WORLD HEALTH DESIGN
ARCHITECTURE | CULTURE | TECHNOLOGY
JULY 2013

HEART OF THE COMMUNITY

Promoting healthy lifestyles at the South West Acute Hospital in Northern Ireland

ALSO:

Market report: Europe
Project review: Children's health
Scientific review: Sustainable design
Arts and culture: Ambient healing

www.worldhealthdesign.com

Design & Health
International Academy for Design and Health

Volume 6 Issue 3


'Designing for well-being'
Proserpine Hospital
Bowen Queensland
www.bvn.com.au
BVN
Donovan Hill

WORLD HEALTH DESIGN
ARCHITECTURE | CULTURE | TECHNOLOGY

Contributors

John Zeisel
Good luck to all reseachers and designers in taking the next step forward in environment-behaviour research in healthcare design

Alan Short
The NHS has a tough challenge ahead to meet its targets to cut carbon emissions by 80% and maintain a high quality of care, but all is not lost

Celeste Alvaro
A new continuing care and rehabilitation centre in Toronto offers an opportunity for a systematic post-occupancy evaluation project

Xuemei Zhu
Has the development of a new 'walkable' community in Texas had the desired postive impact on health. social interaction and cohesion for its residents?

Clare Cooper Marcus
Charting the move towards a more consistent approach to the evaluation and certification of restorative gardens and outdoor spaces in healthcare facilities

Cover Image
The South West Acute Hospital in Enniskillen, Northern Ireland, designed by Stantec
See pp 14-15

Redefining prosperity

The great privilege I enjoy in my role as chief operations officer of the International Academy for Design & Health and editorial director of World Health Design, is the opportunity to travel, to experience different cultures, and to learn from some of the leading researchers and practitioners around the world, with their unbridaled passion and love for the art and science of the field of design and health. Over recent years, as I have experienced and seen with my own eyes the vastly different social, economic and political contexts within which we all live. These journeys have revealed to me the enduring importance and qualities of the arts and the sciences as a platform for freedom, creativity and the progressive development of human society. It may be a long and arduous journey at times, explains John Zeisel (p47), but the rewards come with dedication and endeavour. As Alan Dilani states, scientific enquiry and the development of knowledge are a public good that should be invested in and protected (p13). The world presently defines success in relation to GDP growth, yet as Aristotle vocalised, a functioning and healthy society, will only thrive through a public life in which economy is one element of a greater whole. Salutogenesis provides a model that can help us to redefine prosperity around people and the planet. Let's continue the discussion in Brisbane at the 9th Design & Health World Congress.

Marc Sansom
Editorial director

Contents

Editorial Director
Marc Sansom MBA
T: +44 (0) 1277 634 176
E: marc@designandhealth.com

Associate Editor
Kathleen Armstrong
Emily Brooks

President
Ray Pentecost III, DrPH, FAIA, FACHA
T: +1 757 961 7881
E: pentecost@designandhealth.com

Chief Executive and Founder
Alan Dilani PhD
T: +46 70 453 90 70
E: dilani@designandhealth.com

Editorial Advisory Board:
Dr John Zeisel PhD, USA
Dr Ray Pentecost DrPH, AIA, USA
Dr Alan Dilani PhD, Sweden
Prof Jacqueline Vischer PhD Canada
Dr Innocent Okpanum PhD, South Africa
Dato Dr Abd Rahim bin Mohamad, Malaysia
Prof Anthony Capon PhD, Australia
Prof Ihab Elzeyadi PhD USA
Prof David Allison, USA
Prof Ian Forbes, Australia
John Wells-Thorpe, UK
Mark Johnson, USA
Mike Nightingale, UK

Contributing writers
Veronica Simpson

Subscriptions and advertising
T: +44 (0) 1277 634 176
E: WHD@designandhealth.com

Published by:
The International Academy for Design and Health
PO Box 7196, 103 88 Stockholm, Sweden
T: +46 70 453 90 70
F: +46 8 745 00 02
E: academy@designandhealth.com
www.designandhealth.com

International Academy for Design and Health UK
West Suite, Westgate Court, 17 Western Road, Billericay
Essex CM12 9DY UK
T: +44 (0) 1277 634 176
F: +44 (0) 1277 634 041
E: WHD@designandhealth.com

Design and production:
Graphic Evidence Ltd
www.graphic-evidence.co.uk

WORLD HEALTH DESIGN
Volume 6 Number 3
ISSN 1654-9694

Subscriptions:
To receive regular copies of World Health Design please telephone +44 (0) 1277 634176 to place your order, or email WHD@designandhealth.com

Yearly subscription rates:
1 year £80; 2 years £130; Single Issue £30
World Health Design is published four times a year by the International Academy for Design and Health

Printed in the UK by
The Magazine Printing Company
using only paper from FSC/PEFC suppliers
www.magprint.co.uk

BRIEFING

OPINION

PROJECTS

MARKET REPORTS

DESIGN SOLUTIONS

ARTS & CULTURE

SCIENTIFIC REVIEW

Designers line up **for awards**

A diverse range of health projects from around the world have been revealed in the shortlist for the Design & Health International Academy Awards 2013

From a new children's hospital in Peru to an aged care facility in Australia and a medical city in Abu Dhabi, the Design & Health International Academy Awards 2013 demonstrate that the delivery of health services in the 21st century, the prevention of illness and the creation of wellness takes place in many different settings, building types and cultural contexts.

Sponsored by Lend Lease this year, the awards programme comprises 10 categories across the principal areas of international health delivery, including the prestigious Lifetime Leadership Award.

Firmly established as the world's leading advocacy programme recognising professional excellence in the research and practice of designing healthy built environments, the awards ceremony will be held on 13 July in Brisbane, Australia, during the Gala Awards Dinner of the 9th Design & Health World Congress & Exhibition (10–14 July), where the overall prize winners will be announced.

Each award will be presented by the Queensland Minister of Health, a representative of the judging panel for the category and a representative from the board of the International Academy for Design & Health.

The judging panel consists of a group of independent multidisciplinary experts within both research and practice from around the world.

The Children's Hospital Tony Molleapaza Rojas, Peru is shortlisted in the International Health Project (under 40,000sqm) category

The shortlist:

International Health Project (over 40,000sqm)

South West Acute Hospital, commissioned by Western Health & Social Care Trust, and designed by Stantec

New Public Collado Villalba Hospital, commissioned by Capio Sanidad, and designed by F Forwart

Queen Elizabeth Hospital Birmingham, commissioned by University Hospitals Birmingham NHS Foundation Trust, and designed by BDP

Baylor Charles A. Sammons Cancer Center, commissioned by Baylor Health Care System, USA, and Designed by Perkins + Will

International Health Project (under 40,000sqm)

Children's Hospital Tony Molleapaza Rojas, Peru, commissioned by PAZ-Holandesa, Netherlands, designed by EGM architecten

Akerman, commissioned by Building Better Health and Lambeth Primary Care Trust, and designed by Henley Halebrown Rorrison

St John's Rehab Hospital – the John C and Sally Horsfall Eaton Centre for Ambulatory Care, commissioned by St John's Rehab Hospital, Canada, and designed by Farrow Partnership Architects and Montgomery Sisam Architects

Future Health Project

New Queensland Children's Hospital, commissioned by Queensland Health, and designed by Conrad Gargett Lyons

Vienna North Hospital, commissioned by Vienna Hospital Association, and designed by Health Team KHN – Albert Wimmer

Sheikh Khalifa Medical City, commissioned by SEHA, Abu Dhabi Health Services Company, and designed by Skidmore Owings & Merrill in Joint venture with ICME and Tilke

International Salutogenic Design

Potter Street Redevelopment, commissioned by Wintringham, and designed by Allen Kong Architect

RFBI Basin View Masonic Village Aquaponic Garden, commissioned by Royal Freemasons' Benevolent Institution, and designed by Paul Van der Werf of Earthan Group

Lebovic Campus Community Complex, Sherman Health and Wellness Centre, commissioned by UJA Federation of Greater Toronto, Mount Sinai Hospital, Toronto, Canada, and designed by ARK Canada

International Mental Health Design

Mental Health Care: "High Care", commissioned by Stichting Rivierduinen, and designed by de Jong Gortemaker Algra architects and engineers

Gold Coast University Hospital Mental Health Unit, commissioned by Queensland Health, and designed by PDT + STH + HASSELL

CAMH Village Family Health Team, commissioned by the Centre for Addiction and Mental Health, Toronto, Canada, and designed by ARK Canada

Use of Art in the Patient Environment

University of Kentucky, Albert B Chandler Hospital, Arts in Healthcare program, commissioned by University of Kentucky Healthcare, and designed by AECOM

Royal Brompton Centre for Sleep, commissioned by Royal Brompton & Harefield Hospitals Charity and Royal Brompton & Harefield NHS Foundation Trust, UK, and created by Steven Appleby with rb&hArts

Global Fund MDR TB Hospital, commissioned by The Global Fund, The National Department of Health South Africa, Limpopo Department of Health, Council for Scientific and Industrial Research and Sakhiwo Health Solutions, and designed by HDG

Product Design for Healthcare Application

SafeSee Door, designed by Britplas

Whiterock Wall Cladding Systems, designed by Altro

Artis Q.zen Interventional Imaging System, designed by Siemens Healthcare – AX Division

Interior Design

CAMH Village Family Health Team, commissioned by the Centre for Addiction and Mental Health, Toronto, Canada, and designed by ARK Canada

South West Acute Hospital, commissioned by Western Health & Social Care Trust, and designed by Stantec

Kaleida Health Gates Vascular Institute/Suny at Buffalo Clinical and Translational Research Center, designed by Cannon Design

Sustainable Design

South West Acute Hospital, commissioned by Western Health & Social Care Trust, and designed by Stantec

Flinders Medical Centre New South Wing, commissioned by SA Health, and designed by Woodhead

LEND LEASE IS A LEADING PROVIDER OF INTEGRATED PROPERTY SOLUTIONS

We apply our knowledge and skills to support clients in the creation of better healthcare facilities around the world.

Images: Lend Lease, clockwise from above: NSUH Katz Women's Hospital, New Hyde Park, New York, USA; St Frances Xavier Cabrini, Victoria, USA; Romford Hospital, Essex, United Kingdom; Central Manchester Hospitals, Manchester, United Kingdom; the New Royal Children's Hospital, Victoria, Australia.

Lend Lease

Copper is bug killer

Antimicrobial copper handrail

New research from the University of Southampton shows that copper and copper alloys will rapidly destroy the highly infectious sickness bug, norovirus.

The virus can be contracted from contaminated food or water, person-to-person contact, and contact with contaminated surfaces, meaning surfaces made from copper could effectively shut down one avenue of infection.

Norovirus is responsible worldwide for more than 267 million cases of acute gastroenteritis every year. There is no specific treatment or vaccine, and outbreaks regularly shut down hospital wards and care homes, requiring expensive deep-cleaning, incurring additional treatment costs and resulting in lost days when staff are infected. Its impact is also felt beyond healthcare, with cruise ships and hotels suffering a significant loss of reputation when epidemics occur among guests

Professor Bill Keevil, chair in environmental healthcare at the University of Southampton and lead researcher, presented his work at the American Society for Microbiology's 2013 General Meeting in May. The presentation stated norovirus was rapidly destroyed on copper and its alloys, with those containing more than 60% copper proving particularly efficacious. The contamination model used was designed to simulate fingertip-touch contamination of surfaces.

Bill Keevil, chair environmental research, University of Southampton and researcher

"Copper alloy surfaces can be employed in high-risk areas such as cruise ships and care homes, where norovirus outbreaks are hard to control because infected people can't help but contaminate the environment with explosive vomiting and diarrhoea," Keevil explains. "The virus can remain infectious on solid surfaces and is also resistant to many cleaning solutions. That means it can spread to people who touch these surfaces, causing further infections and maintaining the cycle of infection. Copper surfaces, like door handles and taps, can disrupt the cycle and lower the risk of outbreaks."

New cancer centre breaks ground

The new Fred and Pamela Buffett Cancer Center

The new Fred and Pamela Buffett Cancer Center at the University of Nebraska Medical Center (UNMC), has broken ground.

Designed by HDR, and following the success of the HDR-designed Durham Research Centers I & II and the Michael F Sorrell Center for Health Science Education (CHSE) on the same campus, the US$323m cancer research and treatment centre will join the research centres as part of the Durham Research Plaza.

The Buffett Cancer Center will combine both cancer treatment and research to provide the highest level of cancer care, with the goal of earning a 'Comprehensive Cancer Center' designation from the National Cancer Institute. The project consists of three components: a 10-storey, 252,000sqft (23,412sqm), cancer research tower with 98 laboratories a seven-storey, 325,000sqft (30,193sqm), 108-bed hospital tower, and a multidisciplinary ambulatory clinic. This comprehensive, translational approach will allow researchers to accelerate breakthroughs in the lab and clinicians to provide personalised care plans for patients.

"The Fred and Pamela Buffet Cancer Center represents an unprecedented opportunity for translational medicine," said Bruce Carpenter, HDR senior vice president and project principal. "We're providing research and clinical space in the same facility, focused on cancer patient care, designed to encourage collaboration. This will be a true embodiment of the translational medicine concept."

The new cancer centre is named for Fred and Pamela Buffett. The late Fred Buffett, a first cousin to Warren Buffett, lost his fight to kidney cancer in 1997, and the centre was made possible through a major gift from his wife's foundation. Construction is expected to be complete in 2016.


AECOM
Bringing him home sooner
No one wants to be in hospital.
But if a visit is unavoidable, you want it to be as comfortable – and short – as possible.
AECOM strives to meet the needs of patients, healthcare professionals and communities through smart thinking, design and engineering solutions.
We introduced fresh-air systems to the wards of the Fiona Stanley Hospital in Murdoch, Australia to reduce cross-infection risks and help make the best part of going to hospital – getting out – come a little sooner.
aecom.com

Bahrain Oncology Centre gets the green light

Scheme design has been approved for a new Oncology Centre at the King Hamad University Hospital (KHUH) in Bahrain. Led by HASSELL for the Bahrain Defence Force, and working in partnership with Bahrain-based Mazen Alumran Consulting Engineers (MACE) and team members AECOM, Baker Willis Smith and MJ Medical, the new building will be designed to the highest international standards of healthcare provision, bringing first-class cancer care and research facilities to Bahrain in a single 'translational' environment.

Road entrance to Bahrain's new Oncology Centre

Incorporating the latest advances in technology, the new Oncology Centre will combine research functions with comprehensive inpatient, outpatient, diagnostic and treatment facilities. Its location on the existing KHUH site will ensure an integrated approach to a wide range of healthcare services for all patients, while further treatment integration will include work with other hospitals in Bahrain. This holistic approach to healthcare provision in Bahrain is designed to establish a multidisciplinary and effective care programme for all citizens.

Concept design for the atrium of the Oncology Centre

The Oncology Centre will play a leading role in the worldwide development of radiation oncology. Bahrain's location at the centre of the Arabian Gulf, neighboured by Qatar and Saudi Arabia, will be critical to achieving national and internationally coordinated clinical trials to improve medical knowledge beyond borders and contribute to the worldwide fight against cancer.

Colin Hockley, managing principal for HASSELL in the UK, commented: "Bahrain is working to lead the region in developing first-class healthcare and specialised cancer care. HASSELL is looking forward to cooperating with the Bahrain Defence Force in achieving this goal through our research-based approach to healthcare design, focusing on delivering high-performing clinical spaces and environments for patients, visitors and staff which promote health and wellbeing."

Suters and dwp partner

Australian firms Suters Architects and dwp have announced a fully integrated design partnership: 'dwp|suters'. dwp|suters says it now offers an extended range of capabilities to both local and international markets, and combined design services in four portfolios: community, lifestyle, work and infrastructure. dwp|suters brings to Australia globally awarded expertise in hospitality, residential and corporate design. This augments existing expertise in health, education, workplace, sports and seniors living.

"dwp is delighted at this next chapter in our continuing quest to deliver a one-stop integrated design service offering to our clients. Suters Architects shares our vision of providing excellence at the highest international standards. We are both incredibly excited and proud to be partnering with such a highly reputable and award-winning company," remarked Brenton Mauriello, CEO for dwp|design worldwide partnership.

Clarifications

The Olivia Newton-John Cancer & Wellness Centre in Heidelberg, Victoria, featured on p31 of World Health Design April 2013 was designed by Jackson Architecture/mcconnel smith & Johnson

The Ng Teng Fong General Hospital & Jurong Community Hospital in Singapore, featured on p17 of World Health Design April 2013 was designed by CPG Consultants with HOK and Studio 505.

AECOM in Monaco

An AECOM-led consortium has been awarded a US$85m contract for the new Princess Grace hospital in the Principality of Monaco.

AECOM will act as consortium lead and programme manager for the approximately 90,000sqm, 400-room hospital. The consortium was selected after being one of three groups invited to participate in a design competition for the new hospital.

In addition to AECOM, the consortium includes AIA Associés as international architect, the Monaco architect Natacha Morin Innocenti, AIA Ingénierie for heating, ventilation and air conditioning design and sustainability, and Tractebel Engineering for foundations and structural design. "AECOM is excited to work with our consortium partners in playing a significant role in imagining and creating an innovative design for this prestigious project," said John M Dionisio, AECOM chairman and chief executive officer. "I look forward to the team delivering a state-of-the-art hospital to serve Monaco's residents and visitors for decades to come."

Design work for the new hospital is expected to begin in July and last for two years, followed by a 10-year construction period.

PERFORMANCE DRIVEN DESIGN

ADDING VALUE TO THE BUILT ENVIRONMENT

rtkl.com | 888.337.4685

Sharing our ideas

Science and research is a public good that should be shared to stimulate creativity and innovation in the interests of the progress of a healthier future society, writes ***Alan Dilani***

As western world economies struggle to emerge fully from recession, the banking crisis and massive budget deficits, the focus has failed so far to shift from an emphasis on the role of finance to the need for more balanced, creative and productive economies, stimulated by science, research and innovation.

Like health, education and physical infrastructure, scientific enquiry and the development of knowledge is a public good that requires investment by governments to stimulate innovation and lay the foundations for economic growth that will provide for our future society. A study of human civilization shows that great leaps forward in the arts, culture, technology and science, were achieved through the sharing of ideas and knowledge across geographies, cultures and disciplines.

Since the start of the industrial age and as we journey through today's knowledge society, the speed of that exchange of knowledge and ideas has risen exponentially, positively reinforced by step changes in the way we communicate in a digital world and a global economy.

Knowledge-based organisations like the International Academy for Design and Health are thriving in this new world, building global networks, connecting researchers and practitioners, innovators and applicators, stimulating ideas and providing a credible forum for exchange. Creating an environment for unleashing creativity in the field of design and health has been at the heart of the Academy's mission for two decades, but it is not enough without a context for the pursuit of innovation. It is integral to humanity to be intellectually curious in the development of new ideas, but true innovation is only possible when the context is right for the application of those ideas. The application of the theories of salutogenesis as a framework to understand the processes that support and promote human health and wellbeing in the design of the physical environment, has seen the convergence of the fields of public health and design in a demonstration of the huge potential of interdisciplinary research.

But let us be careful to understand and differentiate between the sciences and the arts, whilst valuing the critical importance of the power of these two pillars of civilized society to work in tandem for human progress.

In the USA, the emergence of evidence-based design (EBD) is flawed in its interpretation that design in itself is a science. Design is not a science, but is an art and a process of creativity. There is a critical role for credible research and science to play in informing the design of our environments, which is at the heart of the Academy's work, but equally it is the skills, knowledge, experience and creativity of the designer and architect that will result in innovation and a successful solution. As the marketers embrace the ideas of 'evidence-based design' in a cynical effort to persuade and speak the 'evidence-based medicine' language of their clients in the healthcare industry, the risk is that EBD is prescribed like a drug to cure a hospital's ills, transferring ideas that have not been based on robust research-evidence, and may not be appropriate to the local context. Continuous research to inform the design of healthcare environments is critical, but we must be careful about what we call evidence.

Like health, education and infrastructure, scientific enquiry and the development of knowledge is a public good that requires investment

As we prepare for the 9th Design & Health World Congress in Brisbane, the interdisciplinary international focus of our work will take another giant leap forward with the creation of a new board of 13 directors, representing both different geographic zones of the world and different professional and research disciplines. We have many talents throughout our community to develop our vision. We invite you to be part of this vision.

