numerous studies demonstrating the impact of the built environment on health and health outcomes^{1,2}. The notion of evidence-based design "borrows from work done in evidence-based medicine to carefully observe, quantify and analyse the way people use buildings" and is increasingly sought after since a lack of published data exists, especially in Canada³.

The primary purpose of this qualitative study was to identify what palliative care patients and their families perceive to be important elements in the design of a palliative care unit (PCU) for end-of-life care. Secondary objectives included exploring whether differences in preferences and perceptions exist between patients and family members. This study looked at the palliative care population of Bridgepoint Hospital in Toronto, Canada, and evaluated patient and family preferences for room design and layout, as well as preference for private versus shared accommodations.

Background to Bridgepoint Health

Bridgepoint Health is Canada's largest integrated healthcare organisation for specialised complex care services, including rehabilitation, long-term care and community-based care⁴. The Bridgepoint Hospital PCU provides 41 patient beds and offers the option for short-term or long-term palliation. The majority of rooms are shared by four patients (ward rooms), several are shared by two patients and there are currently no single or private rooms in either unit⁵. The World Health Organization (WHO) defines palliative care as "the active, total care of patients whose disease is not responsive to curative treatment. Control of pain, of other symptoms, and of psychological, social and spiritual problems is paramount. The goal of palliative care is achievement of the best quality of life for patients and their families."⁶



Figure 1: The existing Bridgepoint Hospital in Toronto prior to redevelopment

One of the health concerns facing the patient population at Bridgepoint Hospital is the physical environment, an important determinant of health⁷. The existing hospital structure, built in 1963, is semi-circular in shape, making circulation a challenge for many patients (Figures 1 & 2).

Wheelchairs are difficult to manoeuvre in a curved hallway and patients suffering from neurological diseases can often become disoriented without proper visual cues. Rooms are small and unable to accommodate wheelchairs, which are left in the hall^{5,8}. There are no washrooms in any of the rooms – they are instead located at the end of each unit.

Bridgepoint Health is currently embarking on a major redevelopment project which will include a new hospital building and the design of a new and larger palliative care unit^{4,5,8}.

Precedent research

Should architects be designing end-of-life care facilities with more private rooms for dying patients and their families? The literature presents us with precedent studies that have suggested single rooms have a number of benefits over shared rooms, including greater flexibility, increased privacy, ease of sleeping and less noise. However, single rooms have also been said to have disadvantages when compared with shared rooms, including mood disturbance due to isolation, and poor nursing observation⁹.

A qualitative study conducted in the UK⁹ demonstrated that while patients in a palliative setting may often prefer shared accommodations for the benefit of social interaction and a constant reminder that another person may be experiencing similar

Table 1

Interview Questions
1) What are your thoughts about the patient rooms here on the 4th floor?
2) What would be your preference for a room if you had a choice? Why?
3) How does this room environment make you feel?
4) What control do you have over this environment? What would make a difference?
5) What do you do for privacy in a four-bedroom room?
6) Do you like to share a room? Why or why not?
7) What are your preferences for washrooms on this floor?
8) How do you feel about other parts of this hospital?
9) If you had a chance to design this unit over again, what would it look like?

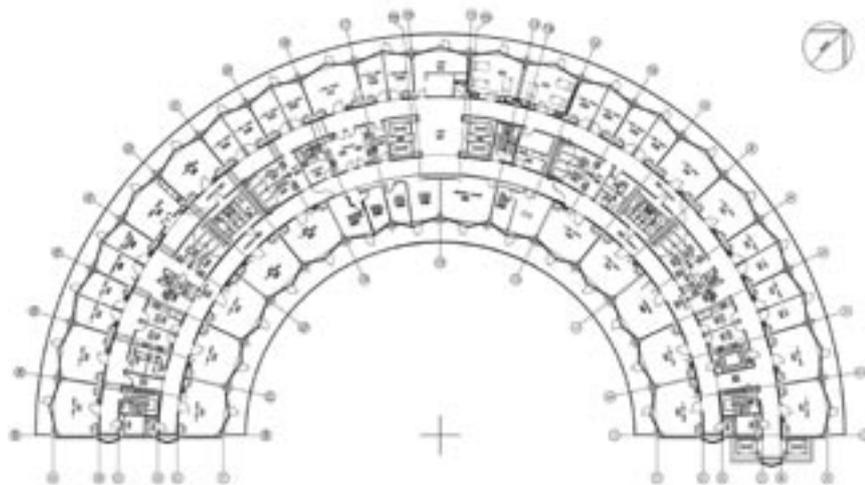


Figure 2: 'Half round' Bridgepoint Hospital building built in 1963 (Courtesy of Perkins Eastman Black Architects)

with similar codes together, keeping patient and family comments separate. This allowed for a thorough analysis of each theme and a way to systematically compare and contrast the two participant groups.

External reality

Under this category, eight themes were determined to be important aspects of the physical environment for patients and families: room size, noise, light, storage, temperature, colour, washrooms, and social spaces (Table 3).

Room size: Although all of the family members interviewed mentioned room size, only one patient did. Families felt that rooms are too small in terms of square footage, approximately 90 ft² per patient: "There is not enough room for families to stand around the dying patient's bed." There is also a lack of storage space, both for personal items and for hospital equipment. One patient suggested incorporating regular service modules into the design of the halls, so that equipment can be stored in these alcoves without obstructing circulation.

events, family members often prefer private accommodations so that they may grieve and show emotion without others around¹⁰. The current study documents whether the research precedents apply to a Canadian hospital and extends the literature beyond the preference of private versus shared rooms to include physical factors that promote comfort, layout and distribution of patient rooms.

between people and their physical environment; and 'internal experience', defined as the way the environment mediates meanings, individual feelings and the relationships between people. The categories and their themes were then compared to issues highlighted in the published literature. A codebook was then created and transcripts were thoroughly coded using the coding frame developed (Table 3). The final step involved grouping interview statements

Materials and methods

Data collection was carried out during the months of February and March 2006 at the palliative care unit of Bridgepoint Hospital. Both the University of Toronto Research Ethics Board and the Bridgepoint Research Ethics Board approved the study. Patients were eligible for the study if they were deemed healthy enough to participate by the medical and nursing staff on the unit. Informed written consent was obtained from all participants. Data was collected through semi-structured interviews using a set of nine open-ended questions (Table 1). Six patients and six family members were interviewed, each individually. Handwritten notes were taken during each of the sessions and were later converted into typed notes. Demographic characteristics of participants are outlined in Table 2.

Data analysis involved five steps adapted from Nancy Diekmann, who developed a seven-step method for analysis of qualitative research based on phenomenological methodology¹¹. The first step involved careful reading of interview notes, aimed at distilling essential patterns and themes from the data. Common themes were then identified in order to develop a coding frame. Themes appeared to fit within two overall thematic categories: 'external reality', defined as the relationship

Table 2

Demographic Characteristics of Participants*		
	Patients (n=6)	Family Members** (n=6)
Gender		
Male	2	3
Female	4	3
Age Bracket		
40-60	2	4
60-80	2	2
80 and over	2	
Room Type		
Shared room (2)	3	3
Ward room (4)	3	3
Palliative Care Unit Type		
Long-term unit (up to 1 year or more)	1	2
Short-term unit (0-3 months)	5	4

*Ethics approval was granted under the guideline that participants remain anonymous, with no personal information obtained regarding type of illness. Ages have been estimated in order to provide some detail with respect to participants. No information was obtained regarding exact length of stay (only short-term or long-term unit), cultural and ethnic backgrounds or religious beliefs. More female patients interviewed reflects the higher number of female inpatients in the Bridgepoint PCU.

**Family members included: 1 wife, 2 husbands, 1 mother, 1 son and 1 daughter-in-law.

Table 3

Light: Natural light was recognised by both participant groups, but more by the families as being “important in the feeling of well-being.” Due to the current room configuration, if the patient by the windows keeps the curtain closed, natural light is blocked for the other bed located near the door (Figure 3). Patients said that they had not seen daylight from their beds for weeks because of this layout. Artificial light was also mentioned, as there currently exists only a fluorescent fixture over each bed. Participants acknowledged the need for softer light sources.

Noise: Patients and families brought up noise as being disturbing, including noise from roommates and other families, as well as staff and hallway noise. However, one patient felt that the noise in the halls from staff was a positive factor as a constant reminder of activity and life. Families prefer not to close the doors to the rooms in order to block the noise, for fear of nobody monitoring their loved ones.

Washrooms: The feelings surrounding washroom preferences in a PCU were unanimous amongst all participants. Each patient room, whether shared or private, needs a connecting washroom, with or without bathing and shower facilities. Washrooms located down the hall are no longer acceptable to patients and families. The PCU currently has one sink per room, but it is not centrally located and tends to be used by only one patient and their family. Suggestions by participants were to have one sink per bed or a central sink for each room, in addition to connected washrooms.

Social spaces: In respect of social spaces, it was felt that choice is needed and one patient said: “There should be several options for lounge spaces; some larger ones and a few smaller ones to sit in with a visitor or by oneself.” It was generally also perceived that lounge spaces on the ward have little privacy and no choice over the television channel selection. Patients and families preferred the smaller “quiet room” on the ward as a more private space that they could reserve for family events, in comparison to the more public lounge spaces.