Prof Alan Dilani is chief executive and founder of the International Academy for Design & Health

South West Acute Hospital, Enniskillen, Northern Ireland

Completion date: January 2012
Client: Western Health & Social Care Trust
Cost: £276m
Size: 69,000sqm
Project consortium: Northern Ireland Health Group
Architect: Stantec
Main contractor: FCC Elliott Construction Partnership

Heart of the **community**

South West Acute Hospital (SWAH) is a new 300-bed acute hospital with designated centres for women and children. It is the first hospital in Northern Ireland with 100% single-patient bedrooms, replacing Erne Hospital which had become too small for the growing needs of its community. The hospital provides ambulatory, diagnostics, A&E, critical care, laboratories, maternity, women's health, neonatal, surgery, older persons and inpatient care services to Fermanagh and South Tyrone. The organic copper-clad form of the education centre and adjacent sculptural entrance canopy give it a distinctive presence, while the strategic positioning of buildings, entrances and site circulation provide a clear sense of order and natural legibility. The linear garden forms a central circulation spine along the entire length of the building, dividing ward accommodation from clinical spaces. This spine provides natural lighting and increases wellbeing by bringing views of the landscape deep into the heart of the building. Internally, clear wayfinding is ensured through clear information points, strategically located wayfinding screens and clear signage, supported by 'beacon' artworks and thematic departmental interior design. A real part of the local community, the hospital has designated spaces in the main atrium and hospital street that are used by community groups, local artists, schools and museums for exhibitions. In addition, its community support services promote healthy lifestyles in the area through education.

Designed to inspire

Emotional intelligence is writ large in the design of the latest healthcare spaces for children. ***Veronica Simpson*** reports on the latest architectural innovations and insights

One of the most dynamic and creative sectors within healthcare architecture, children's healthcare continues to forge ahead with emotionally intelligent and innovative ideas for addressing the needs of patients, families and communities. One would think that the meerkat enclosures and aquaria of the Royal Children's Hospital in Melbourne (reported in *WHD*'s July 2012 sector round-up) would represent some kind of high water mark, but the latest projects completed or currently under way demonstrate just as much ingenuity and commitment to improving healthcare outcomes for all involved.

Even several years into global recession, with massive cuts in healthcare provision across many regions, governments have seen fit to continue to invest in large and high-quality children's healthcare buildings – or, perhaps more realistically, to press ahead with plans that were set in motion long before the severity of this economic downturn became apparent. Australia, for example, is investing billions of dollars in major new children's hospitals: Melbourne's aforementioned AU$995m Royal Children's Hospital (a 160,000sqm clinical treatment and research facility designed by Billard Leece Partnership and Bates Smart with HKS),

The play space in the UK's Royal London hospital is designed to get children and their families interacting with each other, and to reduce fear

Perth's forthcoming AU$1.2bn New Children's Hospital (65,000sqm, also designed by BLP, with Cox and JCY) and the AU$1.5bn Queensland Children's Hospital, Brisbane (71,000sqm, designed by Conrad Gargett Riddell and Lyons) which opens in late 2014. Meanwhile, in the UK, investment continues in new children's facilities for the Royal London Hospital (see case study), while a shortlist of design and construction consortia has been drawn up for the rebuilding of Edinburgh's Royal Hospital for Sick Children (RHSC) in one giant combined facility with the Department of Clinical Neurosciences and the Child and Adolescent Mental Health Service, scheduled to open in 2017. One of the UK's biggest children's facilities, the Alder Hey in Liverpool, is being completely rebuilt and relocated to parkland adjacent to its current site (see case study). Meanwhile the Republic of Ireland is pressing ahead with revised plans for a 100,000sqm children's hospital in Dublin.

In children's heart surgery, it's been shown that the best results come from locations where surgeons are specialists and doing it all the time

"One of the things that's happened with big acute hospitals is that you are getting higher and higher levels of specialism to deal with more difficult conditions," says Andrew Smith, director of healthcare at BDP, which is involved in some of the above projects. "For example, in children's heart surgery, it's been shown that the best results come from locations where surgeons are specialists and doing it all the time." This leads logically to more large, regional, specialist-rich children's facilities. "In the abstract it might be nicer to have a little kids' hospital near where

Play space, The Royal London Hospital, London, UK

Architects Cottrell & Vermeulen, working with graphic artist Morag Myerscough, were given two large areas to transform into havens for play, retreat and restoration for children, away from the clinical and institutional environments of the new HOK-designed Royal London hospital. A two-storey atrium space adjacent to the childrens' ward has become the new Activity Space, and a roof terrace has been turned into the Sky Garden. The design took inspiration from classic children's literature including *Where the Wild Things Are*, *The Borrowers* and *Alice in Wonderland*. Overscaled domestic furniture – a giant television, a lamp, a chair and a globe – encourage interaction and exploration in the Activity Space, and enormous soft toys are woven into the space's narrative. Elsewhere, puzzle cubes form stackable toys as well as seating, and the globe interior reveals itself as a cosy den. "The theme of domestication is so important to children when they are not at home," says architect Maria Westerstahl. "The hospital can seem like a very hostile environment – all blue and steel and glass and wipe down surfaces – so it's important to have variety in materials, textures and nature." In the astro-turfed Sky Garden there is a rooftop forest with a tepee, a shingle-clad den and a vine-covered shelter. Secure glass balustrades are hidden behind wicker fencing and planters. The £1m scheme was funded entirely through donations.

Architecture and design: Cottrell & Vermeulen, with Morag Myerscough
Client: The Royal London Hospital and Vital Arts
Cost: £1m
Size: 180sqm (external), 188sqm (internal)
Completion: 2013
Interactive design: Chris O'Shea
Sound recordings: Chris Watson
Construction: Skanska

you live but that doesn't give you the level of expertise that allows you to deal with difficult conditions," continues Smith. "Another development is the convergence between clinical research and trials and clinical practice." Consequently, many new facilities accommodate large research laboratories along with care and treatment facilities.

Inspiring healthy communities

Some of the most recent projects also demonstrate heartening evidence of long-term thinking, with new children's hospitals being designed as pivotal resources for wider community health programmes. Part of a laudable US health initiative to proactively tackle urban poverty and related diseases, the Children's Hospital of Michigan's Specialty Center is intended to be as welcoming, navigable and user-friendly as possible, to serve one of the most recession-blighted urban populations in the whole of the US. Designed by Shepley Bulfinch, its light and spacious layout includes flexible clinic arrangements (to accommodate clinical needs according to demand) and conference facilities that will be able to deliver advice and workshops on diet, immunisation and fitness to the local population, from teenagers to whole families, throughout the week and into the weekend.

"You have to start when the population is young if you want to improve healthcare outcomes throughout life," says Uma Ramanathan, a principal with Shepley Bulfinch and leader in paediatric healthcare design. Social interaction is writ large in the scheme: consulting rooms are big enough to accommodate a whole family – or even two. "If you have a kid with diabetes, it also helps to have another kid with diabetes for them to talk with," explains Ramanathan. "It's about education through conversation." The Center is also tackling immunisation issues head on: "We think the developing world is the one that's challenged with immunisation through lack of access to facilities, but in cities like Detroit you have to create an event around immunisation. Here we have created a semi conference centre that facilitates this activity." The community will be regularly invited to attend talks on immunisation here, she says, "and the immunisation clinic is just around the corner."

You have to start when the population is young if you want to improve healthcare outcomes throughout life

More of these community children's facilities are planned around US cities. "There are a number of other organisations thinking in this way – in keeping with healthcare reforms. A lot of children's hospitals are moving in this direction," says Ramanathan. Shepley Bulfinch is working on a similar scheme in Baltimore, of around the same size – 9,300sqm. "We've found that this size [of facility] is more navigable; children and their families can find their way around without being intimidated," she adds.

Opened just a year ago, feedback on the Detroit facility so far is good. Ease of parking has proved to be one major plus point, as well as clinic flexibility and transparency. For young patients, a particular boon has been the freedom with which they can interact – especially in the dialysis area, which is open but with curtains across each station for privacy, if required.

Patient rooms in the Pietro Barilla Children's Hospital are located to provide views

Distraction and interaction for patients and families is very much the point in the Royal London's new children's recreation and play spaces. Two large areas, one next to the wards and one on a rooftop terrace, represent some of the most flamboyant, imaginative and beautifully realised spaces for children in any healthcare setting. Architects Cottrell & Vermeulen, together with graphic artist Morag Myerscough, were commissioned by Barts Health NHS Trust's dedicated arts curatorial charity Vital Arts to devise an environment that would remove children completely from the clinical world of the wards and surgeries.

"Royal London is an acute hospital – it treats something like 40,000 children [a year], and 800 are long

DMC Children's Hospital of Michigan Specialty Center, Detroit, US

Close consultation between physicians and architect Shepley Bulfinch has resulted in a potent new building typology for children's health and wellbeing, at the Children's Hospital of Michigan Specialty Center: an environment designed to encourage families to take responsibility for their health and wellbeing and make the facility a regular part of their lives. The five-storey building features a welcoming glass entrance. Transparency of layout facilitates wayfinding and supervision, with generous daylighting, high ceilings and colourful artwork, adding to an atmosphere of calm and comfort throughout. Large exam rooms, restrooms, waiting areas and consultation rooms accommodate whole family groups, and opening hours include weekends so that teens and their parents can attend workshops on diet and fitness. Primary services are located on the ground floor, while the majority of exam rooms on the upper floors are sited along the building's perimeter, with large windows providing light and views. Paediatric and adolescent clinics function separately, but their spaces are not segregated and they share a waiting area (thereby also allowing for flexibility as the patient population changes over time). Incorporating many sustainability initiatives, including daylight and motion sensors throughout the building to reduce power consumption, high-performance building systems and windows, this building is the first LEED-certified project on the hospital's urban campus.

Architect: Shepley Bulfinch
Client: Children's Hospital of Michigan Specialty Center, Detroit
Cost: US$43m
Size: 9,300sqm
Completion: 2012


Billard Leece Partnership
www.blp.com.au
Ballarat Regional Integrated Cancer Centre

Alder Hey Children's Hospital, Liverpool, UK

Liverpool's Alder Hey is one of the biggest and busiest children's hospitals in the UK, with more than 275,000 patients treated each year, but its sprawling complex of buildings is badly in need of rationalisation and upgrading. Alder Hey Children's NHS Foundation Trust worked with the Prince's Foundation and Arts for Health, along with patients and families, to develop a brief for a 'children's health park'. BDP's new hospital is being built inside the existing hospital's neighbouring Springfield Park; once completed, the old hospital will be demolished and a new park built in its place. Three turf-roofed wings of wards extend into the landscape, built on top of the hospital's diagnostic and treatment facilities, which are below ground. This maximises views and daylight into the wards and allows for the creation of terraces and safe play spaces at multiple levels, as well as park access, while fitting facilities into an ergonomically efficient footprint. Says BDP's head of healthcare, Andrew Smith: "If you can make a hospital compact, the doctors and nurses can spend more time treating patients and less time walking around." There will be 270 beds (75% of them single occupancy), and 16 state-of-the-art operating theatres.

Architecture, interior design and landscaping: BDP
Client: Alder Hey Children's NHS Foundation Trust
Developing consortium: Acorn (John Laing, Laing O'Rourke and Interserve)
Cost: £167m
Size: 52,000sqm
Completion: Estimated 2015

term, staying from two to three weeks to several months," says Vital Arts director Anne Mullins. "Many of them come back on and off for years with chronic illnesses like cystic fibrosis, which means that they practically grow up in hospital. You have to create an environment where you can allow them to develop and change enough so that they can continue to enjoy it." Flexibility and adaptability are key, providing for the increasing use of technology as well as a range of physical abilities – for example, iPod docks around the play spaces allow physiotherapists or teachers to programme exercises and classes. Says Mullins: "We have worked with Nexus and Chris O'Shea, one of the leading digital artists for children's apps. He created a new game together with the physiotherapy team." There are a handful of games now, which will be added to through an initiative between Vital Arts and London's Royal College of Art students so that the technology continues to evolve.

The play space opened in January 2013 and so far Mullins is satisfied to see how well each area is being used: "The children go in and they immediately grab all the oversized cubes and start building. It's gratifying that our school will be allowed to use it." (Teenagers studying for their exams use the area after 6pm.) Architect Maria Westerstahl hopes that the provision of ample open space as well as areas for retreat, and moveable soft furnishings will facilitate activity for children and family members. She says: "The stuffed cushions and seating can all be moved around. Parents with very young children can sit and read to them, whatever their condition.


lyons
Designing
Better
Health
Health Architecture & Design | Acute Hospitals | Community Hospitals |
Aged Care Facilities | Strategic Masterplanning | Specialist Centres |
Integrated Facilities | Ambulatory Care Facilities
Lyons 246 Bourke Street, Melbourne, Australia, 3000
+61 3 9600 2818
www.lyonsarch.com.au
image courtesy Conrad Gargett Lyons

Hospital Infantil Tony Molleapaza Rojas, Arequipa, Peru

Architect: EGM Architecten
Client: PAZ-Holandesa
Cost: €3m
Completion: 2012

PAZ-Holandesa is a charity, founded in 2000 and based in Rotterdam, aimed at providing free medical help to children in Peru. In 2005, Dordrecht-based EGM Architecten decided to adopt and fund an initiative to design a children's hospital for it to further these aims. This hospital provides free treatment to a range of children but prioritises those born with physical difficulties, such as schisis or club foot, who would otherwise go untreated. Built in several stages in order to offer help as soon as possible, the design is a series of pavilions. The administration, polyclinic and reception areas were opened in September 2008. Four years later, operating rooms, a pharmacy, X-ray unit, laboratory, private clinic, restaurant and accommodation were completed.

We have to think about all ages and all abilities – ill children, but also well children."

Enriched by technology

The use of digital technology to add sensory richness to children's healthcare spaces is an exciting new area for exploration, facilitated by the medium's growing reliability and relatively low cost – not to mention children's near miraculously intuitive understanding of how to use it. The Royal London's rooftop 'Sky Garden' also features a specially commissioned natural sound recording created by wildlife sound recorder Chris Watson, together with 50 of the Royal's young patients, who helped to edit his field recordings into a series of filmic narratives.

While such advances in the engagement, distraction and education of patients and their families are clearly to be celebrated, there are still further innovations in the operational design of children's

ENGINEERING
EXCELLENCE

if we could bottle it, we would.

As leading consulting engineers, NDY has a history of design excellence and an understanding and expertise in sustainable healthcare design.

With a legacy stretching back to 1959, we continue to provide innovative solutions to turn client's visions into award winning healthcare projects.

www.ndy.com

Norman Disney& Young

Adelaide Brisbane Canberra Darwin Gold Coast Melbourne Perth Sydney Auckland Christchurch Wellington London Dubai Kuala Lumpur

Pietro Barilla Children's Hospital, Parma, Italy

A rainbow-coloured facade greets young patients and their families at the Pietro Barilla children's hospital in Parma, Italy. Designed by OBR Open Building Research and Policreo, the facility, in a built-up area of the city, nonetheless makes the most of connections between inside and out. Viewed straight on, the facade is glazed, reflecting its urban surroundings and surrounding gardens, with the multi-coloured vertical fins only becoming apparent when the building is viewed obliquely. The architects have sited patient rooms and common areas at the periphery of the hospital, opening up views to the surroundings, while interiors are intended to be as homely as possible to set the young patients at ease. Alongside colourful rooms laid out so that parents can visit and stay, there are also large recreational areas to encourage socialising. The hospital is the first dedicated paediatric facility in Emilia Romagna, a region of about 4.4 million people.

facilities to come. With the 2014 opening of Queensland Children's Hospital, Lyons Architecture and Conrad Gargett Riddell have drawn on research in the field to create new service delivery models, including a 'no-wait' triage service (patients are immediately separated into four groups and processed to the next level), and the separation of surgical and medical admissions with their own lounge/lobby on upper floors.

Is it the vulnerability and appeal of its core patient group that inspires such commitment and creativity in architects, carers and healthcare administrations? Who knows. But it certainly looks as if the power of design to transform healthcare delivery is being proven beyond doubt in this sector.

Veronica Simpson is an architectural writer and environmental psychologist

Pietro Barilla Children's Hospital, Parma, Italy
Architects: OBR Open Building Research and Policreo
Client: Fondazione Ospedale dei Bambini di Parma
Size: 13,000sqm
Cost: €15.5m
Completed: January 2013

Social cohesion

Community wellbeing and environmental initiatives are driving some of the more interesting healthcare projects across Europe, as *Veronica Simpson* reports

If European healthcare was "barely managing to cover its costs", according to a 2011 Economist Intelligence Unit (EIU) report[1], the picture must be even bleaker now – two years on, with severe to moderate economic contraction still forecast for Greece, Spain, Portugal, Italy and most of eastern Europe. World Bank predictions that the cost of healthcare could soar to as high as 14% of GDP by 2030 (from a 2000 base of 8%) have been influencing a diverse picture of stagnation, rationalisation and partial privatisation across the region, according to each country's bank balances or political motivations. However, while many healthcare building schemes in eastern and southern Europe appear to have stalled, there is still strong activity in the north as relatively solvent (or those who enjoy high taxation) nations proactively seek to minimise impact from the worst-case future scenarios caused by the triple-whammy of ageing populations, a rise in chronic disease and the escalating costs of medical technologies.

Given that most European countries' healthcare is funded by its citizens on a 'shared risk' principle, the key questions for policymakers are either how current systems can be redesigned for future financial viability without losing that promise of universal healthcare coverage or, judging by the example of the UK (currently undergoing the biggest shakeup in its National Health Service since it was founded in 1948), how can private sector entrepreneurialism and funding be used to either shore up existing universal provision or encourage citizens to switch to privately-funded alternatives.

Among the key probable trends the EIU report predicted are the following:

- Healthcare spending will continue to rise because policymakers accept that improved health is inextricably linked with greater national wealth and productivity
- Services and facilities will be rationed in order to preserve universal healthcare
- GPs will become 'gatekeepers' of the system, moderating access to treatment
- Governments will find ways to actively promote and encourage healthy lifestyles and behaviours to minimise chronic disease
- Methods of collecting nationwide health data will improve in order to allow governments to prioritise investment decisions.

How will any of these trends impact on the type and quality of healthcare buildings being commissioned now and in the future? One of the most controversial but visible manifestations of the trend towards health promotion is the desire to encourage citizens to be more proactive in maintaining health. On the one hand, this manifests itself as controversial threats (from the UK government, for example – backed by 54% of doctors apparently) to withhold potentially life-saving treatment and surgery from at-risk individuals (smokers and the obese) if they have consistently refused to change their behaviour. On the more unequivocally positive side, many new healthcare buildings

The redevelopment of St Bartholomew's Hospital (pictured) and the Royal London will provide London with the largest research, teaching and care facility in Europe

Architects: HOK and HWP Planungsgesellschaft (joint venture)
Client: US government
Size: 92,900sqm
Completion: Estimated 2019

Kaiserslautern Military Community Medical Center, Kaiserslautern, Germany

Built to replace an older facility, this US government-funded centre will serve the 50,000 NATO US military personnel and their families posted in the town, as well as treating all US troops wounded in action in the region. In order to facilitate fast turnaround of the large number of outpatients who might have been flown in from conflict areas, HOK has evolved a design around a Rapid Cycle Evaluation and Treatment (RCET) methodology, which also improves diagnostic and treatment services to the resident population. Outpatient facilities are configured to provide multidisciplinary diagnosis and treatment, with embedded diagnostics in the clinic or ambulatory care environment such as non-invasive cardiology, neurological testing, rehabilitation gyms and simple radiography for orthopaedics. The most frequently required disciplines are clustered together to facilitate multidisciplinary team working. The clinics have been designed as a series of rectilinear modules of varying sizes, that connect along a serpentine corridor, allowing daylight to flow into each clinic and along the public pathways; behind this building is another series of fingers that house the larger, shared elements – surgery, invasive procedures, CT and MRI. Construction of this green-roofed building is on a forested site, using white pre-cast concrete, metal panels and glass. At least 50% of both building heating and cooling needs will be met by renewable energy sources.

Architecture/interiors: Francisco Ortega Montoliu
Client: Capio Sanidad
Cost: €74.5m
Size: 65,000sqm
Completion: 2013
Principal contractor: Obrascón Huarte Lain

Collado Villalba Hospital, Madrid, Spain

Situated just outside Madrid in a spectacular mountain range and parkland, Collado Villalba Hospital is designed to maximise the benefits of the surrounding views and landscapes while minimising the visual and environmental impact of the building. The facility is arranged in three sections depending on the intensity of treatment: social, admission and outpatient areas are at the entrance; to the rear are the inpatient areas and operating theatres, while diagnostics is sandwiched in the middle, serving both populations. These spaces are all accessed via the main public hall/atrium, which is filled with art, views and daylight, and is naturally ventilated, with openable windows. The facility is intended to serve a patient community of 110,000 with 140 bedrooms, 87 outpatient offices and nine operating theatres. Its design is inspired by the terrain – a granite base topped with vegetation – with substantial glazing across each elevation. The building incorporates natural materials – stone, glass, wood, earth – and reuses materials disturbed during construction wherever possible (for example, the granite dug out during construction was crushed and used to fill gabions hung on the facade). Around 2,200 local species of trees have been planted on the rooftop and in surrounding gardens.

sit at the heart of communities, integrating them with other services that help to encourage more active lifestyles and community cohesiveness.