Additional features: Additional design recommendations included a central nursing station so that nurses can access rooms and observe patients easily, colourful spaces and a more home-like setting for the ward, as palliative care does not require the same

Categories and Themes Identified	
1. External Reality	2. Internal Experience
1) Room size 2) Storage a) personal b) equipment 3) Light a) natural b) artificial 4) Noise 5) Temperature of rooms 6) Colour of spaces 7) Washrooms & sinks in patient rooms 8) Social spaces a) family room, lounges, quiet room b) cafeteria c) main entrance & lobby d) halls 9) Air/ventilation 10) Furniture 11) Kitchen & laundry facilities 12) Location of PCU in hospital	1) Room type a) preference: single, shared, wardroom b) feeling/mood when in room 2) Autonomy a) privacy b) control 3) Shared space a) supportive companionship & social interaction b) patient compatibility c) observable death and dying process d) visitor experiences e) feeling secure as patient is not alone 4) Stage of care and room type a) STP vs. LTP b) privacy need as disease progresses 5) Patient being moved as indication of death being near

Note: Bolded themes indicate family member preferences, which were not mentioned by patients (all other themes in regular text were mentioned by both patients and families). Themes are in no particular order.

amount of medical equipment as other wards and thus the environment can be made less institutional in appearance.

Family concerns: Perhaps because of their ‘external reality’, family members raised themes additional to those raised by patients: halls as social spaces, ventilation, furniture and PCU location within the hospital (Table 3). Two family members felt that hallways were a potential space for social interaction, noticing that most communication takes place in these circulation spaces versus the specified lounge areas. Four family members discussed ventilation as a fundamental component of a PCU. Patients requiring help with toileting at the bedside leads to odours which invade the space of other patients, making it unpleasant for visitors and families. Thus, an efficient air exchange system should be considered for shared inpatient wards. Families felt that at least one comfortable chair is needed next to each patient bed, as current chairs are institutional and uncomfortable for visitors: “I sit in my husband’s wheelchair to watch television with him. I can’t even watch television on the chair that is in the room, it is too uncomfortable.” Two family members felt the PCU should be located on the main floor of the hospital, so that patients can access

the outdoors easily if they are ambulatory (architecturally, a terrace or roof garden could be an alternative for higher floors).

Internal experience

Under the category of ‘internal experience’, three overall themes emerged from the data analysis: room type, autonomy (privacy & control) and shared space (Table 3).

Room type: All participants discussed a preference for room type. Three patients said that they would prefer to be cared for in a single room, for reasons of being private individuals and feeling upset by noises from roommates, such as laboured breathing and moaning. Two of the three other patients expressed a preference for a shared room with two beds. Although they acknowledged that a single room gives more privacy, their desire for a shared room was based on companionship and being able to observe the surrounding activity: “I wouldn’t choose a private room – I would rather have a roommate. I would think it would be very lonely in a private room.” However, they acknowledged the need for private rooms to be made available for patients who might prefer this option. The remaining patient was also in favour of a shared space, but for

financial reasons felt that a ward room with four beds would be his first choice.

Similarly, three out of the six family members said that they would prefer a private room, for reasons of wanting to visit with their loved ones in private and because they consider dying a personal process: "A family should have their privacy and should not share the death with three other people. What you say in the heat of the moment, when you announce your love for someone, it is better not to be overheard." In comparison, two of the three remaining family members said they would prefer shared accommodations, because of the possibility of social interaction and having others around to observe their loved ones in case of emergency. The sixth family member said that she had initially wanted a private room for her husband but, on spending time with him in a ward room and interacting with other families, she now prefers a shared room.

Shared space: Due to its frequency during discussions, the theme of shared space was explored further with all participants. Reasons given for this preference were supportive

companionship and social interaction, patient compatibility and observing death and the dying process. Patients with a shared room preference felt that companionship outweighed the desire for the privacy one could obtain from a single room: "Shared rooms in palliative care are an important part of the environment, with respect to the friendships and comfort that develops between patients." Barriers to communication between patients and families in a shared space included different languages spoken and patients who keep their curtain drawn.

Although several patients reported feelings of distress from the experience of watching and listening to their roommates, one patient felt comforted by observing the dying process: "It was good to see that [dying peacefully] because you often hear horror stories surrounding death and dying in a hospital." Families were concerned that the noises and suffering of roommates would distress their loved ones. One mother said that her daughter insisted on keeping the curtain open so that she could constantly check on her dying roommate to make sure

she was not in distress. Family members suggested an additional benefit of a shared space – the notion of feeling secure as their loved one is not alone when they cannot be there. In case of a medical emergency, families were at ease to know that roommates could notify medical personnel, as there is limited visibility into the rooms by staff.

Overall, half of participants showed a preference for private rooms in a hospital PCU. Individual preferences for room type are shaped by both personality (e.g. being a private person) and events (e.g. seeing a family member; as a patient, enjoy a shared room). It became clear throughout the data collection that towards the end of life, people are highly adaptable to the environment. Firm beliefs on room type were expected at the outset of the research, but views appear to change for both patients and families depending on various factors, such as illness stage, roommates and witnessing events.

Patient compatibility: Patient compatibility was a greater issue than initially anticipated. One patient felt that choice for room type is dependent upon the compatibility of the



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roommate: "I would most likely welcome a single room if I was with someone I couldn't get along with." The majority of patients and families said that there should be more attention given to placing similar patients together in the same room in terms of health status. They explained that being placed with a roommate who is not compatible would enhance the difficulty of the experience: "The physical environment is always the same, but the feeling shifts according to the roommate." This patient felt that a PCU design should focus on separating the ambulatory patients by giving them smaller private rooms to sleep in, but provide more community spaces.

Privacy and control: When asked about privacy and how it is achieved in a shared space, patients said they use the curtain when medical or nursing care is administered, or for personal hygiene reasons. However, even with the curtain fully drawn, patients reported feeling uncomfortable. One patient preferred to keep the curtain fully drawn at all times, while the others expressed a preference for not wanting to feel separated from the activity around them: "I don't like to be shut in; I don't draw the curtain. I like to be aware of things going on around me."

All six family members said that there is a complete lack of privacy in the rooms and that a curtain is not sufficient. A curtain does not provide a sound barrier and one family member suggested the use of moveable screens or soundproof partitions as an alternative. Generally, patients appeared to adjust to the space around them, while families showed concern for a lack of privacy for their loved ones and for them as visitors.

Family concerns: In an assessment of their 'internal experience' it is interesting to note that family members identified a number of additional themes (Table 3). In terms of stage of care and room type, one family member felt that patients in a short-term ward could benefit from shared spaces, but in a long-term ward there is more time to observe suffering and death, so a private room is preferred.

Four family members felt that privacy is needed as diseases progress: "If someone is obviously dying, maybe they should be wheeled into a private room where the family can congregate." However, another family member expressed fear in seeing a patient moved to a new space, as this could indicate the nearing of death. Thus, there is a need for flexibility of room assignments

throughout the stay, taking into account patient and family desires. Finally, two family members mentioned the need for spaces that recognise their role as family and promote a feeling of independence, such as laundry and kitchen facilities. These spaces allow families to participate in the care of their loved ones, part of the overall philosophy of the palliative care environment.

Study limitations

Certain limitations existed in this research. Audio-recording of interview sessions was not possible and no transcripts were produced. In order to address this issue, the data was kept consistent by taking the best notes possible, in addition to strategic listening during the interviews in order to record text to use as quotes in the final research report. Perhaps the most apparent limitation to the study is the fact that the researcher was the only individual to collect and code the data. Finally, this small sample of participants was drawn from a single hospital setting, which may limit the ability to generalise results. However, the qualitative literature also argues that a small participant group is not necessarily chosen to represent some part of the larger world¹². Thus, the results of this research may not be applicable

to all palliative care patients and their families, but it does provide a glimpse into the nature of palliative care at one Canadian hospital. These results may also vary across cultures and geographic locations, so this would have to be explored further in future studies.

Choice and control

Palliative care patients and their family members have identified significant issues related to end-of-life care, with an emphasis on the design of the physical environment. It would seem that patients' individual preferences may depend on their own symptoms and experiences, particularly how they interact with other patients. Therefore, it could be assumed that end-of-life care facilities require a range of room types and sizes to enable patients to select the type that they prefer, despite the recent trend to provide primarily single patient rooms in new hospital development.

The data obtained from this study supports two interesting conclusions. Firstly, that being able to decide levels of privacy and community is of great significance to patients and families. Secondly, that being able to control the environment is also essential. Meeting these needs through various