Danish practice Henning Larsen Architects, for example, is putting health and civic engagement at the heart of a new scheme, Egedal Town Hall and Health Centre in north Copenhagen. The Health Centre is designed as a 'village', with courtyards and green, internal walkways connecting to a central square, around which various activities sprout up; its ground floor foyer offers spaces for exhibitions, concerts or special events, and the health centre itself has an attractive roof garden. The firm has also won laudits for its design of Herlev Hospital in Helsingborg, a low-rise 52,000sqm extension to the existing hospital's 1960s tower block that it says will create a "sensory hospital" that will become an exemplar for patient-centred design.

In north London, Murphy Philipps Architects recently completed a new community facility, Finchley Memorial Hospital (see case study), which plays a key role in establishing an urban park, complete with healing and therapeutic gardens, a bowling green, playing fields linked to a local primary school, a memorial garden and a cafe. These schemes build on the emerging trend that was noted in *World Health Design*'s July 2012 European regional report of a 'core hospital' model, placing healthcare at the heart of a community.

Meanwhile, in the Netherlands, an exemplary new scheme recently won by architects Mecanoo – famous for creating exuberantly detailed destination libraries and civic centres – sees the practice presenting an admirably restrained but handsome urban block combining extra-care accommodation with a nursing home, a community wellness centre, a neighbourhood school, a shopping centre and parking garages. It exemplifies social and cultural health, even if it doesn't contain any treadmills.

Driving the agenda for sustainability

The need to cut costs has also powered the agenda for sustainable design, with several exemplar projects emerging across all territories – including the Collado Villalba Hospital outside Madrid,

in recession-blighted Spain (see case study).

HLM, meanwhile, is part way through the construction of several healthcare projects for Wales that put sustainability high on the agenda, recently completing a £70m, 18,500sqm hospital in south Wales, Ysbyty Cwm Cynon. With stepped, low-rise green roofs pitched to minimise impact on surrounding housing and the rolling landscapes beyond, the scheme has just won a prestigious LABC South Wales Building Excellence Award for Best Community/Healthcare Development, thanks to its socially and environmentally intelligent design.

In the north of the UK, Houghton Primary Care Centre, a new facility in Tyne and Wear, won a Leaders in Sustainability Award 2012 for its holistic design solution. Designed by P+HS Architects, it's the first UK healthcare facility to achieve BREEAM Outstanding accreditation. Welcoming and accessible, its ambition to set the sustainability bar high involved working with BREEAM assessors from the earliest stages, and brainstorming with natural ventilation engineering consultants to develop a groundbreaking solution – a bespoke 50m thermal wall constructed along the spine of the building. PV and solar-thermal panels, a green roof, a ground-source heat pump, wind turbine, rainwater harvesting and electric car plug points all contributed to the Outstanding assessment.

Steve Naylor, head of estates for NHS South of Tyne and Wear, will be striking a cord with any healthcare manager when he says of the project: "Our ultimate aim is to meet the needs of the present without compromising the needs of future generations. The extended work at Houghton contributes to improved public health and reduced health inequalities as well as sustainable development."

Our ultimate aim is to meet the needs of the present without compromising the needs of future generations

The BREEAM Excellent Finchley Memorial Hospital has also garnered praise for the extensive community consultation that informed its design and the wider masterplanning – helping to dictate its eventual placement at the heart of a range of appealing and inclusive outdoor community spaces.

A strong sense of civic engagement and generosity is also tangible in schemes such as Henley Halebrown Rorrison's (HHbR) recently completed Akerman Health Centre in Lambeth, south London (see case study) – a building that both establishes its own solid civic credentials and somehow unites all the disparate elements of the surrounding urban grain in one beautifully resolved structure.

With its Corten steel podium, brick facade, generous, light-filled spaces and integral public art work, this looks like a building that was commissioned long before 'austerity Britain' became a daily reality (and sure enough, it was started in 2006 and went on site in 2010).

However, BDP director of healthcare Andrew Smith says that the UK sector is beginning to improve. "Immediately following the new government coming in, in 2010, things slowed down in health and education," he says. "There are a number of schemes starting up again. There does seem to be more activity in the UK and Ireland right now for a number of different healthcare fields."

Gareth Hoskins Architects, with offices in Scotland and Berlin, is increasingly busy in the healthcare sector in Scotland and Northern Ireland where the practice, in conjunction with Keppie Design, is busy creating a new

The atrium in London's St Barthomolew's Hospital. Its redevelopment illustrates how estates managers are gaining a greater understanding of design and sustainability issues

OLV Robotic Surgery Institute: animal training lab, Merelbeke (Belgium) | VK services: architecture - structural engineering - building services - interior architecture

VK delivers fully integrated architecture and engineering services for demanding healthcare clients worldwide who want to invest in healing environments in a constantly evolving society where our quality of life is under stress. www.vkgroup.be

Want to help build tomorrow's world? Check out how you can realize your possibilities on **www.vkgroup.be/careers**.

ARCHITECTS & ENGINEERS

Loana Marinescu

Loana Marinescu

Akerman Community Health Centre, London, UK

The fourth community health centre designed by Henley Halebrown Rorrison, the Akerman's services include GP surgeries, dentistry, children's services, midwifery, primary care and community health. It also serves as a base for Lambeth Council's nursing teams. A very civilised and civic building, it responds sensitively to its users' needs and its particular urban surroundings. The 16m-deep floorplate creates east- and west-facing accommodation between which ancillary spaces such as toilets, storage rooms, stairs and lifts are located. Foyers, stairs and lifts are positioned to minimise the journey to each clinical cluster for staff and visitors. Two GP practices share the first floor and another two the second floor. A shared waiting space per floor sits directly opposite the central stair and lifts, and overlooks the nearby parkland. Staff accommodation is on the top floor, offering showers, small meeting rooms, a library/training space, staff room and roof terrace. High-quality artworks are integrated into the building's materials, including an external Corten steel frieze by Daniel Sturgis and murals in the hall and staircase by Paul Morrison.

Architects: Henley Halebrown Rorrison
Client: Lambeth Primary Care Trust with Building Better Health/ Fulcrum
Cost: £12.4m
Size: 5,186sqm
Completion: 2012
Contractor: Willmott Dixon
Structural engineers: Price & Myers
Services engineer: Cundall
Landscape architect/designer: Landscape Projects

CAPITA

Working with you to achieve better healthcare for all

Capita is at the heart of helping reshape the delivery of international healthcare.

We understand the impact of the built environment on health and recognise the need to support ever evolving models of healthcare delivery in the face of socio-economic change.

Our multi-disciplinary health planners employ specialist knowledge of planning and design, along with their extensive experience of managing health services and facilities, to help clients world-wide achieve improved public health.

For further information please contact:

Craig Dixon, Director

T: +44 (0)7753 916648

E: craig.dixon@capita.co.uk

www.capita.co.uk/consulting

BDP's design for Bispebjerg Hospital in Copenhagen uses the landscape to bring old and new together

wave of community health centres, continuing the region's pioneering, progressive and design-centred approach.

Strategic masterplanning

Across northern Europe, BDP has noted an increase in masterplanning of existing hospital sites so that facilities can be used more effectively, with additional interventions. "This makes it more interesting for the architects, while achieving greater efficiencies for hospitals. It's about responding to the pressures that they face," says Smith. There are several UK schemes on the cards, he adds, which demonstrate this welcome, more sustainable and long-term approach – including an enormous HOK-designed project uniting two of London's key hospitals, St Bartholomew's and the Royal London, to become Europe's largest teaching, research and care facility. This evolution, says Smith, reflects a greater understanding within healthcare estates of design and sustainability issues: "Maybe through the process of doing PFI hospitals with major redevelopments we have now got a number of project directors around the NHS who recognise the benefits of strategic development. The NHS project directors who have done several schemes all tend to learn and want to improve on what has gone before each time."

> **Our solution is to extend that landscape to create a park in the middle of the site that joins everything together and supports it**

BDP has also recently picked up some coveted healthcare work in Scandinavia, beating off stiff competition from Dutch, Danish and French firms to win Copenhagen's Bispebjerg Hospital masterplan. "It's a massive acute hospital, with a whole lot of psychiatric facilities, labs and logistics, and all on a site where you've got listed buildings [from 1913] and a landscape that is also listed," says Smith. "Our solution is to extend that landscape to create a park in the middle of the site that joins everything together and supports it. It separates the new buildings from the old ones so that they can live with each other. And we've brought the approach to the site through the groups of historic buildings so they won't be cut off from peoples' experience of the new hospital."

As an international practice with a proven track record in healthcare, looking for new opportunities, BDP

Ben Luxmoore

Finchley Memorial Hospital, London, UK

The Finchley Memorial Hospital replaces a 100-year-old facility with a sustainable, purpose-built, welcoming building integrated into a community health campus. Developed following extensive consultation with local residents, it sits within parkland that includes healing gardens for patients, a memorial garden for the community, plus playing fields – accessible by a nearby school – and a cafe. Extensive glazing brings natural light into the heart of the building. Double- and triple-height spaces facilitate clear sightlines throughout the hospital. The layout is based around generic modular clinical rooms and clusters to maximise flexibility and future-proofing. The building facade includes cladding with shades of green and blue to add an uplifting element, sympathetic to its landscaped setting. Colours are replicated internally as part of wayfinding and signage strategies.

Architects: Murphy Philipps Architects
Client: NHS Barnet/North London Estate Partnerships
Cost: £28m
Size: 9,500sqm
Completion: September 2012
Contractor: Galliford Try Partnerships

Ben Luxmoore

says Denmark, Sweden, Norway and Germany are the strongest, though they tend to be extremely well provided for by their own home-grown firms. One of Denmark's leading practices, Schmidt Hammer Lassen (SHL), tends to lead the field in Scandinavia, along with the aforementioned Henning Larsen. SHL recently won a restricted competition for the new €551.5m Aalborg University Hospital in Denmark, comprising a 330,000sqm masterplan with a 134,500sqm hospital and a faculty of health science of 17,000sqm, completing in 2020.

Germany also has a great reputation for excellent healthcare architecture, but it, too, is blessed with fine architects of its own and – more forbiddingly for international firms – its competition process is expensive (open competitions, usually bidding against at least 30 other practices). However, HOK has

CREATE STIMULATING, SAFE & SECURE HEALTHCARE ENVIRONMENTS FROM TRIED & TESTED FENESTRATION

britplas

MULTI AWARD-WINNING COMPANY FABRICATING WINDOWS, DOORS, CURTAIN WALLING & FENCING SYSTEMS

☎ +44 (0) 1925 824317 ✉ sales@britplas.com www.britplas.com

Denmark's Herlev Hospital was designed by Henning Larsen with outdoor spaces that aim to create a "symbiosis between the hospital and its surroundings"

just begun an unusual scheme in Germany, the Kaiserslautern Military Community Medical Center (see case study). The unusual configuration of its patient population, as well as the unique requirement to meet the highest standards of both German and US healthcare architecture (it is US government-funded), has led to a unique solution. The town of Kaiserslautern is home to 50,000 NATO and US military personnel and their families (including army and air force troops) and also treats troops wounded in action around Europe and the Middle East. The previous facility often had to move patients off campus for diagnostics, which delayed both assessment and treatment. With the design developed using the RCET methodology, patients can be admitted and assessed by the entire team and then dispatched within two days, either back to their assignment or to the US for specialist care. Virtual collaboration is also designed into the scheme for rapid evaluation and sign-off: every examination/treatment room is configured to call up test results and host teleconference calls with other specialists – albeit only where the patient's conditions facilitate such treatment.

Everyone is looking at having to produce better outcomes with fewer resources

HOK's practice director Chuck Siconolfi says: "There are clear benefits for both the military and the local community: high speed diagnosis and the right diagnosis. Imagine being a doctor and not having all the available information or being able to consult a colleague. The proximity and virtual connectivity these doctors and specialists have gives them that ability to have that conversation or collaboration to make it possible to make a quick and accurate judgment."

This solution has potential implications for future facilities. "All health systems are now under financial pressure," says Siconolfi. "Everyone is looking at having to produce better outcomes with fewer resources. The ability to have multidisciplinary collaboration, and have it up front in the initial assessment of the patient, is a very important tool in realising that result. Regardless of the system an individual facility may have, everyone shares this interest."

Veronica Simpson is an architectural writer and environmental psychologist

References

1. Economist Intelligence Unit. *The Future of Healthcare in Europe*. 2011.

Ngonyama Okpanum & Associates

ARCHITECTS | PROJECT MANAGERS | URBAN DESIGNERS | INTERIOR DESIGNERS | TOWN PLANNERS

Ngonyama Okpanum and Associates is dedicated to providing knowledge-based solutions to health care design.

Architecture has a strong behavioral influence on the community and society at large. Our approach to design is characterised by a focus on the interpretation of factors which impact on the built environment i.e. the social, architectural, spatial, philosophical, political and technological aspects of design; and their interpretation in the site- specific context.

Ngonyama Okpanum and Associates provides developmental, managerial and technical services in this respect, and within the context of human upliftment and the development of the built environment. Our architecture seeks to promote quality buildings with a strong recognition of the positive influence of architecture through the creation of pleasant therapeutic environments and well- designed spaces.

Member of: GREEN BUILDING COUNCIL...

JOHANNESBURG
T: + 27 11 463 9429
F: + 27 11 463 6835
sibo@noact.co.za
Unit I Block 2, 1st Floor
Coachmans Crossing
Office Park,
4 Brian Street, Lyme
Park, Bryanston, 2021

CAPE TOWN
T: + 27 21 418 9224
F: + 27 21 418 9229
info@noact.co.za
Unit 21 & 22
Foregate Square
Foreshore
Cape Town
8001

EAST LONDON
T: + 27 43 743 3888
F: + 27 43 743 3892
admin@noael.co.za
13 Lukin Road
Selborne
East London
5247

PORT ELIZABETH
T: + 27 41 582 2753
F: + 27 41 582 2869
mail@noharchitects.co.za
16 Clyde Street
Trafalgar Centre
Central
Port Elizabeth
6000

BLOEMFONTEIN
T: + 27 51 447 8338
F: + 27 51 4478339
sibo@noact.co.za
63, 65 & 67
Kelner Park
Suite 6 Kelner Street
Westdene
Bloemfontein, 9301

MMABATHO
T: + 27 18 384 1568
F: + 27 18 384 2788
sibo@noact.co.za
Office 204, Mega
City Shopping Centre
Cnr of Sekame &
Dr James Roads
Mmabatho, 2735

NELSPRUIT
T: + 27 13 755 3614
F: + 27 13 7553615
info@noact.co.za
Suite 407
The Medcen Building
14 Henshall Street
Nelspruit
1200

POLOKWANE
T: + 27 15 291 4987
F: + 27 15 291 5947
sibo@noact.co.za
Standard Bank
Building, 3rd Floor
Cnr of Landross Mare
& Thabo Mbeki streets
Plokwane, 0699

NIGERIA
Cell:+234 82 566 3650
T: +234 806 263 5401
info@noact.co.za
51 Lobito Crsecent
Wuse 11, Abuja
Nigeria
23409

Ngonyama Okpanum & Associates

ARCHITECTS PROJECT MANAGERS URBAN DESIGNERS INTERIOR DESIGNERS TOWN PLANNERS

Email: info@nosact.co.za Tel: 021 - 418 9224 Fax: 021 - 418 9229

CANCER RESEARCH FACILITY

PROJECT: MOTHER AND CHILD CANCER RESEARCH INSTITUTE
BAYELSA, NIGERIA

PRIVATE HEALTH CARE

PROJECT: BELLVILLE HOSPITAL
CAPE TOWN, SOUTH AFRICA

INTERNATIONAL AIRPORT

PROJECT: ABUJA INTERNATIONAL AIRPORT
ABUJA, NIGERIA

REGIONAL AIRPORT

PROJECT: ENUGU REGIONAL AIRPORT
ENUGU, NIGERIA

COMMUNITY LIBRARY AND CLINIC

PROJECT: ALBOW GARDENS
CAPE TOWN, SOUTH AFRICA
COMPLETED 2000

PRIMARY HEALTH CARE FACILITIES

PROJECT: OPOLLO HOSPITAL
BAYELSA, NIGERIA
COMPLETED 2009

TERTIARY HEALTH CARE FACILITIES

PROJECT: CHRIS HANI BARAGWANATH HOSPITAL
JOHANNESBURG, SOUTH AFRICA
COMPLETED 2009

PHILIP CHUN

IMAGE BY JOHN GOLLINGS

International Construction Consultancy Company Philip Chun is delighted to be associated with the Design and Health World Congress and Exhibition.

Our services include: Building Code Consultancy, Accessibility, Fire Engineering and Essential Services Auditing.

Projects:

- Royal North Shore Hospital (RNSH) - $1.127 Billion (Image Above)
- Victorian Comprehensive Cancer Centre (VCCC) Melbourne - $1.2 Billion
- New Perth Children's Hospital (NPCH), Perth - $1 Billion
- Austin & Mercy Hospital Redevelopment, Victoria - $356 Million
- ANU, John Curtin School of Medicine Research, Canberra - $200 Million

For more information contact: Tracey Burgess on +61 434 220 332 or marketing@philipchun.com

www.philipchun.com

BDP wins Hampshire cancer centre

Hampshire Hospitals NHS Foundation Trust has selected BPD from a shortlist of six to design its new cancer treatment centre in a north Hampshire location, due to be completed in 2016. According to the trust's clinical director for cancer services, Dr Lara Alloway, the facility will "improve the experience of living with cancer for our patients, their families and friends, and which reflects the excellent care we provide," adding that BDP "showed their experience and knowledge by not only considering the look of the outside of the building but carefully considered how the inside of the building will feel, making it a welcoming, reassuring and comforting space." BDP's proposal envisages a 'hospital without corridors', which will be filled with light and bring the outside inside; it will provide a vital service for cancer patients from the north of the county who may currently have to travel long distances for radiotherapy. The Ark Cancer Charity is currently raising a further £5m to fund support services for the facility, such as complementary therapies and counselling.

Sexual health clinic breaks taboos

London's Burrell Street sexual health clinic is architectural practice Urban Salon's first project for the NHS – the result of a competition to attract non-healthcare design specialists to the fold. Run by Guy's and St Thomas's NHS Trust, the facility is aimed at 16–24 year olds and aims to break down traditional taboos surrounding sexual health. It takes up two railway arches, its non-standard format neatly setting the tone for the studio's tongue-in-cheek design approach. Art is used to put patients at ease (such as the mobiles by Parisian artist Arnold Goron in reception), to distract (the ceiling art in each of the 16 rooms, by Allison Dring, is intended to be viewed from the treatment couch), and to assist wayfinding (Martin McGrath's outsized wall graphics). The furniture comes in bright colours and is distinctly non-institutional, such as Vitra's Eames chairs. A double-height reception space fills the front of the arches, with consultation, counselling and treatment rooms towards the rear.

Forum for health

Cambridge is set to receive a major new health complex in 2016. The Forum, a £120m mixed-use development located on the Cambridge Biomedical Campus (CBC), will include a postgraduate medical education centre with specialist surgical training facilities, a conference centre, a 200-bed hotel and a 75-bed private hospital. Nearby Addenbrooke's Hospital will oversee the training facility while Ramsay Health Care UK will operate the private hospital. CBC aims to be one of the leading biomedical centres in the world by 2020. The new development is strongly motivated by the need to create a central collaborative hub for Cambridge University Hospitals, where clinicians, researchers and academics can come together to share knowledge and expertise. NBBJ is designing the complex, with the practice's principal Jane McElroy describing it as "a landmark development on a human scale".

We know health facilities are complicated, but more effective if designed for success.

ARCHITECTURE
INTERIORS
URBAN DESIGN
PLANNING
LANDSCAPE

To appoint Hames Sharley for a healthcare project enables you to access our demonstrable experience in evaluating the operating cost implications of different designs of health facilities. Our team of health planners, health service planners and health facility planners ensures that your vision and model of care are successfully translated into the most cost efficient design based on world's best practice in Evidence Based Design and research.

For more information regarding how Hames Sharley can assist you with your next project contact Warren Kerr AM on w.kerr@hamessharley.com.au

www.hamessharley.com.au

ADELAIDE | BRISBANE | DARWIN | MELBOURNE | PERTH | SYDNEY

Hames Sharley

Oak Ward grows from office space

IBI Nightingale has demonstrated the importance of flexible, adaptive healthcare design with the conversion of existing offices into a high-specification ward for a specialist heart and chest hospital. The new 20-bed Oak Ward at the Liverpool Heart and Chest Hospital is a surgical cardiac ward consisting of 12 single bedrooms and two four-bed bays, giving patients spacious surroundings and superior facilities. The practice originally designed the hospital in 2008, and was drafted in again to help realise the expansion plans that had intentionally been built in first time around. "The proposed solution for the Oak Ward meant design and installation was quick as services were already accounted for," says project director John Knape. "Consequently we were able to focus on the quality of the patient environment, testing the single bedroom and en-suite ergonomics, aesthetics and buildability to ensure they fully supported the clinical services."