Table 4

Design Recommendations for a PCU	
I. External Reality	
<ul style="list-style-type: none"> • Provide adequate room size, approximately 150-200 square feet per patient. • Alcoves in hall for storing equipment and shelving in rooms for belongings. • Natural light accessible for each patient bed and provide a reading lamp. • Moveable partitions create privacy and block noise as an alternative to curtains. • Patients and families desire colourful spaces and a home-like setting. • Washrooms connected to each room and a sink for each bed or a central sink. • A variety of social spaces, with the allowance for several smaller community areas as patients and families prefer this. Architecturally, the design of halls as possible interaction areas for patients, families and staff has much potential. • Provide an adequate air exchange system, as odours can disturb patients and families. • At least one comfortable, easily moveable chair next to each patient bed. • If the PCU is not on the ground floor; terraces and roof gardens can be designed. 	
2. Internal Experience	
<ul style="list-style-type: none"> • A variety of room types are needed, both private rooms and shared two-person rooms. • Control over personal space is essential in terms of sound, temperature, lighting, etc. • Placement of patients at similar health stages together in a shared space as well as providing ambulatory patients with smaller rooms and larger community spaces. • Room type related to stage of care and spatial flexibility should be considered, as environment needs to be adaptable to the changing needs of patients. • Kitchen and laundry facilities should be provided for families to create a sense of independence and allow them to help in the care of the patient. 	

planning and design strategies is likely lead to higher levels of comfort for patients and their families towards the end of life.

The results of this study have significant clinical and design guideline implications. The findings suggest that a more customised approach to palliative care design may be required, given the variability in preferences amongst patients and between patients and their family members. Ultimately, what is needed is a sensitive design approach to an environment for the terminally ill, taking into account both patient and family preferences.

Recommendations

An important observation made throughout the interview process and later confirmed with data analysis was the notion of individual variation in the perception of physical environment design. This indicates the need for a variety of patient rooms and public places. The need for further individual assessments is suggested, in order to gain a more detailed understanding of what each patient and their family experiences. In addition, patient and family preferences for room type may change as death approaches and thus more careful research into the stages of the dying process and how this relates to room preferences must be explored.

Design recommendations for a shared patient room include an allowance for privacy through some form of partial walls or soundproof partitions that could then be opened should companionship and social interaction be desired. In addition, there is potential for incorporating the idea of halls as community spaces into a PCU design. The current research results suggest that this type of design concept may support patient and family preferences for rooms that allow privacy with ample space provided just outside the rooms for social gathering. Patient room sizes could be reduced to allow a wider corridor,



Figure 3: View of two patient beds in a ward

serving both as a circulation space as well as community space. Table 4 outlines a summary of design recommendations for a PCU.

Future directions for this research include the possibility of expanding the participant population to include hospital staff members and integrate their suggestions with those of patients and families. The results from this research study suggest that a choice should be provided through the provision of several room types. One family member from Bridgepoint said: "I think at different stages of care, you need different things. I think you'll always need the option of single and shared rooms." When asked what they would do if they could redesign the unit themselves, all twelve Bridgepoint participants reinforced this design suggestion.

Author Biography

Diana Anderson is in her final year as a medical student at the University of Toronto. She earned both her undergraduate and graduate architectural degrees at McGill University in Montreal. For her master's thesis in architecture, she was awarded a Graduate Fellowship in

Health Facility Planning and Design by the American Institute of Architects and the American Hospital Association. Her hospital design proposal for the McGill University Health Centre was presented at the AIA Academy of Architecture for Health 2004 conference. Anderson was also awarded a McGill travelling scholarship on completion of her master's degree, allowing her to visit and study a number of North American hospitals. Over the past year, she has researched evidence-based design in the field of palliative care.

Acknowledgements

This study was supported by the University of Toronto Faculty of Medicine's Determinants of Community Health II course and Bridgepoint Hospital. The author wishes to acknowledge Dr Ian Johnson, Dr Robert Sargeant, Dr Vincent Chien, Kathi Carroll, Lori Wilson, Lori Jimenez and Brenda Stein, for their support and guidance. The author offers sincere appreciation to the study participants – the patients and family members who took the time to participate, despite all of their grave personal difficulties.

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"The message - and it can be read in every detail - is that the disabled lead real lives and belong in the real world".

*Christopher Hume,
Architecture Critic
The Toronto Star*



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Arts and Culture



Changing Hospital Architecture

Edited by Sunand Prasad

RIBA Publishing Code: 55094 Price £45.00

There are plenty of thin-lipped critics who chastise architects for being unable to produce hospital designs as fashionably smart as today's offices and airports, but who fail to realise that the sheer complexity of the problem and extent of political interference has made good design hard to attain. The arrival of *Changing Hospital Architecture*, with its presumed emphasis on changing for the better, is timely. It contains individual essays from a wide variety of contributors, all of whom are alive to the difficulty of making progress in the face of the political opportunism and short-term thinking, which have plagued the situation for so long.

The book starts with an excellent piece by Sunand Prasad who combines his considerable intellect with hard-won experience as a healthcare architect to produce a well-argued essay, so readable it could almost be regarded as a stand-alone critique. He states clearly the purpose of the book which "is intended to be a tool. Its aim is to help improve the quality of design by pointing to potential exemplars, presenting key issues and occasionally signalling caution. This book is not intended to be a world survey." He goes on to stress: "If this book is a tool, it is intended for the hands of change agents." But we have to ask ourselves, who are they and how do we ensure that those with sufficient political power to implement the book's recommendations will ever read it?

Derek Stowe, who has had longer in the game than most, follows with a chronological review of hospital design since World War 2. He observes: "A striking aspect of the story is the lack of continuity of purpose, as governments came and went, initiating this and abolishing that. This frustrated the efforts of health planners and architects". He rightly gives credit to practices like Powell & Moya who overcame many of the problems, political and bureaucratic, which stood in the way. Stowe also draws attention to the grotesque waste incurred by newish buildings being abandoned in the wake of yet another new initiative from the centre, soberly concluding that "ultimately, as in the past, the architecture of hospitals, their location, content and built form will be determined by the wealth, culture and ethics of the society that commissions them."

One of the book's strengths is that it includes contributions from outside the hospital design mainstream. The first is by John Worthington, best known as a founding partner of DEGW, whose spatial analysis for the commercial office world has transformed the way large organisations provide a civilised and efficient working environment. He reminds us of the critical importance of a thorough brief; the essential role of post-occupancy appraisal; and the need to plan for infinite flexibility. All of these are well-known clarion calls but still too often given short shrift.

The second 'outsider' is Michael Davis who, in many ways, is more of an insider than most, having devoted much of his time to examining how new hospitals are financed. His succinct chapter is a model of clarity. He understands the design/cost interface better than most and is equally forthcoming about the disruptive effects of sudden change.

Global perspective

Susan Francis' thoughtful contribution broadens the scope to include several schemes in mainland Europe. These provide a good comparison. However, in describing the highly creative work of Alberts and van Huut at Zwolle in the Netherlands, it would have been even more illuminating had she alluded to the dominating influence of the social philosopher Rudolf Steiner which suffuses all their work and has marked 'healing design' potential.

American and Australian contributions follow by Douglas Olson and Lawrence Nield respectively. The former describes the particular demographic challenges of the US and is chillingly observant about the power of political lobbyists representing the 'managed healthcare industry', and the resulting stranglehold on progress towards a fairer system. Nield gives a thorough account of the early days of Australian hospital design when it was heavily influenced by UK practice and describes how local influences, both organisational and architectural, have now yielded a more authentic expression.

The only distraction from this excellent book is the concluding postscript, which is poorly written. To repeat the word 'paradigm' on one half page no less than 11 times is a disincentive to read any further. The whole book deserves to have a conclusion written by an authoritative third party who, above all else, should give a lead on how the pertinent and constructive suggestions in this timely volume can be implemented at a sufficiently high level in Government to really make things happen: otherwise we will be left spitting into the wind.

John Wells-Thorpe is an architect and former NHS trust chair.

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Sustainable Healthcare Architecture

Robin Guenther and Gail Vittori
 Hoboken NJ, John Wiley & Sons, 2008
 Code 63346 Price £39.99



Sustainability and healthcare architecture are two big subjects, each including many component topics that are themselves highly complex. For example, sustainability includes stewardship of resources – water, energy, materials, local and planetary ecology – while healthcare architecture takes in the design process, procurement and construction, ventilation, daylight, lifecycle design, ‘green’ legislation and infection control. This book appears to cover them all – or certainly it tries to – but I confess I did not have the stamina to read it from cover to cover taking in every page.

So to preface my comments, I offer some statistics. There are some 400 pages of text and illustrations and 24 pages of bibliography and references. The book is divided into three parts: Part 1 Context; Part 2 Actualising the Vision; and Part 3 Visioning the Future. Together, the parts contain 13 chapters within which are distributed 25 separate essays by some 30 contributors and 60 ‘case studies’. Each chapter deals with a specific topic germane to sustainable healthcare architecture introduced by the authors with some extensive expositions. The expository texts

contain numerous diagrams, graphs, bar charts, tables, checklists and other highlights. The 60 case studies are illustrated with monochrome photographs and drawings, including about 40 small plans and sections. There is a section of colour plates with 48 examples of current healthcare facilities. The book is one inch thick and weighs 1.2 kilograms in a page format of nine by seven inches, which I find a pleasing change from A4.

In their endeavours to be comprehensive, the authors have compiled a book which may prove useful as a source of reference on many specific topics but is too long and dense to be easily readable. On the minus side, however, the so-called ‘case studies’ are of little use. The factual data given is not consistent and the descriptive texts are mostly sourced from the projects’ clients or architects. Without adequate floor plans (the very few included are mostly too small to read), these features offer limited value for the reader. There were no objective evaluations or critical assessments in the case studies that I have read, but without examining all 60, I cannot say there were none. These are not case studies in the sense used and understood by serious professionals. However, some readers may find these tasters sufficiently interesting as examples of either sustainability or healthcare architecture or both to be worth the effort of following up to find out more.