Cancer care for Ballarat

March saw the opening of the new Ballarat Regional Integrated Cancer Centre, designed by Billard Leece Partnership. The centre will serve a region of approximately 100,000 people in and west of Ballarat, in Victoria, Australia. The building includes facilities for care, therapy and treatment, as well as office, research and education spaces, community facilities and a Wellness Centre. The design combines old and new – reinvigorating the former Ballarat Base Hospital building and adding a new five-storey glass tower which flanks a central waiting/meeting atrium space. The atrium acts as a visible town square through which all activity passes. Using feedback from cancer survivors and their families on the need for privacy, a discreet entry location was created separate from the main hospital entry, while recliners in the day chemotherapy area were turned towards views rather than facing the staff station. The design incorporates elements drawn from the surrounding streetscape, including bluestone flooring and natural timbers, to help create a non-intimidating, spatially familiar, calming environment for patients and their families.

In the neighbourhood

Toronto has a new hospital with the opening in April of the 10-storey, 472-bed Bridgepoint Hospital, whose focus is on advancing the treatment, management and prevention of complex chronic disease and disability, and providing rehabilitation services.

The former 148-year-old Don Jail, transformed into the hospital's administration and education centre, sits at the centre of the site's nine-square grid of streets, which are organised into 'neighbourhoods of care', encouraging a feeling of community. The design by HDR Architecture and Diamond Schmitt Architects prioritises deinstitutionalisation, with spaces for socialising and direct access to the healing benefits of nature. Patients' rooms have wall-to-wall, low-silled, horizontal windows and each patient unit has a floor-to-ceiling glazed lounge with dramatic views for patients, family and visitors. The hospital also has communal dining and therapy spaces on every floor, as well as a therapeutic pool, sky garden and multiple terraces to encourage patient self-efficacy.

OLYMPUS

Your Vision, Our Future

Perfecting the Art of OR Integration

Introducing ENDOALPHA, the world's most advanced laparoscopic operating theatre, recently installed at John Flynn Private Hospital in Queensland, Australia.

When John Flynn Private Hospital had a vision of providing world-class working facilities for their clinicians, Olympus were able to make it a reality by delivering Australia's first fully integrated glass-modular operating room.

The new generation of ENDOALPHA OR's provide an unrivaled working environment by incorporating the latest in modular glass construction technology, with state-of-the-art digital integration for video management, communication and documentation, into one seamlessly integrated platform that inspires both medical staff and patients alike.

Increased efficiency, clinical value and inspired teams are key factors to any hospital's future success. With ENDOALPHA, this can become reality.

To find out more about ENDOALPHA, contact your local Olympus representative or follow the web links on the right.

olympus.com
endoalpha.com.au
olympus-europa.com
olympusamerica.com

twitter.com/endoalpha

endoalpha.tv

ENDOALPHA

Durable and hygienic

Altro Whiterock PVCu walling systems provide a durable, hygienic alternative to paint or tiles. The surface is seamless and watertight, preventing water getting into the substrate and causing structural damage. Because it does not require grout, it reduces the risk of contamination and its thermoformed pencil rounded corners, making it easy to clean and disinfect. "The smooth surface, fully sealed welded joints and thermoformed corners were all attractive features for the walling of our new theatres," comments Lorraine Munn, project manager at Brisbane's Queen Elizabeth II Jubilee Hospital. "The cladding provides the level of impact resistance a hospital needs to protect the walls from the barrage of beds an trolleys that constantly make contact with the walls." In addition to a standard range of colours, Altro Whiterock is also available in solid colours in a high-gloss finish, and a digitally printed option is available for bespoke designs.

www.asf.com.au

Safety first

Britplas has developed a bedroom door that helps to increase safety and security in mental health units. The SafeSee door allows staff to get an unrestricted view into a patient's room using a swipe card. The operation is silent, so it does not disturb the patient. The swipe card also provides staff with instant access in or out of the room. An electronic record is logged each time the swipe card is used, should a follow-up investigation be required. The door also has a programmable anti-ligature sensor that registers the weight of any ligature attached to the door. The trigger weight for the alarm (silent or audible) can be chosen by the design team and changed by staff at any time – for example if the profile of the user group changes. Any ligature incident is also instantly logged on the system. SafeSee software for doors is included and loaded onto the relevant computer(s) during installation.

www.britplas.com

Solid underfoot

The refurbishment of Dublin's Mater Misericordiae University Hospital included 35,000sqm of Tarkett flooring. Seven different types of Tarkett flooring were used in the project, which was overseen by Sisk Group – including Tarkett iQ Toro SC flooring, which was chosen for the 12 new operating theatres because of its static dissipative properties. The floor is made specifically for use in areas that need to remain free of static electricity. Tarkett's Linoleum Veneto xf and Etrusco xf were used in the corridors and ward bedrooms, while the non-slip Tarkett Safetred Universal was chosen for the toilets and sluice rooms, and Tarkett Granite Multisafe for the en-suite bathrooms and wetrooms. "Tarkett has a broad range of impressive products designed specifically with health and aged care in mind," says sales director John Devine. "The products come in a variety of colours and styles with enhanced performance characteristics."

www.tarkett.com

Informed Healthcare Design

medical architecture
strategy · design · evaluation

www.medicalarchitecture.com

Design & Health
International Academy for Design and Health

Design & Health Scientific Review
Ad Astra Per Aspera

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

The Latin phrase, "Through hardships to the stars" reflects the journey the field of environment-behavior (E-B) in healthcare design has traveled since its beginning in the 1960's: defining post-occupancy evaluation (POE) in ways that adequately captures both designers' intent and users' responses, demonstrating how triangulating multiple-methods augments the analytic power of each, formulating evidence-based guidelines that capture the essence of the research base yet do not restrict design creativity, describing design in terms of testable hypotheses instead of non-falsifiable tautological solutions.

The research-design articles in this issue demonstrate that we have arrived at an important plateau in this arduous journey and that we still have a way to go. The Bridgepoint Hospital POE represents multi-method research firmly located in a practical-academic researcher-designer collaboration aimed at better design, explicit policy, and defined user outcomes hypotheses. Such a project was only a glint in the eyes of those who started on the E-B journey nearly half a century ago. To prevent us from sliding off this new plateau, only one thing is necessary – to carry out the POE as planned, to carefully analyse the complex interacting data, to make the findings available in an easily accessed form, and to modify design practice on the basis of the evidence developed. All I can do is wish the team good luck.

Clare Cooper Marcus, one of those on this treacherous journey since its beginning, and Naomi Sachs have clawed their way onto the plateau with a plea that those who influence design of healing gardens through policy-making, certification and regulation base guidelines on well-established research linking access to nature with health outcomes. To firmly establish evidence-based research as the foundation for policy and regulation, all that is needed is to follow the dictum of this article – move evidence-based guidelines from the back shelf "should" to the front shelf "shall." All I can do is wish healing garden advocates good luck.

In Austin, Texas, the Mueller mixed use community serves as a natural setting for research – a planned community with explicit behavioral goals – both physical and social health. Mueller is made for walking rather than cars and research shows these goals are being achieved. True success will be seen in the way the community manages its mixed use and pedestrian emphasis into the future – using outcomes research carried out regularly as a tool for community management. All I can do is wish Mueller good luck.

The UK National Health Service (NHS) computer modeling of design approaches aimed at resolving the "conundrum" of reducing carbon emissions while keeping patients safe and comfortable, has made it to the plateau by careful attention to logic and causal reasoning linking desired outcomes to specific designs. The next step is clearly to refine these original guidelines by employing them in design and carefully evaluating their impact. All I can do is wish the NHS good luck.

We have arrived at a significant resting spot on our journey to the stars. It is up to us to use the calm of the moment to commit ourselves to taking the next crucial step – to act. All I can do is wish us all good luck.

Climate change:
Robust hospitals in a changing climate

The Climate Change Act aims to cut 80% of the UK's emissions by 2050 – a target it is hard to see being reached. A series of research projects, led by the University of Cambridge, explore how the NHS's new and existing estate can make a serious contribution

C. Alan Short MA (Cantab) DipArch RIBA, University of Cambridge, Kevin Lomas BSc (Hons) PhD, University of Loughborough; Alistair Fair BA (Hons) MA PhD, University of Cambridge; Catherine Noakes BEng (Hons) PhD, University of Leeds; Giridharan Renganathan BArch MUrDgn PhD AIA (SL), University of Kent; Sura Al-Maiyah BSc MSc PhD, Portsmouth School of Architecture

The UK's National Health Service (NHS) currently confronts a conundrum of global consequence: how can it deliver safe environments in a changing climate while at the same time dramatically reducing its carbon emissions? The UK Climate Impacts Programme predicts the increasing incidence of extreme heat events in England, particularly within large conurbations, where the impact of summer heatwaves is amplified by the 'urban heat island' effect. The UK heatwave of June/July 2006 is thought to have led to an increase in deaths over baseline mortality of 4%, and there were approximately 300 excess summer deaths after the 2009 heatwave between 30 June and 2 July.[1] In the aftermath of the 2006 heatwave the Department of Health concluded, regretfully: "During relatively mild heatwaves, excess death rates are significantly, but avoidably, higher in this country."[1] We have a particular research interest in the maintenance of thermally safe, comfortable environments in hospitals.

NHS environments accommodate 1.4 million employees, 5% of the UK workforce; they receive one million visitors every 36 hours.[2] The NHS generates 18% of the carbon emissions of the UK non-domestic stock, 25% of UK public sector emissions and 3% of total UK emissions[3] at an annual cost of almost £600m.[4] NHS carbon reduction targets are mandatory, but the NHS Sustainable Development Unit regularly tells us that the NHS is dramatically missing its targets. In 2013 the prognosis is exactly as it was in 2008; there has been little or no progress.[5] A strategy of installing more mechanical cooling in more NHS buildings might lower temperatures, but it will not deliver the energy savings – quite the reverse. The NHS estate is immense. Within England alone, it comprises 28m square metres; there are 330 acute hospital sites with a gross floor area of 18.83m square metres.[6] Our observations of the estate in England using aerial views reveals that some 70 sites still have significant numbers of pre-1939 buildings – which presents opportunities, as we shall see.

In a typical UK hospital, 44% of the energy used can be attributed to air and space heating.[7] NHS organisations have ambitious targets for delivered energy of 35–55GJ/100m^3 in new buildings and 55–65GJ/100m^3 when refurbishing existing facilities; this covers all building uses, including space heating, hot water, lights, appliances and catering.[8] However, the energy use of the majority of NHS trusts in England is significantly higher, being in the range of 44.8–98.0GJ/100m^3 for 2004/05, peaking at 125GJ/100m^3. It has been summarised in a film which may be streamed or downloaded at http://sms.cam.ac.uk/media/1446036.

New-build hospitals: implications

There is no viable strategy for resolving this dilemma at the time of writing. We believe it requires a fundamental reinvention of the hospital form, but neither the industry nor central government are resourced to conduct this scale of reinvention as they were in the 1950s and 1960s. In our research, very much ongoing, the hospital form is fundamentally reconsidered through work funded by the National Institute of Health Research (NIHR), 'Design strategy for low energy ventilation and cooling of health buildings' (project B(06)03).[9]

The current tendency to devise deep hospital plans, tessellating clinical departments, has been developed over perhaps 40–50 years. Deep plans are mechanically conditioned using strategies originally designed to maintain comfortable internal conditions artificially in fierce continental climates. One might question their appropriateness in a more temperate climate, especially one that might be warming. A recent hospital in London lauded for its excellent medical planning is 50 rooms deep between one window wall and the next at ground and first floor levels. However, our work suggests that a significant proportion of hospital spaces might be naturally ventilated: why impose the air conditioning needed only in a small part of the building onto the whole?

Figures 1 and 2 depict our proposed alternative. The Consulting/examination/treatment rooms are arranged around an external courtyard (7.2m x 21.6m) attenuated east to west, to offer predominantly south-facing elevations. The L-shaped accommodation to the north and east of the courtyards fits into a 'slipped' tartan grid of circulation routes, directly adjacent to the courtyard on the south and west sides. These circulation routes thus enliven what will inevitably be long corridors and aid navigability. The plan yields 'dark' locations for services, support rooms, and other largely unoccupied spaces. To the north of the rooms adjoining the courtyard lies a further range of rooms, facing the next courtyard to the north across a lateral circulation route.

Circulation routes are naturally ventilated directly from the courtyards. Rooms adjacent receive supply air ducted within a deep facade and exhaust back into further ducts within the facade. The facade depth shields the south-facing glazing from summertime solar gain. The inboard rooms receive supply air from the courtyard to the north across a lateral circulation route.

Supply air enters the rooms through an acoustically attenuated transfer duct. The exhausts are coupled together via a lateral high-level extract duct, connecting into exhaust stacks at regular intervals. As the tartan pattern builds, envisaged on three storeys, the 7.2m and 10.8m planning module develops 14.4m-deep floorplates on the north-section axis, 21.6m deep on the east-west axis. While North American hospital planning tends to develop a minimum of 35.0m-deep packets of floorplate, much contemporary UK hospital planning is achieved in 25m plan depth.

The cross-section (Figure 2) depicts supply air passing through a concrete labyrinth lined in anti-fungicidal surface treatment below the courtyard, feeding supply ducts within a double facade, delivering to three floors. Exhaust is provided by stacks spliced onto the supply ducts below, a simple 'edge-in/edge-out' strategy delivering pre-cooled (or pre-warmed) supply air. Across the courtyard, air is admitted in the circulation zone and across adjacent rooms, exhausting through a central duct, connecting, as described, to stacks. All the stacks indicated are provided with fan assistance, operated by flow sensors to prevent flow reversal.

We have developed a five-category coding system to denote the proposed environmental control strategy for each space. The principle is to employ the simplest, least energy-intensive strategy to deliver the airflow performance required by the Department of Health for each space:

Simple natural ventilation (SNV) all the time (opening windows): the ventilation of outdoor air directly into the space through occupant-controlled windows. The flow of air out of the space may be through the same window, other windows or via stacks. It is uncontrolled, except by the immediate occupant for the least sensitive spaces.

Advanced natural ventilation (ANV) with passive cooling: outdoor air is supplied via stacks fed from below-ground concrete plena providing passive cooling/warming depending upon the season. Air leaves the space via ventilation stacks. It is 'advanced' because of the possibility of optimised central control. Air flow rates are managed by Building Management System (BMS)-controlled dampers at the inlet and outlet locations to each space. It entails equipment to maintain and there are controls to master. Occupant override will compromise energy

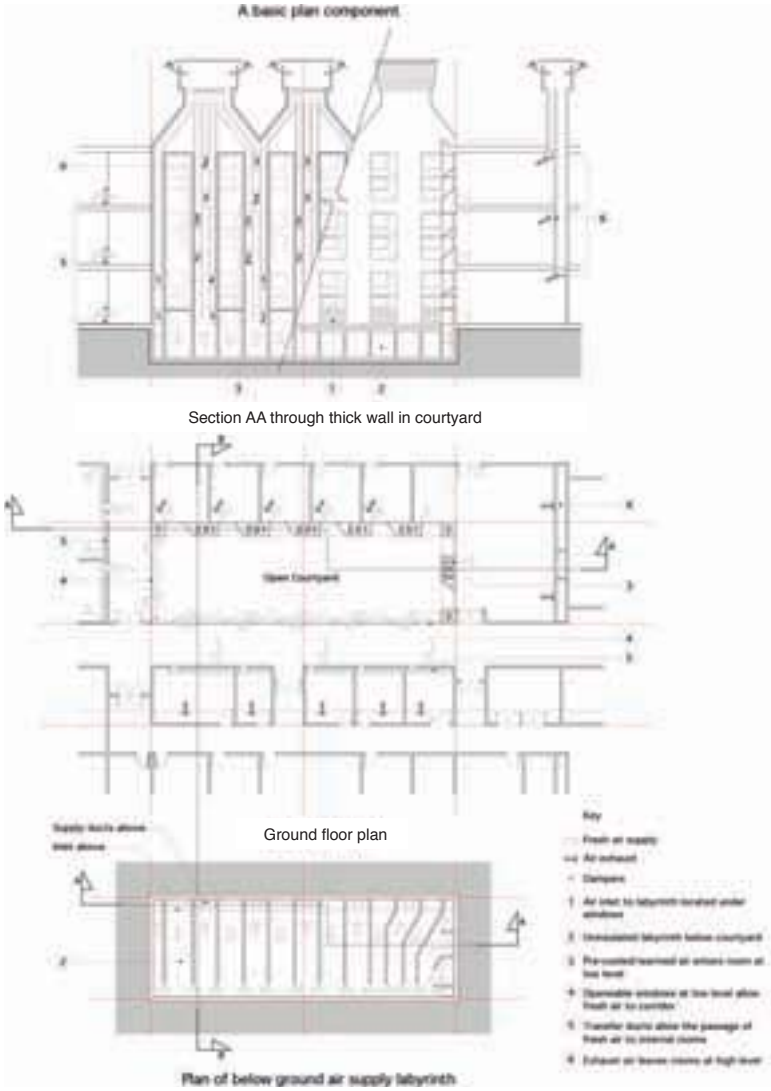


Figure 1: A proposed alternative to deep hospital plans with mechanical conditioning: clinical rooms are arranged around an east-west oriented courtyard

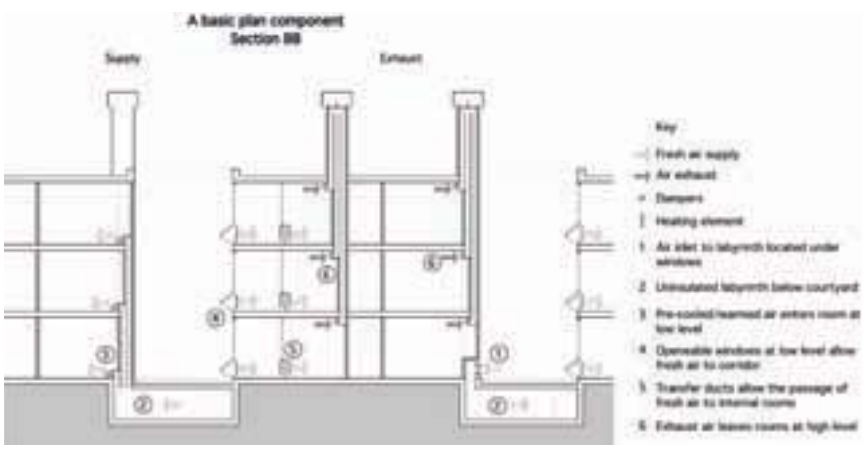


Figure 2: In the proposed new plan, supply air passes through a concrete labyrinth below the courtyard, feeding supply ducts within a double facade

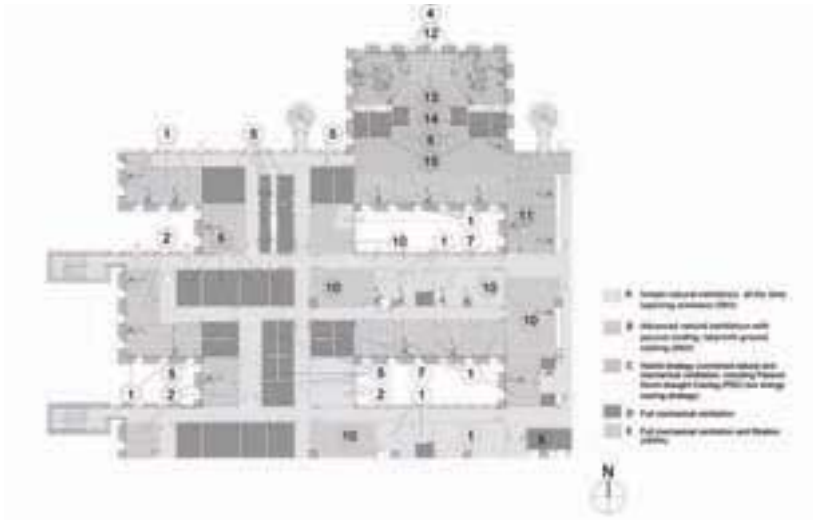


Figure 3: A representative quadrant of the notional hospital plan. The lighter the shading, the more 'natural' the environmental strategy

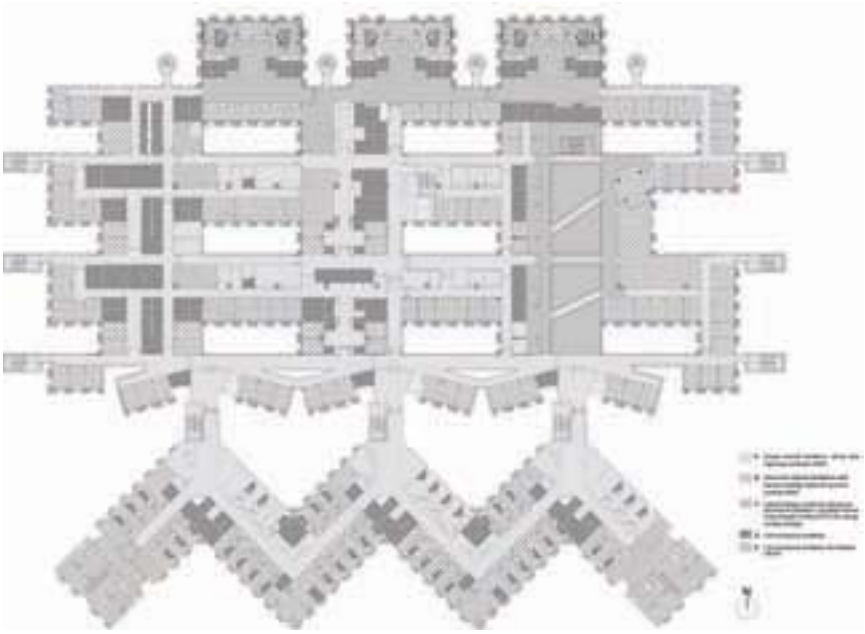


Figure 4: First-floor plan of the notional 35,000sqm acute hospital

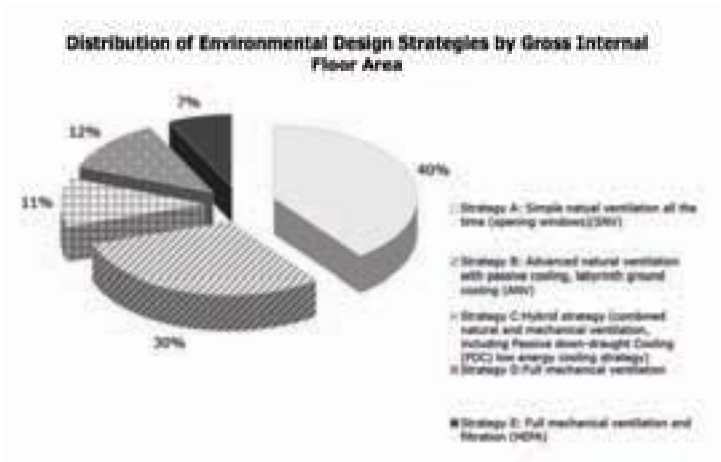


Figure 5: The relative proportions of the five broad environmental strategies. Some 70% of the total floor area is indicated as naturally ventilated

efficiency but may enhance 'wellbeing'.