Although the book may have some value as a reference source, its apparent intention to cover this huge field of knowledge is bound to be thwarted by the current pace of change. Every day brings us new data about galloping climate change, developments in biomedicine and epidemiology, and the penetration of new IT into every human activity, as well as legislation, regulation and social change. But all of us in healthcare development need all the help we can get and *Sustainable Healthcare Architecture*, for all its weaknesses and faults, does appear to offer quite a lot.



Peter Scher is an architect, writer and consultant

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Coming Soon **Changing Hospital Architecture** Sunand Prasad

What can good design offer that most functionally-distinct of building types, the hospital? Few well-known architects have been involved in their design and even fewer big architectural prizes have been awarded for them. And yet in almost no other building type are the consequences of getting the design wrong quite so serious.

Richly illustrated in full colour, this book shows what can be achieved by reflecting on the UK's current huge hospital building programme in the light of historical and international experience. Aimed at health policy makers, architects and other construction professionals in the health sector, it points to potential exemplars, presents key issues and occasionally signals caution.

Written by distinguished experts in the field and edited by the new RIBA President Sunand Prasad, **Changing Hospital Architecture** is a timely and important work set to galvanize the debate about design quality in our health buildings.

RIBA Publishing
April 2008
Code 55094
260 pages
Paperback
£45.00



Sustainable Healthcare Architecture Robin Guenther and Gail Vittori

Design, restorative building, biophilia, enhanced air quality and high performance building systems. Written by leading national experts on the subject – one of whom was recognised by 'Time' magazine as a green innovator – **Sustainable Healthcare Architecture** is the key guide to designing sustainable healthcare facilities. Building on the authors' combined knowledge and experience, this book includes case studies of more than 50 of the best contemporary sustainable healthcare projects.

The book also contains numerous essays contributed by other leaders in sustainable design and healthcare. Additionally, the authors provide background information on LEED for Healthcare, as well as on the Green Guide for Health Care, which they were instrumental in developing.

Wiley
January 2008
Code 63346
448 pages
Hardback
£39.99

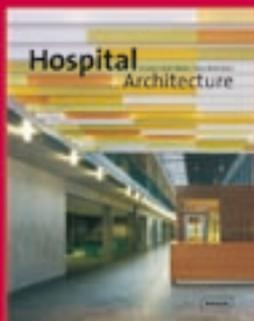


New Hospital Buildings in Germany P Meuser and C Schirmer

A superbly classy two-volume set, exclusive to RIBA Bookshops in the UK. Volume 1 covers general hospitals and health centres, presenting 53 such facilities. Volume 2 shows specialist clinics and medical departments, and there are 49 of these, grouped by speciality.

The photography and plans are of a consistently high standard and there are also short essays addressing the design exigencies of medical buildings. This set is required reading for architects, designers and innovators in the health care sector.

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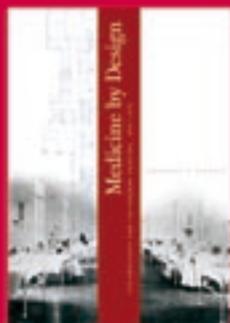
Hospital Architecture Christine Nickl-Weller

The hospital of the future views itself as being a modern service provider. The central aspect of this new thinking in the field of health care provision is the quality of life and the well-being of patients, staff and visitors. Architecture and design are becoming integral components of the approach to treatment and recovery. Special uses of light and colour, sustainability in the choice of materials and the flexibility of rooms: all form innovative concepts in contemporary hospital architecture – whether brand new building, conversion, or extension project. **Hospital Architecture** focuses its attention on more than one hundred high quality buildings in Germany, Austria and Switzerland. Using texts, photos, design sketches and ground plans, the collection illustrates the shape of pioneering trends in contemporary hospital buildings.

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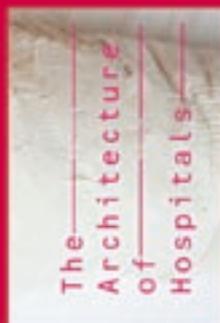
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Medicine by Design
The Architect and
the Modern Hospital,
1893–1943

Annamarie Adams

In the history of medicine, hospitals are usually seen as passive reflections of advances in medical knowledge and technology. In this book, Annamarie Adams challenges these assumptions, examining how hospital design influenced the development of twentieth-century medicine and demonstrates the importance of these specialised buildings in the history of architecture.

Adams uses the Royal Victoria Hospital in Montreal – along with other hospitals built or modified over the next fifty years – to explore critical issues in architecture and medicine: the role of gender and class in both fields, the transformation of patients into consumers, the introduction of new medical technologies, and the use of domestic architecture and regionally inspired imagery to soften the impact of high-tech medicine.

University of Minnesota Press
March 2008
Code 62715
240 pages
Paperback
90 b&w photos
£17.00



The Architecture of
Hospitals

Edited by Cor Wagenaar

Recent French and German hospital examples suggest that good architecture can contribute to an agreeable, orderly and well-maintained environment. American evidence-based design recently compared the effects of various spatial factors and provided, for the first time, indisputable evidence of architecture's positive influence.

The Architecture of Hospitals considers both that kind of influence and the position of the hospital as a public, representative building with special societal functions. This richly illustrated book includes, along with essays and in-depth historical studies, a selection of ground breaking new designs.

NAI
July 2006
Code 58281
512 pages
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Medical Design

J Fischer

Plenty of iatrogenic fun to be had with Daab's latest foray into visually maximal, textually minimal case studies. Sixty two medical projects – divided into clinics, pharmacies and practices – by 52 different firms, get 2007 off to a healthy start. As one might imagine, cleanliness and simplicity are the watchwords here, so lots of straight lines, corridors and strategies to maximise natural light.

Using photos, diagrams and floor plans, it illustrates the significance that a humanitarian architectural language will have in the modern and ever-changing health field.

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March 2008
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A crude, but useful, way of understanding the working environment is to consider it within a physical and a psychological context. Both are significant in relation to their impact on the performance and the well-being of the operating room nurse. And a stressed or underperforming nurse is a threat to a patient's human right to safe and good care.

After 24 years as a Swedish operating room nurse, I am well placed to reflect on the many types of environments within the medical service I have had the opportunity to work within – ranging from good and the bad to the ugly.

But what is a Swedish surgical department like? Typically, patients will arrive in a large waiting room, often lacking in seclusion and privacy. Thereafter, they are transported along long and barren corridors before arriving at the operating theatre.

Bare and inhospitable with stark lighting, the operating room is filled with technical equipment and monitors, which are necessary for the patient's care and safety. While they are waiting for the operation, there is little for the patient to rest their eyes on, in an unfamiliar environment that is certainly stressful, and occasionally, frightening – a highly clinical space with bare walls, strong lighting and nursing and medical staff working at a high pace in blue or green clothes, caps and masks.

Lately, I have thought about how patients experience the operating theatre environment and its impact on their well-being. I have also considered how the features of the physical surroundings could be changed, to create a less stressful experience that promotes the health of both the patient and the staff. In addition, for the operating theatre nurse, creating an environment that supports our own well-being is essential, both as a support to our caring work and to reduce patient anxiety.

The operating room nurse's work is demanding, with a significant responsibility for patient care. Yet, with ever-rising pressure on productivity, there is seldom time to relax, other than a brief break in a crowded staff room or a snatched bite to eat for lunch. It is also rare to enjoy the opportunity for a pleasant and reflective conversation in staff rooms that are often noisy and lacking in windows – artificially lit with minimal access to daylight.

One surgical department I worked in did offer staff a room in which they could relax after finishing their meal. The lighting, however, was poor, consisting of little more than a lamp in the corner for reading a book or magazine. A sofa provided an opportunity to rest aching muscles and tired eyes, but the computers which were used by many of the staff during their lunchbreak, meant the room was not sufficiently peaceful and quiet to allow for real relaxation and recuperation.

Yet, simple improvements to the environment can quickly and easily be made at little expense. The creation of an attractive symbiosis between light and colours in the hospital's surroundings, for example, would make the daily ward round a more pleasant experience, improving the level of nursing care and helping to relax the patient.

I have often reflected on the impact on patient care of my fatigued physiological state after a long shift in the surgical department, with no access to natural daylight. It is a recurring theme and issue amongst many operating nurse professionals.

In Sweden, the law concerning health and medical care recognises that staff, room and equipment are all essential components in ensuring that the patient receives good and safe care. So, what do we need to do to create a physical milieu which supports care in the operating room by creating positive effects on the patient's well-being?

This is a critical debate across the different nursing and medical professions in the surgical department. An environment designed to support both well-being and function energises staff psychologically and spiritually, thereby creating the optimal conditions for high quality care delivered in a humane way.

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This article is a personal view and does not necessarily reflect the position of EORNA.

Theatre of care?

The work within a surgical department is often demanding for nursing staff, who have limited control over the design, quality and performance of their environment, reflects *Irini Antoniadou*.



Irini Antoniadou, RN, ORN, SocBsc, BscN is a university lecturer and president of the European Operating Room Nurses Association (EORNA)

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.



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