Hybrid ventilation: combined natural and mechanical ventilation (including passive downdraught cooling (PDC)) and mixing ventilation strategies. This option adds robustness to an ANV system. The supply of outdoor air is made directly into the space via damper-controlled inlets. The flow of air out of the space is via exhaust stacks. During peak load (warm) conditions, fans are used to increase the ventilation cooling potential. PDC, encouraging air to fall through chilled water pipes at a high level, may also be used to provide additional cooling where and when necessary. Mixing ventilation, using exhaust flows to warm incoming supply air in winter, is also included in this category. Higher energy consumption is tempered by increasing the efficiency of fans. Sensors and controls are employed to detect down-draughting and flow reversals.

Full mechanical ventilation: The need for this option is when ANV and hybrid systems are unable to deliver required constant airflow rates. Air flow into and out of the space is driven by variable speed fans providing full control over ventilation rates, but no mechanical cooling. The system enables heat recovery via an air-handling unit (AHU).

Full air-conditioning and filtration: This provides reliable, very clean, temperature- and humidity-controlled environments. Air is supplied to and exhausted from spaces via high-efficiency particle arrestor (HEPA) filters, driven by a central (AHU) controlling temperature and humidity according to the requirements of each space. It is impossible to overcome filter resistances with naturally driven airflows.

A representative quadrant of the notional hospital plan was assembled (Figure 3). The lighter the shading on the plan, the more 'natural' the environmental strategy. Simulations were conducted on the northwest quadrant. It has a higher proportion of spaces requiring controlled mechanical ventilation and cooling than is the case for the rest of the design; the results gained may be pessimistic in the context of the whole hospital. The first-floor quadrant revolves around the operating theatres, recovery and support spaces. The theatres shown adopt a hybrid environmental strategy; we hope to develop this concept with colleagues at Imperial College. A pathology laboratory is included, the actual

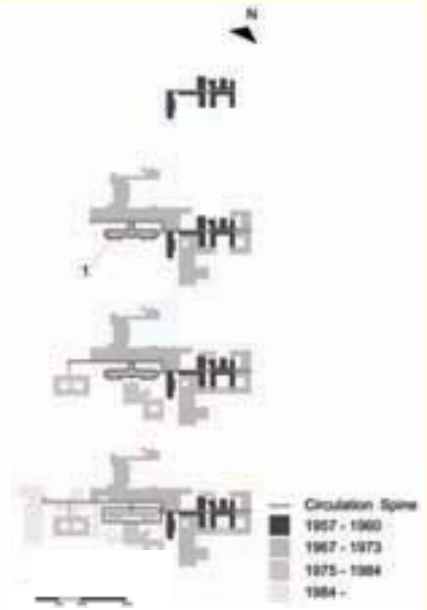


Figure 6: Addenbrooke's Hospital in Cambridge, with the 10-storey slab block marked

laboratories ventilated mechanically, of course, to UK Home Office standards.

The component plan elements were then developed into a full 35,000sqm, 180-bed, acute hospital. The first floor plan is shown as Figure 4. It indicates the tartan mat unrolled to accommodate the principal departments and ancillary functions of a small- to medium-sized acute hospital. As discussed, compact planning is favoured by clinicians and managers over shallow, linear planning because it offers a greater frequency of closer medical adjacencies. However, this theoretical deep plan will be liberally punctured to offer fresh air, using garden courtyards as daylit navigation landmarks. There is no need for the courtyards to be similar or for the plan to be orthogonal throughout, although extended west-facing elevations are avoided to mitigate solar gains. Again, the plan is coded to indicate the distribution of the five environmental strategies to cope with the present-day climate of southern England, which may become the future climate of the English Midlands, as the simulations indicate. The relative proportions of the five broad environmental strategies is indicated in Figure 5. Surprisingly perhaps, some 70% of the total floor area is indicated as naturally ventilated, simply or in a more contrived way.

The computer simulations predicted the following annual energy consumptions for the four climatic conditions considered:

- 2005 climate: 377kwh/m^2 or 38.0GJ/100 m^3
- 2020 climate: 379kwh/m^2 or 38.5GJ/100m^3
- 2050 climate: 370.2kwh/m^2 or 37.6GJ/100m^3
- 2080 climate: 361.7kwh/m^2 or 36.7GJ/100m^3.

These results suggest a near halving of typical achieved figures. As the study from which they are taken was calibrated against energy use predictions based on current hospital designs and construction, it is clear that significant energy savings can be achieved. However, the exercise reveals that delivering the lowest best target of 35GJ/100m^3 will be very demanding. Medical equipment heat loads will be required to be significantly reduced at source. There is little evidence that this is a procurement priority.

Could renewable energy technologies solve this conundrum, restricted to those technologies that do not burn fossil fuels on site? The base case prediction on 2005 data of 376.7kwh/m^2 yields a total energy consumption of 467,485kwh. Even a 10% contribution (46,749kwh) requires a total of 234 wind turbines with a 3.2m blade diameter, rated at 1.5kw and assuming an average wind speed of 2m/s. This is infeasible in development control terms alone. Environmentally responsive design is much more effective.

The potential of refurbishment

Funded by the Department of Health and the Engineering and Physical Sciences Research Council, the next stage of our work was entitled 'Design & delivery of robust hospital environments in a changing climate' (De^{2}RHECC, grant reference EP/G061327/1). The research asked whether the same concepts could be applied to the existing acute estate to increase resilience. By increasing resilience, would energy consumption rise? Would effective adaptation be prohibitively expensive?

How can one possibly comment on a distributed estate this size? Although vast, the NHS estate comprises a recognisable number of repeating 'type' building forms/plans of different eras. The first type comprises pre-1939 buildings, typically with 'Nightingale' wards arranged as finger-like pavilions. Subsequent 1950s/early 1960s 'Nuffield'-type ward buildings may be high or low rise, of heavyweight or lightweight construction. A tower of Nuffield-type wards can be combined with a lower podium as the so-called 'matchbox on muffin' type. 1970s and 1980s hospitals are, in many cases, lower rise buildings punctured by courtyards; over 100 such schemes were built using the Department of Health's 'Nucleus' template planning system. Very few existing buildings on the NHS estate were designed to be air-conditioned. Many are poorly insulated and often over-glazed, leading to increased risk of summertime overheating, even in relatively recently completed buildings.[10]

We selected one or more of each type from four partner NHS trust campuses. Here we report on two particularly revealing investigations exploring the potential to achieve the Department of Health's target of 55–65GJ/100m^3 for exemplary refurbishments.

Addenbrooke's Hospital ward tower is in Cambridge, in the east of England. It was built between 1967 and 1972 comprising a 10-storey slab block (Figure 6).[11-13] An initial survey of NHS hospital sites by the authors identified at least 50 buildings of this basic type. The tower is 120m long on its southwest/northeast axis and variously 14.1m and 18.3m deep. All floors have the same overall geometry, a long central corridor to which, on the south side, multi-bed wards (10.2m deep from corridor to window wall) occupy the wider end parts of the building. Private rooms and offices

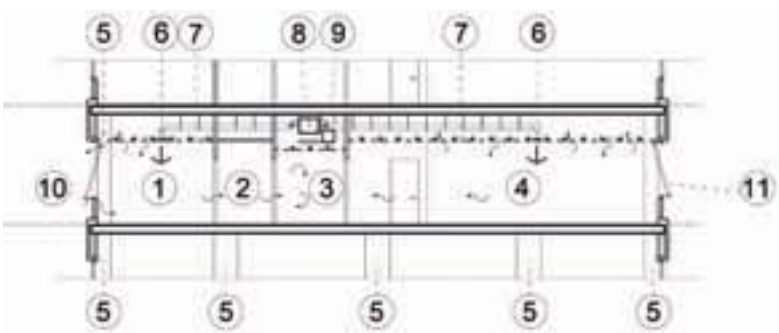


Figure 7: Cross-section through a typical floor in Addenbrooke's Hospital ward tower

	Predicted			HTM 03-01:	CIBSE:	BS EN 15251:	
	Max. temp. (°C)	Min. temp. (°C)	Mean night time[1] temp. (°C)	Total hours[2] over 28°C	Night time[3] hours over 26°C	Total hours over Cat I Upper limit[4]	Total hours over Cat II Upper limit
Existing	28.6	21.3	24.0	16	21	789	300
1. SMVHC: Sealed building, mechanical ventilation with heating and cooling	27.3	21.5	23.1	0	1	na	na
2. SMVRHC: Sealed building, mechanical ventilation but radiant ceiling heating and cooling	25.2	21.6	22.8	0	0	na	na
3. NVMVPH: Natural ventilation, mechanical ventilation, perimeter heating	25.7	20.9	21.5	0	0	0	0
4. CVPH: Natural cross-ventilation, perimeter heating	26.8	20.4	21.6	0	1	0	0
5. SVPH: Natural stack ventilation, perimeter heating	25.6	21.0	21.8	0	0	0	0

1 Night-time hours are 21:00 to 06:00.
2 Simulated hours are for May to September (153 days, 3,672 hours).
3 The grey shows where limiting criteria are exceeded.
4 The HTM 03-01 threshold is based on air temperature and rest are based on dry resultant temperature.
5 It is assumed that during the winter half of the year (October to April), the space will not overheat due to elevated ambient temperatures and solar gains. The limiting overheating values are therefore: HTM 03-01, >50hrs over 28°C; BS EN 15251, >438 hours above category upper thresholds; and CIBSE, >37 night time hours (1%) over 26°C).

Table 1: Predicted dry-resultant temperatures in the refurbished wards during May to September: 2010 Cambridge weather

face north. The occupied levels have a structural floor-to-ceiling height of 3.66m with, as designed, a 0.90m void above the suspended ceiling. Figure 7 shows a cross-section through a typical floor, showing the relative proportions of the single- and multi-bed spaces and also the relative height of the wards.

The windows run as a continuous ribbon at all levels on both facades, a facade-glazing ratio of 57%, incorporating opaque panels. Precast concrete panels form the spandrels. The original fenestration comprised large centre-pivot windows, offering prodigious opening area if required, but these windows were replaced with double glazing in the 1990s, which are restricted to 100mm opening, radically disrupting the natural ventilation opportunities. The continuous glazing here was intended to maximise views. Sun shading was planned, but omitted during construction. The priority was to achieve adequate winter heating (the 1962–63 winter had been brutal). Air was mechanically supplied from a central plant room into the central corridors. There is no organised exhaust except in bathrooms and utility rooms. Patent radiant ceilings, still in operation, helped to heat wards to 18.3°C (65°F) when the external temperature was -1°C (30°F).

Two floors were monitored by the research team. The building emerges as pretty resilient. Level 8 ward temperatures varied between 21.4°C and 28.5°C. Forty-five per cent of the hours during a mid-summer measurement period (1 July–15 August 2010), had internal temperatures over 25°C, which for healthy people is seen as the value above which thermal dissatisfaction will occur, with 28°C being the upper limit of thermal comfort acceptance. There were 38 night-time hours (taken as 21:00 to 06:00) above 26°C (ie 8% of the total). The nurses' stations mid-plan were consistently warmer. Temperatures were arrested by the very high air leakage from the building's construction, while the windows were observed to be continuously open, so that energy consumption is close to the maximum recorded in the NHS, more than 100GJ/100m^3.

Five refurbishment options were devised by the team, ranging from the industry-standard PassivHaus-type approach (sealing the building within a heavily insulated jacket, with very efficient heat recovery) of Option 1 to hybrid Options 2 and 3, and more innovative passive schemes 4 and 5. Each is described in turn in what follows.

Option 1: sealed building, mechanical ventilation with heating and cooling (SMVHC). This depicted in Figure 8. The external envelope is overclad to substantially improve air-tightness and U-values. The relatively recent thermal-break aluminium double glazing is retained to save cost. The ventilation system operates at 6 AC/h, as required by the Department of Health's document Health Technical Memorandum (HTM) 03-01. Windows are sealed and a third layer of glazing added internally. The glazing is shielded by new interstitial blinds. Resilience to overheating is provided by increased mechanical ventilation with mechanical cooling for peak lopping when required. Modelling showed few summertime hours above the thresholds given in HTM 03-01 or those suggested by the Chartered Institution of Building Services Engineers (CIBSE): see Table 1. The annual predicted energy demands and emissions were 59GJ/100m^3, so within the DH target, and 137kgCO_2/m^2 respectively (Figures 9 and 10). These figures exclude delivered energy, which would add to this figure. Relatively little energy was used for cooling but the ventilation energy demand to deliver the high airflows was significant.

Option 2: sealed mechanically ventilated environment, radiant ceilings active in winter (heating) and summer (cold water for cooling) and heat recovery (SMVRHC). This option exploits the radiant action of the ceilings both in heating and cooling mode, thermally upgrades the envelope

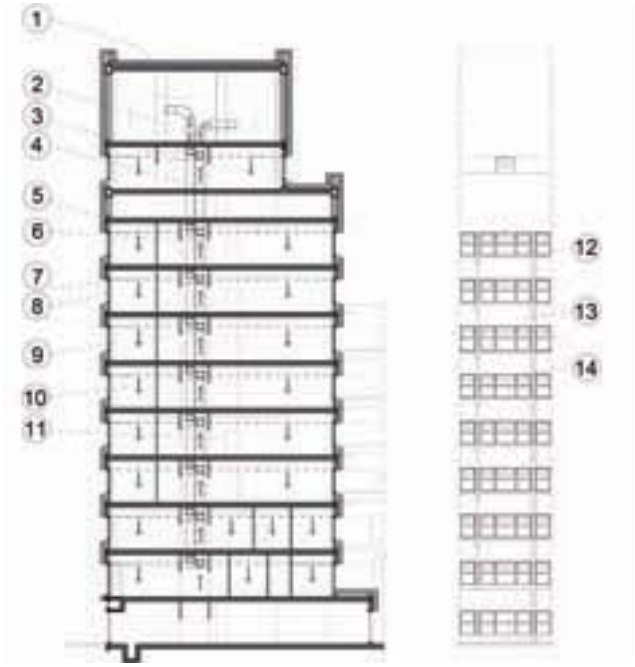
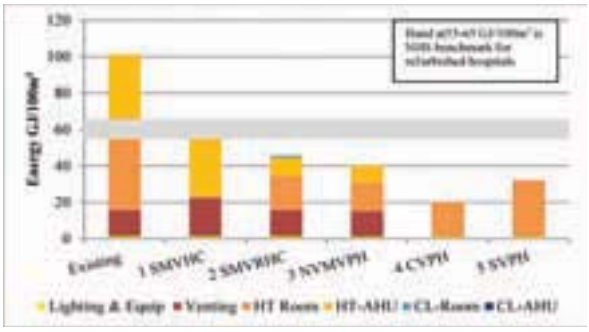


Figure 8: Refurbishment option 1: sealed building, mechanical ventilation with heating and cooling



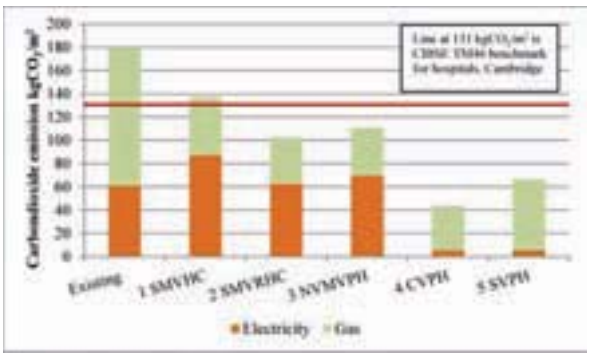


Figure 9: Annual predicted energy demand for the five refurbishment options
Figure 10: Annual predicted energy emissions for the five refurbishment options

as Option 1, and retains the double glazing but adds solar shading. The mechanical supply delivers the fresh air requirement only so that it is below 6 AC/h and heat recovery is provided. The original radiant ceiling installation is refurbished to provide additional radiant heating. The simulations indicated an insignificant number of summertime hours above each of the HTM 03-01 and CIBSE thresholds (Table 1). The annual predicted energy demands and emissions were 46GJ/100m^3 and 102kgCO_2/m^2 respectively (Figures 9 and 10). This represents a further improvement.

Option 3: natural ventilation and concurrent mechanical ventilation supply, heat recovery, opening windows and perimeter heating (NVMVPH). This hybrid option adopts a similar thermal upgrading of the envelope, retaining the current double glazing. All of the glazing can be opened by the occupants in peak summer periods, an important contribution to the overheating defence strategy of this option. In addition, the suspended ceilings are cut back as far as the supply ductwork allows, in order to expose the thermal mass of the concrete soffits. It performs well. There were no predicted summertime hours above the CIBSE or HTM 03-01 thresholds, or indeed the recent adaptive comfort British Standard, BS EN 15251, which allows for occupants to become accustomed to raised temperatures over a period of time (Table 1). The annual predicted energy demands and emissions were 40GJ/100m^3 and 111kgCO_2/m^2 respectively (Figures 9 and 10), with ventilation energy (to deliver 4 AC/h) being about 40% of the whole.

Option 4: natural cross-ventilation, perimeter heating (CVPH). This option (Figure 11) dispenses with the mechanical ventilation system altogether. It enables cross-ventilation by threading crossover ducts in alternating directions across the width of the floorplate and upgrades the external envelope to the standard of Options 2 and 3. Perimeter heating is provided with actuated trickle vents below fully operable occupant-controlled windows, adapting the existing installation. Effective night ventilation will be important. All suspended ceilings are removed to expose the full flat concrete soffit above all patients so that vigorous night ventilation will cool the soffits. In this entirely naturally driven scheme there were no predicted summertime hours above each of the thresholds (Table 1) and the annual predicted energy demands and emissions were just 20GJ/100m^3 and 44kgCO_2/m^2 respectively (Figures 9 and 10), the omission of fans being the key to such low energy demand.

Option 5: natural stack ventilation with perimeter heating (SVPH). This option (Figure 12) adds external exhaust stacks to develop more reliable air flows as required. A potential difficulty is the effectiveness of stub stacks on the windward face in which the flows may reverse with a reversing flow

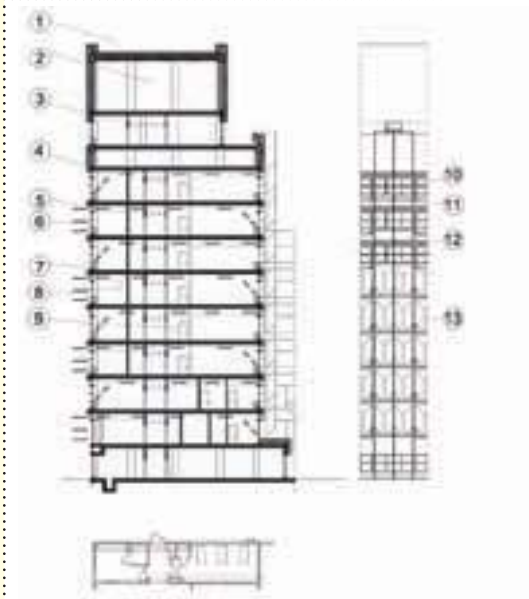


Figure 11: Refurbishment option 4: natural cross-ventilation, perimeter heating (CVPH)

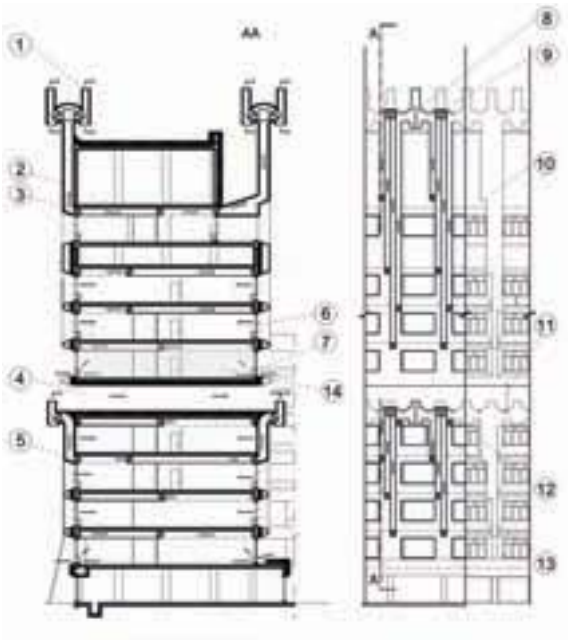


Figure 12: Refurbishment option 5: natural stack ventilation with perimeter heating (SVPH)

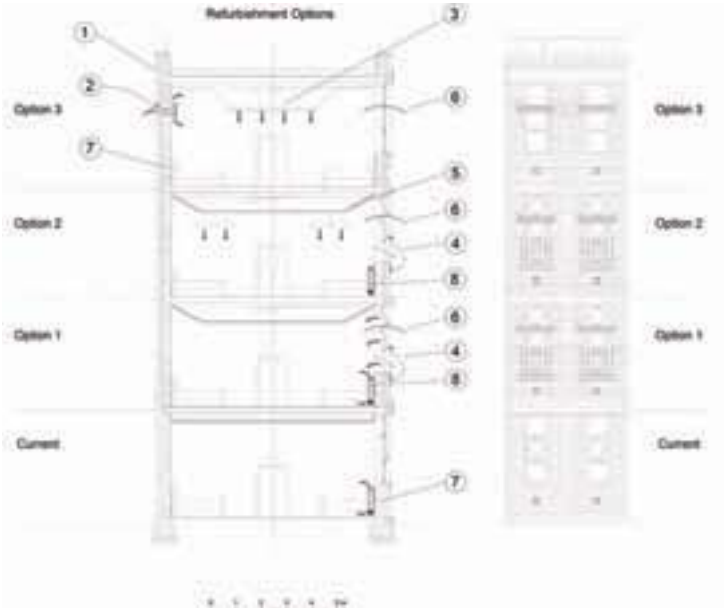


Figure 13: Three refurbishment options for Nightingale-type wards

regime set up on each floor. In a hospital where the avoidance of the risk of airborne infection spread is clearly important, reversing flow regimes are unacceptable. This option removes the envelope of a floor at mid-height to provide a free air environment in which the stacks to the lower four floors can terminate. The stacks are strictly dedicated to one space per cell, as the part elevation/section reveals. The occupation of the elevation by deep stacks reduces the glazed area beneficially and the depth also shades the glazing through the critical summer overheating period. All windows are rendered operable and the cross-ducts of Option 4 are introduced below a fully exposed flat concrete soffit. The intention would be to vigorously night-ventilate within the comfort parameters of sleeping patients and patrolling medical staff.

All five schemes dramatically improve performance, but these predictions do not include energy use for matters unconnected with space conditioning (small power, medical equipment, restaurants etc), which can be 44% of the total. Given this, it is likely that only Options 2 to 5 could plausibly meet the NHS energy target and CO_2 emissions benchmark of 55–65GJ/100m^3. Importantly this excludes Option 1, which has a mechanical supply of 6 AC/h as stated in HTM 03-01.

Predictions of future performance used Test Resultant Year (TRY) and Design Summer Year (DSY) data for 2030, 2050 and 2080 supplied by the Prometheus project at Exeter University using the UKCP09 Weather Generator assuming the benign A1B scenario, which is now less credible due to the unexpectedly rapid rise in atmospheric carbon concentration. The existing building will 'go off the rails' by the 2030s. Table 2 shows that that Options 1 and 2 can eliminate overheating hours, but in the case of Option 1 this is done at a prodigious energy cost. Radiant cooling is much more effective. In extreme years, the hybrid Option 3 can maintain comfort to 2050 but clinical spaces are in difficulties by 2080. In standard TRY years, the natural ventilation Options 4 and 5 are remarkably robust but in extreme years performed well, as judged by the BS EN 15251 adaptive comfort method, in the 2030s but by the 2050s performance is unacceptable in Cat I spaces, the clinical spaces for the vulnerable, and by the 2080s also in Cat II spaces for less vulnerable patients.

In these extreme years, the number of hours internal temperatures exceeded 28ªC was greater than exceeded externally, suggesting that passive night-time cooling will be less effective in future extreme years. The answer, then, is a naturally ventilated option with the capacity to install cooling in the future.

The UK's pre-1939 stock

A parallel De²RHECC investigation suggests the masonry-built 'Nightingale' ward type is exceptionally resilient and has the potential to contribute to the solution of the conundrum if fundamentally reconfigured to deliver NHS modernisation policy goals.[14] In the early 2000s, the NHS was directed to abandon the traditional collective healthcare model of an open shared ward and adopt the single room model hitherto reserved for the very unwell and the privately insured. Pre-1948 wards built to Florence Nightingale's original, very detailed specifications were condemned by the British government.[15] Nightingale wards in Britain comprised open dormitories for, on average, 24–30 patients.

The De²RHECC research team has measured and modelled the Nightingale wards at Bradford Royal Infirmary since 2009. These are four-storey ward buildings, a little narrower than the typical Nightingale ward, but in all other respects they conform to the type. The original Nightingale glazing configuration offered prodigious free areas for cross-ventilation, quadruple-banked hopper windows alternately top- and

Refurbishment option	TRY							DSY						
	Max. temp. (°C)	Min. temp. (°C)	Mean night-time[1] temp. (°C)	Total hours[2] over 28°C	Night time[1] hours over 26°C	Total hours above Cat I upper limit	Total hours above Cat II upper limit	Max. temp. (°C)	Min. temp. (°C)	Mean night-time[1] temp. (°C)	Total hours[2] over 28°C	Night-time[1] hours over 26°C	Total hours above Cat I upper limit	Total hours above Cat II upper limit
2005														
Existing	28.6	21.3	24.2	10	10	1,041	399	30.1	21.3	24.3	115	60	1,198	497
1. SMVHC	27.2	21.8	23.2	0	5	na	na	28.8	21.9	23.5	13	78	na	na
2. SMVRHC	24.9	21.6	23.0	0	0	na	na	25.8	21.6	23.0	0	0	na	na
3. NVMVPH	24.9	20.8	21.4	0	0	0	0	27.8	20.7	21.7	0	30	0	0
4. CVPH	24.9	19.7	21.5	0	0	0	0	28.2	20.0	21.7	5	17	16	2
5. SVPH	24.9	20.8	21.7	0	0	0	0	27.6	22.3	22.0	0	20	0	0
2030														
Existing	30.6	21.6	24.3	93	59	859	395	33.0	21.2	24.7	383	231	711	341
1. SMVHC	28.3	22.0	23.7	0	36	na	na	29.2	22.4	24.4	14	210	na	na
2. SMVRHC	26.1	21.8	23.1	0	0	na	na	27.1	22.2	23.5	0	5	na	na
3. NVMVPH	27.2	20.8	22.1	0	6	4	0	30.4	20.9	23.4	98	185	58	18
4. CVPH	28.2	20.3	22.3	3	32	21	3	32.3	20.6	23.4	199	208	166	70
5. SVPH	26.7	21.0	22.3	0	13	0	0	30.1	20.9	23.3	102	141	60	22
2050														
Existing	31.0	21.2	24.3	163	87	866	351	34.8	21.8	25.2	620	388	938	445
1. SMVHC	28.6	22.0	24.0	0	64	na	na	29.5	22.5	24.9	59	396	na	na
2. SMVRHC	26.2	21.9	23.2	0	0	na	na	27.8	22.3	23.8	2	23	na	na
3. NVMVPH	27.3	20.9	22.4	0	11	2	0	31.9	21.0	24.4	395	451	240	72
4. CVPH	28.9	20.3	22.5	18	41	22	4	33.9	20.8	24.5	582	435	462	203
5. SVPH	27.9	20.9	22.5	2	12	4	0	31.6	21.2	24.5	491	416	345	117
2080														
Existing	31.7	20.7	24.5	232	152	806	396	36.5	20.9	26.0	1035	609	1132	645
1. SMVHC	28.6	22.3	24.2	0	151	na	na	29.7	22.6	25.5	145	610	na	na
2. SMVRHC	26.5	22.1	23.4	0	1	na	na	28.4	22.3	24.2	20	84	na	na
3. NVMVPH	28.1	21.0	23.0	15	110	23	0	33.8	21.0	25.8	990	654	693	324
4. CVPH	29.7	23.3	23.0	96	136	136	46	35.7	20.8	25.9	1060	638	870	577
5. SVPH	28.3	21.1	23.0	11	87	10	0	34.1	21.3	25.7	1014	636	758	418

1 Night-time hours are 21:00 to 06:00.
2 Simulated hours are for May to September (153 days, 3,672 hours).
3 The HTM 03-01 threshold is based on air temperature and rest are based on dry resultant temperature
4 The grey shows where limiting criteria are exceeded.
6 The darker grey indicates where the exceedence is deemed important in that it could not be easily corrected by refining the control strategy.
7 It is assumed that during the winter half of the year (October to April), the space will not overheat due to elevated ambient temperatures and solar gains. The limiting overheating values are therefore: HTM 03-01, >50hrs over 28°C; BS EN 15251, >438 hours above category upper thresholds and CIBSE, >37 night-time hours (1%) over 26°C).
8 The ambient temperature exceeds 28°C in the current and future TRYs/DSYs by 2/44, 37/219, 62/341 and 126/566 hours in 2005, 2030, 2050 and 2080 respectively.

Table 2: Summary of predicted internal air and dry resultant temperatures for May to September: future Cambridge climate

bottom-hung. Internal temperatures in two full wards were recorded using calibrated data-loggers. During the monitoring period (1 June–11 August 2010), the ambient temperature reached a maximum of just 24.1°C. In mid-June, external night-time lows of just over 5°C were recorded. Across all eight measuring points in the first ward measured, the temperature only varied from 20.1°C to 27.4°C with a mean of 23.7°C. The mean night-time temperature was 23.2°C and the maximum diurnal swing recorded was just 5.2°C. The temperatures in a second ward were similar.

Overall, the temperatures in all the spaces were well controlled and well within the wide range recommended for wards by HTM 03-01 of 18–28°C. The predicted energy demand in 2010 was 14GJ/100m^3 with over 90% of this being for space heating. Assuming national norms

Transforming the future of healthcare

"The best way to predict the future is to invent it."

Alan Kay, computer scientist

Right now, we have a very real opportunity to influence and transform the future of healthcare. Arup believes future affordable healthcare systems and the associated delivery infrastructure is one of the most pressing issues we face globally in the 21st century.

Our consultants help our clients respond to the complex challenges of healthcare across all stages of delivery. We take a sustainable approach to the delivery of resilient healthcare that is fit for purpose now and into the future.

We shape a better world | www.arup.com

ARUP

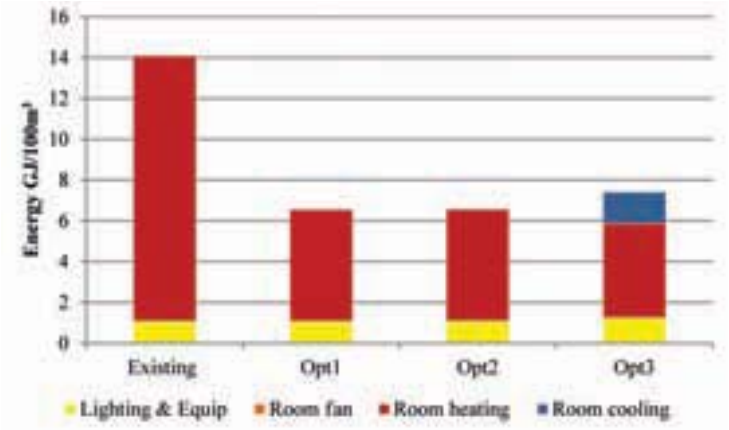


Figure 14: The 2010 predicted annual energy consumption for Bradford Royal Infirmary's Nightingale-type wards, and the three suggested refurbishment options

for the adjusted energy demand of about 25GJ/100m^3 is significantly below the NHS target of 55–65GJ/100m^3 for refurbished buildings and significantly below the target of 35–55GJ/100m^3 for new buildings. In other words, it delivers the NHS carbon reduction target. Concerning CO_2 emissions, the predicted value for energy use to sustain the clinical function is about 30kgCO_2/m^2, which would uplift the total to about 53kgCO_2/m^2, just below the best Department of Health target. It is this level of provision that the target implies.

Three incremental refurbishment options were devised for the Nightingale wards (Figure 13). The first adds 100mm of insulation to the walls and 300mm to the roof; opens up the triple-light windows and protects occupants with an architectural external steel grillage; and provides a sunshade at each opening. Fresh air supply in winter is provided by the reopening of a trickle vent behind a perimeter heating element. The second option adds ceiling fans operable by the patients to this strategy, while the third option introduces 100mm-diameter high-level air inlets above each bed space, between each window, with a damper, and a simple convective heating device fixed to the internal face to enable supply air to be pre-heated and/or recirculation within the space. Primary heating and cooling is delivered through the installation of radiant panels. The addition of radiant cooling eliminates entirely the risk of overheating. The further adaptation work reported here takes the second option as the base treatment of the envelope.

For each option, the annual energy demands and CO_2 emissions were predicted (Figure 14). For the first option the space heating demand dropped from about 13GJ/100m^3 to an extremely low value of about 5GJ/100m^3; lighting and small power gains remained unchanged. The CO_2 emissions were about 15kgCO_2/m^2. Clearly the added insulation has an impact. There were just 196 hours above the BS EN 15251 Cat I upper threshold, which represents about 5.3% of the total for the summer period (May to September) modelled. Assuming that the heating system is appropriately controlled during the wintertime so there is no overheating, then over a year there will be just 2% of hours over the Cat I envelope, which is well within a suggested BS EN 15251 limit of 5%. The refurbishment reduces the impact of higher ambient temperatures and solar gain, resulting in a reduction in the peak temperatures. This effect may well yield benefits as the climate warms (see below). Full removal of the suspended ceiling might result in greater benefits still.

The second option's slow fans are set at 0.3m/s air speed, well inside the allowable upper limit of 0.8m/s, to give an operative temperature depression of 1.2°C, at an assumed fan power of 70 watt per fan. The fans resulted in very little change to the occurrence of elevated summertime temperatures, there being about 5.2% of summertime hours above the Cat I upper threshold. Neither was there much difference in the energy demand and CO_2 emissions. This is because the predicted internal temperature rarely exceeded 26[a]C, the temperature at which the fans were set to switch on.

Internal temperatures were predicted

Refurbishment Option	Test Resultant Year: Max. temp. (°C)	Test Resultant Year: Min. temp. (°C)	Test Resultant Year: Mean night time* temp. (°C)	Design Summer Year: Max. temp. (°C)	Design Summer Year: Min. temp. (°C)	Design Summer Year: Mean night time* temp. (°C)
2005						
Existing	33.2	21.7	22.8	29.1	21.7	22.7
Opt-1	31.2	21.9	23.0	27.8	21.9	23.0
Opt-2	30.0	21.9	23.0	26.8	21.9	23.0
Opt-3	28.3	21.2	22.6	26.8	21.8	22.7
2030						
Existing	30.6	21.8	23.3	32.5	21.8	23.9
Opt-1	28.4	22.0	23.2	30.5	22.0	23.4
Opt-2	27.2	22.0	23.2	29.3	22.0	23.4
Opt-3	27.1	21.8	22.7	27.8	21.3	22.7
2050						
Existing	30.7	21.8	23.5	33.0	21.8	24.8
Opt-1	28.8	22.0	23.2	30.2	22.1	23.7
Opt-2	27.7	22.0	23.2	29.0	22.1	23.7
Opt-3	28.0	20.9	22.7	27.8	21.2	22.8
2080						
Existing	30.8	21.7	23.8	36.1	21.9	25.4
Opt-1	28.5	22.0	23.3	33.8	22.2	24.2
Opt-2	27.3	22.0	23.3	32.6	22.2	24.1
Opt-3	27.1	20.9	22.8	29.7	21.3	23.1

Table 3: Predicted internal operative temperatures in the Bradford Nightingale wards for May to September 2005, 2030, 2050 and 2080

for current and future typical and extreme temperature years as represented by TRYs and DSYs for current and future conditions, developed for Bradford by the University of Exeter using the customary CIBSE methods, as for the Addenbrooke's exercise. Simulations were undertaken with all eight weather years for 2010, 2030, 2050 and 2080. Predictions of the likely air and operative temperatures were compared with the CIBSE, HTM 03-01 and BS EN 15251 overheating criteria (Table 3) as appropriate. The results clearly indicate that neither the existing or refurbished building will overheat in typical years, as judged by the HTM 03-01 and BS EN 15251 criteria. However, in the 2050s warmer night-time temperatures may be experienced (although these might be ameliorated easily with a refined window-opening regimen if the windows are openable to a useful degree in sufficient numbers). In the extreme temperature years (ie the DSYs), however, HTM 03-01 shows overheating will occur in the existing building and in

WORLD HEALTH DESIGN

ARCHITECTURE | CULTURE | TECHNOLOGY

Reporting globally on developments in healthcare s built environment, WORLD HEALTH DESIGN is the only journal to bridge the gap between research and practice. Uniting opinion in architecture, design and clinical disciplines, each quarterly issue provides essential knowledge and insight for:

- Leading architects and designers
- National and local government officials
- Health planners and capital project consultants
- Public and private healthcare providers
- Senior estates and facilities managers
- Building construction and healthcare industries
- Universities and academic researchers

Save £40 off the cover price when you subscribe

The one magazine that I can t wait to get as soon as it is available!

Kurt Wege, Architect, Canada

Absolutely fabulous! The articles are all of high substance, the projects are interesting and well-designed, the art direction and layout is superb and there are lots of colour photos.

Jain Malkin, Jain Malkin Co, USA

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

Craig Dixon, Tribal Consulting, UK

WHD is the missing platform for all who share the same vision for healthcare design.

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

Design & Health
International Academy for Design and Health
8 Weir Wynd, Billericay, Essex CM12 9QG

Four times a year there s nothing like WORLD HEALTH DESIGN with..

- The latest scientific research
- Incisive comment and analysis
- Thought leadership interviews
- Health policy briefings
- Architectural project reviews
- International market reports
- Global technology updates
- Arts and culture reviews

Don t miss out!

SUBSCRIBE TODAY and SAVE £40 off the cover price!

12 month subscription □UST £80.00
(single copy price: £30.00 per issue)

Subscribe online at
www.worldhealthdesign.com
or call: +44 (0) 1277 634176

Subscription rates: Cover price: £30; Annual Individual: £80; Annual Team (5 copies): £260; Two Years Individual: £130; Two Years Team (5 copies): £435

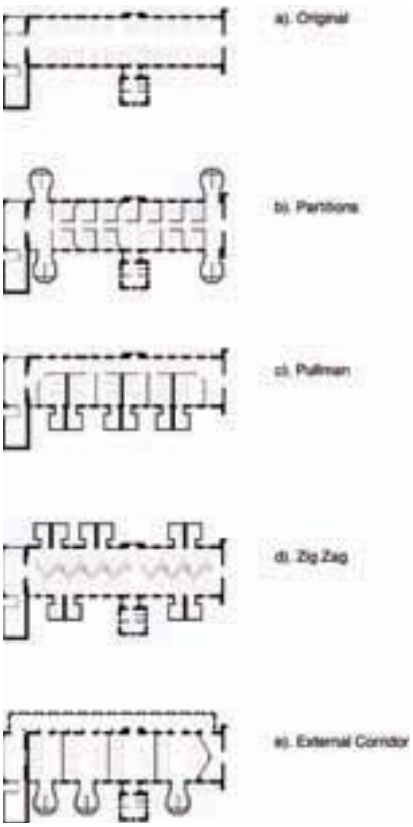


Figure 15: Various options for reconfiguring a Nightingale-type ward's internal layout

refurbishment Option 1 as early as the 2030s. Options 2 and 3 are resilient.

The highly resilient Option 2 was then taken as the basis for exploring reconfiguration possibilities with staff at the Bradford Royal Infirmary. The aim was to couple this resilient envelope with an internal layout better suited to privacy, though evidence from the hospital suggests the value of open wards for geriatric patients. Figure 15 shows:

a) The original Nightingale layout

b) Partitions: Subdivided into one-bed cubicles, the full 16 feet in height, with the addition of external bathroom towers

c) Pullman: An arrangement like a compartmentalised railway carriage, with the incorporation of an internal corridor and subdivision into six two-bed rooms served by split bathroom towers

d) Zig-zag: Preserves the full open volume but configures the beds either side of a wardrobe-high central partition set out to a zig-zag plan, offering visual if not acoustic privacy with five external bathroom towers

e) External corridor: The recovery of more usable floorspace by adding an external corridor to each floor, enabling ward rooms of three to five beds.

The options were modelled to assess airborne infection implications by our colleagues at Leeds. They perform well, and the results will be published in early 2014. The British government Cabinet Office is enthusiastic about the zig-zag arrangement, almost a kind of aeroplane 'business class', rethought for NHS patients.

Conclusion

In addition to the projects reported here, other types of hospital building have been modelled. They include an early 1970s medium-rise maternity wing, a low-rise 1980s maternity hospital, and a Nucleus hospital (which is highly resilient because of its recurring courtyards, but is dramatically impaired if courtyards are infilled). Work on modular buildings suggests they merit concern: being fundamentally lightweight, they have inherently low resilience.

All the schemes have been costed in detail. The new-build scheme is costed at £5,360/m^2 by AECOM Davis Langdon. This figure can be compared, perhaps harshly, with capital costs for notional best upper and lower target hospitals at £5,060/m^2, but these targets are not achieved at this scale in reality. However, in payback terms, the new-build option comes into its own in the 2030s as 'business-as-usual' hospitals suffer radical air-conditioning refits. The Addenbrooke's refurbishment schemes costed between £1,000 and £1,300/m^2. The Nightingale adaptation schemes are very similar, ie within current NHS refurbishment norms. The new director of the Department of Health Estates and Facilities Policy believes the optimal adaptation schemes could be rolled into the annual backlog maintenance operation across the NHS. These are grounds for optimism and action.

Authors

C Alan Short MA (Cantab) DipArch RIBA is professor of architecture at the University of Cambridge and a fellow of Clare Hall, Cambridge; Kevin Lomas BSc (Hons) PhD is professor of building simulation at the University of Loughborough; Alistair Fair BA (Hons) MA PhD is a research associate in the Department of Architecture at the University of Cambridge; Catherine Noakes BEng (Hons) PhD is reader in infection control engineering at the University of Leeds; Giridharan Renganathan BArch MUrDgn PhD AIA (SL) is lecturer in architecture at the University of Kent; Sura Al-Maiyah BSc MSc PhD is senior lecturer at the Portsmouth School of Architecture.

References

1. National Health Service. *Heatwave Plan for England: Protecting health and reducing harm from extreme heat and heatwaves*. 2011 [Accessed 11 June 2013]. Available from: www.nhs.uk/Livewell/Summerhealth/Documents/dh_HeatwavePlan2011.pdf

2. National Health Service. *NHS Workforce, Summary of staff in the NHS: Results from the September 2012 census*. 2013 [Accessed 14 May 2013]. Available from: www.hscic.gov.uk/catalogue/PUB10392

3. National Health Service Sustainable Development Unit. *Saving Carbon, Improving Health*. London: NHS; 2008.

4. National Health Service. *Improving Energy Efficiency in the NHS: Applications for capital funding 2012-13*. London: Department of Health; 2012.

5. NHS Sustainable Development Unit. *Sustainable Development Strategy for the Health, Public Health and Social Care System*. Consultation document. 2013.

6. National Health Service Information Centre. *Hospital Estates and Facilities Statistics*. 2010. [Accessed 14 May 2013]. Available from: www.hefs.ic.nhs.uk

7. Department of Health. *Health Technical Memorandum 07-02: EnCO2de: Making energy work in healthcare*. London: The Stationery Office; 2006.

8. Department of Health. *Health Technical Memorandum 07-07: Sustainable health and social care buildings*. London: The Stationery Office; 2009.

9. This section summarises Short CA, Al-Maiyah S. Design strategy for low-energy ventilation and cooling of hospitals. *Build Res Inf* 2009; 37(3): 264-92.

10. Hall C. Babies swelter in 90ºF at new hospital. *The Telegraph*; 21 June 2006 [Accessed 14 May 2013]. Available from: www.telegraph.co.uk/news/1524435/Babies-swelter-in-90F-at-new-hospital.html

11. The work on Addenbrooke's Hospital is reported in Short CA, Lomas KJ, Giridharan R, Fair AJ. Building resilience to overheating into 1960s UK hospital buildings within the Constraint of the National Carbon Reduction Target: Adaptive strategies. *Building and Environment* 2012; 55:73-95.

12. Animations of the models can be found in our film: Cook P (dir). *Robust Hospitals in a Changing Climate*. Cambridge: Screenspace Productions; 2013 [Accessed 14 May 2013]. Available from: http://sms.cam.ac.uk/media/1446036

13. Details of the monitoring strategy may be found in Lomas KJ, Giridharan R. Thermal comfort standards: Measured internal temperatures and thermal resilience to climate change of free-running buildings: A case study of hospital wards. *Building and Environment* 2012; 55:57-72.

14. The Bradford work is reported fully in Lomas KJ, Giridharan R, Short CA, Fair AJ. Resilience of 'Nightingale' hospital wards in a changing climate. *Build Serv Eng Res & Tech* 2012; 33/1:81-103.

15. Nightingale F. *Notes on Hospitals: Being two papers read before the National Association for the Promotion of Social Science with evidence given to the Royal Commissioners on the State of the Army in 1857*. London: John Parker and Son; 1859.

Healthcare facility design, psychosocial wellbeing and health: **A scientific approach to assess impact**

The opening of a continuing care and rehabilitation facility in Toronto offers an opportunity to undertake a systematic post-occupancy evaluation project – one that focuses on the interplay of mental, social and physical health rather than operational outcomes

Celeste Alvaro, PhD, Bridgepoint Collaboratory for Research and Innovation and Ryerson University, and Cheryl Atkinson, BArch, MRAIC, OAA, Ryerson University

Bridgepoint Hospital is a new 404-bed complex continuing care and rehabilitation facility with the largest cohort of complex continuing care and complex rehabilitation patients in east Toronto, Canada. Patients at Bridgepoint Hospital have multi-morbidity (many health issues), often accompanied by psychological and social issues that affect health outcomes and quality of life.[1,2] The new hospital – designed by Stantec Architecture/KPMB Architects (planning, design and compliance architects) in joint venture, and HDR Architecture/Diamond Schmitt Architects (design, build, finance and maintain architects) – was purposefully designed to address the needs of this patient population.[1]

In 1860, a 100-bed house of refuge was opened on the site. Over the ensuing years, various new and repurposed facilities evolved to address healthcare challenges of the time, including a smallpox hospital, an isolation hospital, a regional centre for polio and a provincial centre for complex continuing care for people living with HIV/AIDS.[3] The new hospital replaces a deteriorating (both in form and function), architecturally distinct half-round facility that was built in 1963 to meet the growing need to support people with long-term illnesses. Care provided in this facility had shifted from long-term care to complex continuing care and rehabilitation and it was branded as Bridgepoint Health in 2002. The new Bridgepoint Hospital, opened in 2013, has been branded as Bridgepoint Active Healthcare.

This research examines the impact of architectural design on psychosocial wellbeing (ie psychological wellbeing as a function of interactions with the social environment) and health in the context of the Bridgepoint Hospital redevelopment. This unique opportunity for a naturalistic quasi-experiment allows for the comparison of consistent patient, staff, and organisational performance outcomes based on design elements of the new facility design against their counterparts in the old facility, with a constant comparator. Three buildings are at the focus of this research: the in-situ historic building (occupied until April 2013), the new build (occupancy effective April 2013), and a complex continuing care and rehabilitation facility with similar patients, slated to undergo redevelopment in the coming years.

Bridgepoint Active Healthcare

Figure 1: Stantec and KPMB's Bridgepoint Hospital in Toronto, subject of a post-occupancy evaluation

Background and rationale

Worldwide, chronic disease (eg long-term progressive illnesses such as diabetes, heart disease, osteoporosis, or neurological diseases that require ongoing management for which there is no cure) is considered to be one of the most pressing health issues of the 21st century.[1,2] Public health advances together with an ageing population have contributed to an increased prevalence and burden of chronic disease,[4] resulting in an expanding crisis within the healthcare system. While some individuals with chronic disease manage with minimal health intervention, growing proportions of individuals are complex and require ongoing care. Individuals with complex chronic disease (CCD) have frequent or lengthy stays in the hospital[5] and face considerable challenges in adapting to changes stemming from their illness.[6-8]

Over and above the physical health conditions, individuals with CCD experience considerable psychological distress resulting from the erosion of their self-concept as they adjust their role from that of a healthy individual with a normal life to that of a patient with a debilitating disease requiring long-term to permanent medical care.[9] With the acceleration of population ageing over the next three decades,[10] the complex continuing care and rehabilitation patient population will be the norm rather than a niche patient population.

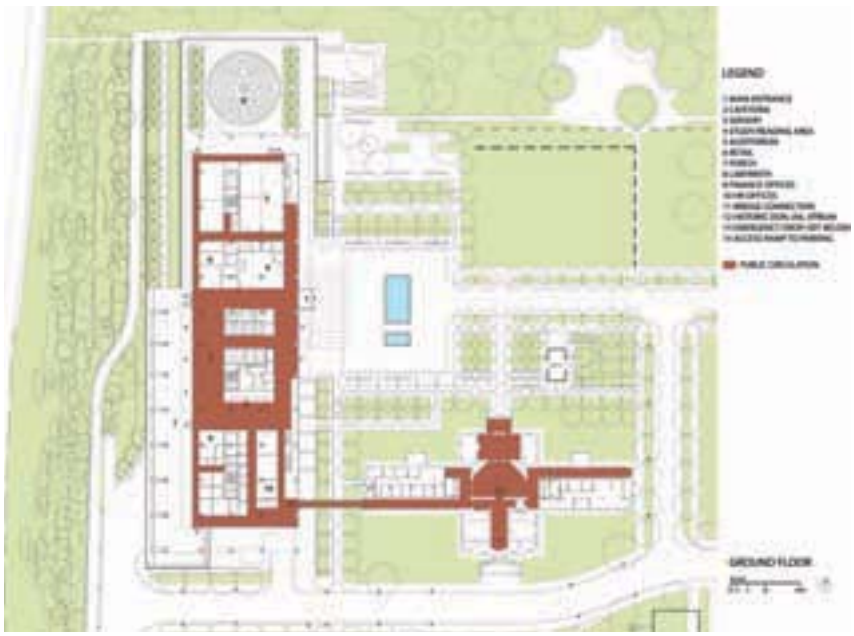
The chronic disease crisis is global,[2]

and as care needs shift from acute to chronic disease management, the ability to accommodate the current and future cohorts of patients with the current infrastructure is diminishing.[11,12] Knowledge of design that leads to a high-performance healthcare facility for the patient of the future is limited. The shift in care needs, coupled with the projected growth of capital investments in healthcare facility redevelopment presents an opportunity to develop new architectural paradigms to optimise health outcomes for this emerging patient demographic. As evidence shows that psychosocial support and adaptation can influence health outcomes,[13] psychosocially supportive or salutogenic design (ie design to promote positive psychological and social wellbeing)[14] is increasingly relevant in the planning, design, and construction of healthcare facilities for this patient population.

Post-occupancy evaluation (POE) is the systematic evaluation of newly constructed buildings after they have been occupied for at least one year.[15,16] POE of hospital buildings emerged in the 1990s to assess the effects of healthcare environments on safety, efficiency, and clinical outcomes[17] with limited focus on outcomes related to psychosocial wellbeing.[17-19] Despite the acknowledgement of POE as standard practice,[20] and the burgeoning literature on evidence-based design, there are very few industry standards, guidelines or established methodologies for conducting POEs of healthcare facilities.[21-23] Among the published research, there is variable methodological rigour and limited comparability of measurement and outcomes across POEs.

Moreover, POEs often lack a true pre-test comparison, which is commonly attributed to the construction or redevelopment of a facility to serve a different purpose than the original facility.

To date, relatively few research studies have compared pre- and post- construction facilities to assess the impact of design elements on health outcomes, thereby limiting the ability to attribute causality of outcomes to differences in architectural design. In addition to these shortfalls, POEs are often conducted by architectural firms and/or healthcare organisations with a vested interest in identifying successful outcomes associated with the design and investment rather than an independent research team to ground the evaluation in science. [20]



Stantec Architecture/ KPMB Architects and Don Collins, Spacecraft

Figure 2: Plan of Bridgepoint Hospital showing programme layout

Design intentions for Bridgepoint

With an awareness of the evidence on salutogenic design[14] and the therapeutic benefits of nature,[19,24] the architects sought to "enhance quality of prolonged life"[25] and "restore courage and lift spirits" through the "power of good design".[26] The central design intentions were to create an environment of wellness by enhancing the connection to community, nature and the urban environment, providing opportunities for social interaction and inspiring physical activity and health. According to the architects, "the project is as much about city-building and engagement with the community as it is about creating an architecture of wellness".[25]

These intentions are evident in the design through specific elements described below.

Communal and social spaces: A greater quantity and variety of lounge, retail, and public spaces are provided in the new hospital. They are typically positioned off circulation hubs to facilitate impromptu encounter and exchange and offer destination points to encourage patient mobility. 'Stacked neighbourhoods of care'[25] reminiscent of a vertical city are designed with a variety of material characters, locations, orientations and views to enhance desirability for activity. Examples of these design elements include:

- communal and dining spaces located on each floor off the elevator lobby
- public spaces at grade with amenities (eg auditorium, library, pharmacy, coffee shop, urban porch[25] connected to the public park and street access
- outdoor south facing terrace, café and 'sky lounge' on the top (10th) floor with distant views to the lake and city
- cybercafé located on the 5th floor (mid-building).

Physical and visual connection: Expansive glazing and passages from both rooms and corridors connect the patients to both the adjacent community and park both visually and physically. Its connection to the adjacent community is balanced with a conscious and constant connection to the park to derive "therapeutic benefits of nature".[25] Examples of these design elements include:

- use of glazing configured to draw patients to near and distant views of the lake, city, park and community
- main internal corridors and elevators terminate in views, exits and entrances to the exterior
- programming at grade encourages community interaction.

Therapeutic, respite and contemplative spaces: More and varied spaces that allow for rehabilitative and restorative therapy, quiet contemplation and respite were incorporated to foster calm and reduce anxiety. The new hospital includes an increased amount of

private space for patients and quiet indoor and outdoor lounge spaces. The generous spatial dimensions of rooms and corridors eliminate clutter and the sense of congestion and noise of the original building. Examples of these design elements include:

- single and double rooms, replacing four beds per room
- quiet contemplative gardens at various levels
- clear wayfinding and circulation corridors
- natural materials and colours (eg wood ceilings)
- lounges and therapeutic spaces with views to nature and the city
- outdoor labyrinth.

A rigorous approach to POE

The design intentions of the new hospital informed the theoretical basis for development of methods and measures for the POE. The overarching goal was to select outcomes that could be attributed, directly or indirectly, to the building design with consideration of the factors that might moderate the effect of design on psychosocial and health outcomes. As outlined in Figure 4, our approach to POE can be summarised according to five steps: collaborative research team development, review of sources to establish performance domains, selection of performance domains, development of the research design and methods, and consideration of research outputs. Each component is described below.

1. Collaborative research team development: This research represents a unique interdisciplinary, intersectoral collaboration consisting of academic researchers, high-level government decision makers, principal architects in the field of healthcare facility design and healthcare directors. The full research team of nine core members has contributed to the development of the research questions and the consideration of outcomes to be assessed across methods in the research. All stakeholders have a vested interest in the development of consistent methods and measures to assess the impact of healthcare facility design on health, particularly as related to this facility. In contrast to POEs conducted by architects or hospital personnel,[20] this collaboration was initiated by an independent research team with specialised theoretical and methodological expertise. This 'one step removed' aspect of the research has fostered the engagement of architects, stakeholders in executive/management roles at hospitals and their clients (patients) in the common goal of advancing research in the evaluation of healthcare facility design. Ongoing monthly meetings with opportunities for consultation and contribution fostered the active engagement of the architects and healthcare leaders and scientists throughout all phases of the research. This POE serves as a demonstration project for POEs across the province through the active engagement and participation of a senior architect within government.

2. Sources of performance domains: Sources used to identify the healthcare facility performance domains and resulting methods that are being used in the study are described below. The steps were:

Document review and validation of design intentions: A review of redevelopment documents (eg the building programme, architectural design intent, building budget, models of care, blueprints, meeting minutes, briefing notes and user group summaries) provided context for the logic and decisions related to the building design. A stakeholder focus group consisting of architects, hospital administrators and redevelopment officers involved in various stages of the design process was convened to validate the design intent. The architects' direct input in translating the design intentions, the design features, and hypothesised outcomes, together with the hospital administrators' input on the relevance and importance of particular outcomes, enabled the development of methodological and measurement tools unique to the POE.

Literature review: The impact of the built environment on psychological, social, and physical health has been widely documented[14,19,27-33] and is fundamental to the study and practice of architecture.[17,18,34] A literature review and synthesis was conducted to identify design elements that contribute to psychosocial wellbeing and health more generally, and to develop measures of relevance to the salutogenic design of the new Bridgepoint Hospital.

Patient needs assessment: Chronic conditions are affected by several factors including physical health,[35] personal characteristics and socio-demographics,[4] mental health[36] as well as health and social experiences.[4,37] These dimensions formed the basis of an extensive patient needs assessment conducted at Bridgepoint Hospital prior to moving to the new facility. An emergent theme in the assessment results was the patients' perceptions of how the building design (eg access to daylight and views, fresh air, social spaces, wheelchair mobility, wayfinding and privacy) influenced their experience, rehabilitation, and associated health outcomes.[6-8]

Feasibility: Using the evidence generated from the document review and validation, the literature review, and the patient needs assessment, the team selected measures

Stantec Architecture/KPMB Architects and Don Collins, Spacecraft

Figure 3: View from the lobby to the civic plaza and entry corridor

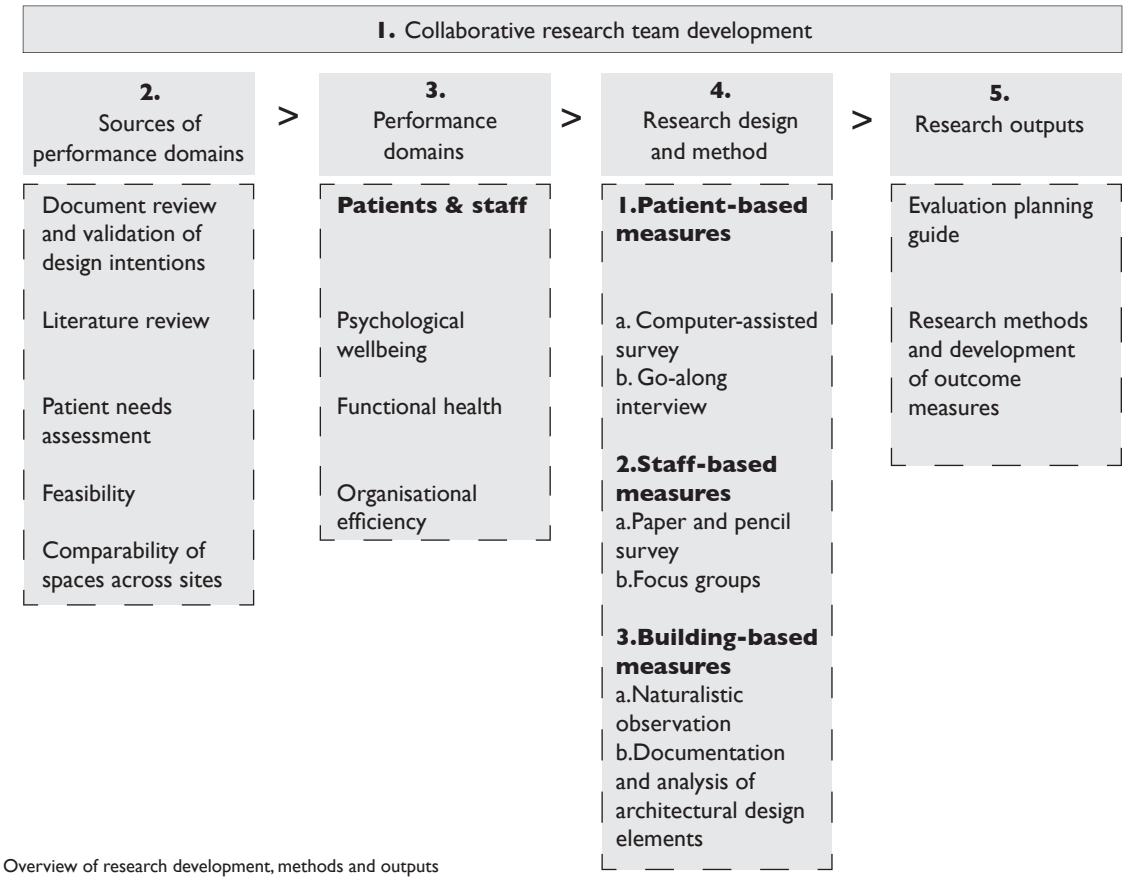


Figure 4: Overview of research development, methods and outputs

on the basis of: (a) measures that are most directly relevant to the design intentions of the new facility, (b) measures for which there was a basis for comparison between the existing facility and new facility, and (c) measures that are readily available and of high quality within hospital databases.

Comparability of spaces across sites: Spaces were selected on which there was a basis for comparison and/or contrast across the existing (old) new and comparison facility.

3. Performance domains: The performance domains and associated measures were selected to be consistent with the design intentions for the new Bridgepoint Hospital, to make a novel contribution to the evidence-based design literature, and to be relevant to complex continuing care and rehabilitation. Three performance domains were selected: Psychosocial wellbeing (eg depression, social connectedness, sense of community, motivation, mood, stress reduction and coping), functional health (eg pain, mobility), and organisational efficiency (eg falls, infections, medical errors) across patients and staff.

4. Research design and methods: Overall, this research is based on a pre-post test quasi-experimental design with a comparison group[38] to compare patient, staff and organisational outcomes across the earlier facility, the new facility and a comparison facility. This research design enables evaluation of interventions when randomisation is not possible, enhances the ability to infer causality between an intervention and an outcome, and enables the comparison across facilities over time.

Several quantitative and qualitative methods were embedded within the overall pre-test, post-test quasi-experimental design. Methods were selected on the basis of the research questions to be addressed, the construct to be assessed and the desired conclusions to be made. Whereas quantitative methods allow for the attribution of causality and enable generalisation, qualitative methods allow for the contextualisation and documentation of the lived experience. The selected methods enable the assessment of both anticipated and unanticipated uses and consequences of the building design.[39,40]

The pre-test sample includes patients, staff, and the buildings at the earlier Bridgepoint Hospital and the similar comparison facility West Park Healthcare Centre (August 2012–February 2013). The post-test sample includes both patients and staff. Pre- and post-test groups are matched at the data analysis phase on the basis of medical conditions (patients), complexity of illness (patients), employment type (staff) and socio-demographic variables (eg socio-economic status, age, cultural background) of patients and staff. In addition to utilising standardised measures, other measures were uniquely created for this research to ensure relevance to the context and study objectives. The research protocol has been reviewed and approved by the Joint Research Ethics Board (JREB) of Bridgepoint Health/West Park Healthcare Centre/Toronto Central Community Care Access Centre/Toronto Grace Health Centre.

There were three patient-based research methods. First, computer-assisted survey examined the experience of the building design, psychosocial wellbeing and perceived health of patients. Data was collected via an interview format created using the Empirisoft Media Lab software platform, allowing for presentation of images, randomisation of question order,

HDR and Diamond Schmitt Architects

Figure 5: Therapeutic spaces with views to nature and the city

visual response options and direct entry of responses on the computer.[41] Measures included the experience of the building, its setting and designated spaces; sense of belonging;[42] perceived improvement;[43] satisfaction, mood, wellbeing, and affective reactions to various spaces in the hospital (changes in behaviour such as increased or decreased uses of various spaces), changes in emotional state (eg increased or decreased states of calm), and perceptions of room or space character (eg cheerful, contemplative, calming, exciting, depressing, stressful). Participant characteristics, psychological traits such as outlook on life[44] and socio-demographic information (eg age, gender, cultural background) were also included in the survey.

Second, go-along interviews provided context and further understanding of the patient experience; this research component was led by Dr Paula Gardner. The go-along interviews combine focused interviewing with participant observation wherein the researchers accompanied participants on their natural outings and actively explored the physical and social practices by asking questions, listening, and observing[45] while capturing visual (photographs), textual (field notes) and auditory (audio recording) data. This method is effective for studying the implications of place on health and wellbeing.[46] In this study, patient go-along interviews involved guided tours of 'day-to-day living' with prompts from an interviewer to explore perceptions, experience and knowledge related to the design of the facility, with a particular focus on mobility, ease of navigation and self-efficacy.[47,48]

Third, existing clinical and administrative data sources were used to examine differences in functional health and organisational efficiency outcomes related to patients while controlling for patient characteristics. A randomly selected subset consisting of 220 cases from patient administrative databases was extracted at each site at pre-test (spring 2013) and post-test phases (spring 2014). Measures included functional health outcomes (eg mobility, pain, level of physical function, stability of condition) and organisational efficiency and quality outcomes (eg discharge rates, length of stay, critical incidents such as falls and infections) for patients.

There were three staff-based research measures. First, a paper and pencil survey examined the experience of the building design, psychosocial wellbeing (eg burnout, satisfaction, interactions with colleagues), and functional health (eg, ability to carry out their work) of staff. To allow for mass distribution and self-completion, the staff survey was administered in paper and pencil format. Key measures mirrored those in the patient computer assisted survey with slight modifications for relevance to staff. The survey also captured psychological traits and information relating to socio-demographics (eg age, gender, cultural background).

Second, focus groups with staff (eg clinical, executive/administration and facilities management) were conducted at each site at the post-test phase to provide context for the staff survey data and further understanding of the staff experience of the facility design and its implications for their work and wellbeing. Third, as a parallel to the patient database extraction, existing administrative data sources were used to extract information on staff health (eg employee turnover, sick days, critical incidents, workplace injury).

There were two building-based research measures. First, naturalistic observation, whose purpose is to examine the usage patterns of designated indoor and outdoor spaces by patients, staff and visitors. Naturalistic observation offers the unobtrusive collection of in-depth information about behaviour such as social interactions, activities and patterns of use, without disrupting naturally occurring behaviour and/or interaction. Selection of spaces to be observed was based on time of day, likelihood of use and design intentions. Six spaces were observed at each site at both pre- and post-test phases. Our team has developed a customised application for tablets (eg iPads) to capture the space, time of day, users of the space, field notes and observer narratives, contextual factors, as well as expected and unexpected uses of space. Second, the architectural design elements were documented and analysed, led by Cheryl Atkinson. The purpose of this documentation was to compare the architectural design elements of the spaces under study (based on form and function) across the old, new and comparison hospitals.

The documentation and analysis of design

elements across facilities was achieved through the visual comparison of building plans, functional and relational diagrams, and section plans. This analysis was supplemented with photographs of designated spaces and the use of software to model daylight penetration. Documented components include:

- type of space
- area and proportional differences in rooms and spaces
- organisational patterns of movement and circulation
- sectional organisation of public spaces
- plan relationships (proximities and adjacencies) of rooms and spaces
- travel distances (for patients and staff) to various activities and functions
- natural light quantity, location orientation and type (direct and indirect)
- acoustic conditions (actual noise quantity versus perceived noise quantity)
- window locations in the building and site
- window proportion, scale, dimension and configuration on wall
- material type, texture and colour.

Following the separate analyses of data within a given method, interpretive synthesis across methods and content analysis were used to triangulate and synthesise findings. The objectives of the interpretive synthesis is to identify common themes, factors and explanations across methods to inform knowledge translation and decision making support to knowledge users.[49,50] Analyses include pre- and post-test comparisons between patients and staff within a facility (Bridgepoint Health or West Park Healthcare Centre) and across facilities (Bridgepoint Health versus West Park Healthcare Centre).

There are some limitations to using a pre-test post-test quasi experimental design. The most significant limitations are a consequence of: (1) a lack of randomisation and (2) pre-existing differences across comparison facilities (eg differences in physical elements of the site, differences across patients and staff) and contextual factors (eg organisational changes, unexpected outbreaks, accreditation activities, functional programming). To address these limitations, the differences across facilities have been documented and included in the data analysis to assess their impact on the results.

5. Research outputs: Results of this research will inform the development of a healthcare facility design evaluation planning guide. The planning guide will include tools, templates, and standards for research design, methodologies, and measurement of health outcomes to be applied to future hospital redevelopment projects.

Discussion

The redevelopment of Bridgepoint Hospital offers the opportunity to assess the impact of architectural design on psychosocial wellbeing and health via the comparison of outcomes at a purpose-built facility against its predecessor, on the same site and with a control facility of similar staff and patients. Akin to best practice guidelines in healthcare delivery, this research offers insight into improved practices and enhanced rigour to assess design aimed at improving the psychosocial wellbeing and health of a complex continuing care and rehabilitation patient population. This research is the largest systematic POE in Canada. It represents a marked departure from the existing studies in this domain that tend to focus on operational, functional, and organisational outcomes rather than the interplay of mental, social and physical health within a complex care and rehabilitation patient population. Over and above the value of the project as an exemplar for standardised and mixed methodologies in the evaluation of healthcare facility design, it represents a unique approach to evaluation that uses the design intentions as a theoretical basis on which to measure outcomes.

In Canada, POEs of facility functionality are commonly included in the redevelopment plan but typically they are not designed as systematic research studies. The movement towards evidence-based design and increased need to demonstrate substantive outcomes related to capital investments has initiated a movement to incorporate facility evaluation from the beginning of the planning and design process.[51-53]

The expertise of our team and engagement of knowledge users will ensure a comprehensive, relevant and scientifically rigorous programme of research to improve decision making about strategic investments and policies related to healthcare facility design to improve health outcomes, and models of complex care and rehabilitation that include the built environment. On a smaller scale, results will be used to develop interventions related to design and the use of space at the new facility post-occupancy.

Beyond the Canadian context, this research is well positioned to contribute at an international level. Worldwide, healthcare planners are faced with the challenge of how to address the needs of this growing population in an era of deteriorating infrastructure and financial constraints. Key questions remain concerning how to make strategic investments in facility design. The development of consistent methodologies and measurement tools will generate the data that are necessary for comparisons across facilities. It will also enhance our understanding of the design elements that have the greatest impact on psychosocial wellbeing and health in general, as well as those that show greatest promise for specialised patient populations. This will serve the ultimate goal of improving wellbeing and health within a hospital context.

Acknowledgements

This research was funded by the Capital Investments Branch of the Ontario Ministry of Health and Long Term Care, Bridgepoint Collaboratory for Research and Innovation, and Bridgepoint Health Foundation. The authors acknowledge the contribution of the core research team: Renée Lyons, PhD, Bridgepoint Chair in Complex Chronic Disease Research, TD scientific director, Bridgepoint Collaboratory for Research and Innovation, professor, Dalla Lana School of Public Health and Institute of Health Policy, Management and Evaluation, University of Toronto; Paula Gardner, PhD, assistant professor, Department of Community Health Sciences, Brock University, research scientist, Bridgepoint Collaboratory for Research and Innovation, assistant professor (status), Dalla Lana School of Public Health, University of Toronto; Gregory Colucci, OAA, MRAIC, principal, Diamond Schmitt Architects; Clifford Harvey, OAA, MRAIC, senior architect, Capital Investments Branch, Ontario Ministry of Health and Long Term Care; Tony Khouri, PhD, PEng, chief facilities planning & redevelopment officer, Bridgepoint Active Healthcare; Kate Wilkinson, MA, director, quality and patient safety, Bridgepoint Active Healthcare; Stuart Elgie, OAA, MRAIC, principal, Stantec Architecture; Mitchell Hall, OAA, MRAIC, principal, KPMB Architects. We also thank our collaborators: Janet Huber, chief business development and planning officer, West Park Healthcare Centre; David Garlin, planner,

HDR

THOUGHT LEADERS IN: HEALTH | SCIENCE | JUSTICE

hdrinc.com

OFFICES IN:
United States | Canada | United Kingdom | Germany | United Arab Emirates | China | Australia

King Saud Medical City
Riyadh, Kingdom of Saudi Arabia

West Park Healthcare Centre; Tim Pauley, manager, research and evaluation, West Park Healthcare Centre; Alejandro Jadad, PhD, MD, chief innovator and founder of Global eHealth, University Health Network, Canada Research Chair in eHealth Innovation, University of Toronto. Special thanks also to the research assistants for their data collection and preliminary data analysis efforts, and to Kerry Kuluski, PhD and Michael Wasdell, MA for their review of various drafts of this manuscript.

Authors

Celeste Alvaro, PhD is research scientist at Bridgepoint Collaboratory for Research and Innovation, Bridgepoint Active Health, and adjunct professor, Department of Architectural Science, Faculty of Engineering and Architectural Science, Ryerson University. Cheryl Atkinson, BArch, MRAIC, OAA is assistant professor, Department of Architectural Science, Faculty of Engineering and Architectural Science, Ryerson University.

References

1. Walker D. *Caring for our Aging Population and Addressing Alternative Level of Care*. Report submitted to the Minister of Health and Long-term Care; 2011.

2. World Health Organization *Preventing Chronic Diseases: A vital investment*. Geneva: WHO; 2005.

3. Bridgepoint Active Healthcare. 2013 [Accessed 13 May 2013]. Available from: www.bridgepointhealth.ca/history

4. Uijen AA, van de Lisdonk EH. Multimorbidity in primary care: Prevalence and trend over the last 20 years. *European Journal of General Practice* 2008; 14 Suppl 1:28-32.

5. BMA *Science and Education. The psychological and social needs of patients*. 2011 [cited 2011 April 1, 2011]; Available from: http://bmaopac.hosted.exlibrisgroup.com/exlibris/aleph/a21_1/apache_media/G8KXL7EIUQNLK7RQTQ5EP9ERF4AF1L.pdf

6 Kuluski K, Hoang S, Schaink AK, Alvaro C, Lyons RF. The care delivery experience of hospitalized patients with complex chronic disease. *Health Expectations*. in press.

7. Kuluski K, Schaink A, Lyons R, Alvaro C, Bernstein B (eds). *The Face of Complex Chronic Disease: Understanding the patient population at Bridgepoint Health*. Bridgpoint Collaboratory for Research and Innovation, Toronto, Ontario; 2012 May.

8. Kuluski K, Bensimon CM, Alvaro C, Schaink AK, Lyons RF, Tobias R. Life interrupted: A qualitative exploration of the impact of complex chronic disease on the daily lives of patients receiving complex continuing care. *Illness, Crisis, & Loss*. in press.

9. Yaghmaie F, Khalafi A, Majd H, Khost N. Correlation between self-concept and health status aspects in haemodialysis patients at selected hospitals affiliated to Shaeed Beheshti University Medical Sciences. *Journal of Research in Nursing*. 2008; 13(3):198-205.

10. Statistics Canada. *A Portrait of Seniors in Canada*. 2006. Available from: www.statcan.gc.ca/pub/89-519-x/89-519-x2006001-eng.pdf

11. Harvey C (ed). *Health Capital Built Infrastructure Research: Roundtable meeting of the Post-Occupancy Evaluation Think Tank*. University of Toronto; 26 September 2012.

12. Ministry of Public Infrastructure Renewal. Five-year investment plan will help ensure high-quality services for Ontarians. Press release; 25 May 2005. Available from: http://news.ontario.ca/archive/en/2005/05/25/FiveYear-Investment-Plan-will-Help-Ensure-HighQuality-Services-for-Ontarians.html

13. Schüssler G. Coping strategies and individual meanings of illness. *Social Science & Medicine* 1992; 34(4):427-32.

14. Dilani A. Psychosocially supportive design: A salutogenic approach to the design of the physical environment. *Design & Health Scientific Review*. 2008; July:47-53.

15. Preiser WFE (ed). *Health Center Post-occupancy Evaluation. Towards community-wide quality standards*. Sao Paulo, Brazil: NUTAU/USP; 1998. .

16. Preiser WFE, Vischer JC. *Assessing Building Performance*. Oxford: Elsevier; 2005.

17. Ulrich RS. Effects of interior design on wellness: Theory and recent scientific research. *Journal of Health Care Interior Design* 1991; 3:97-109.

18. Kagan AR, Levi L. *Health and Environment – Psychosocial stimuli: A review*. 2nd ed. Levi L (ed). London, New York and Toronto: Oxford University Press; 1975.

19. Ulrich RS. Biophilia, biophobia, and natural landscapes. In: Kellert SR, Wilson EO (eds). *The Biophilia Hypothesis*. Washington, DC: Island Press; 1993. p. 73-137.

20. Forbes I. Benchmarking for health facility evaluation tools. World Health Design 2013; 6(2): 50-7.

21. Victorian Government Health Information. *Capital Development Guidelines;* 2010. Available from: www.capital.health.vic.gov.au/capdev/PostOccupancyOverview

22. NHS Scotland. *Scottish Capital Investment Manual – Project evaluation guide*. 2012.

23. University of Westminister. *Guide to Post Occupancy Evaluation*; London: HEFCE; 2006. Available from: www.aude.ac.uk/info-centre/goodpractice/AUDE_POE_guide

24. Wilson EO. *Biophilia*. Cambridge: Harvard University Press; 1984.

25. Award of Excellence: Bridgepoint Health. *Canadian Architect*. 1 December 2008.

26. Diamond and Schmitt to design new Bridgepoint Hospital. *Canadian Architect*. 18 October 2009.

27. Guiliani MV, Scopelliti M. Empirical research in environmental psychology: Past, present, and future. *Journal of Environmental Psychology* 2009; 29:375-86.

28. Kaplan R, Kaplan S. *The Experience of Nature: A psychological perspective*. Cambridge: University Press; 1989.

29. Sundstrom E, Bell PA, Busby PL, Asmus C. Environmental psychology 1989–1994. *Annual Review of Psychology* 1996; 47:485-512.

30. The Center for Health Design. Definition of evidence-based design for healthcare. 2008 [cited 1 April 2011]; Available from: www.healthdesign.org/edac/about

31. Ruga W. Designing for the six senses. *Journal of Health Care Interior Design* 1989; 1:29-34.

32. Ulrich R, Quan X, Zimring C, Joseph A, Choudhary R. *The Role of the Physical Environment in the Hospital of the 21st Century: A once-in-a-lifetime opportunity*. Report to The Center for Health Design; 2004.

33. Joseph A. *Health Promotion by Design in Long-term Care Settings*. Concord, CA: The Center for Health Design; 2006.

34. Joye Y. Architectural lessons from environmental psychology: The case of biophilic architecture. *Review of General Psychology* 2007; 11:305-28.

35. Upshur RE, Tracy S. Chronicity and complexity: Is what's good for the diseases always good for the patients? *Canadian Family Physician* 2008; 54(12):1655-8.

36. Fortin M, Hudon C, Bayliss EA, Soubhi H, Lapointe L. Caring for body and soul: The importance of recognizing and managing psychological distress in persons with multimorbidity. *International Journal of Psychiatry in Medicine* 2007; 37(1):1-9.

37. Noel PH, Frueh BC, Larme AC, Pugh JA. Collaborative care needs and preferences of primary care patients with multimorbidity. *Health Expectations* 2005; 8(1):54-63.

38. Crano WD, Brewer MB. *Principles and Methods of Social Research*. 2nd ed. Mahwah, NJ: Erlbaum; 2002.

39. Alvaro C, Atkinson C, Harvey C, Wilkinson K, Lyons RF, Gardner P *et al*. *Assessing the Impact of Healthcare Facility Design on Health Outcomes: Implications for strategic investments in design*. Canadian Institutes of Health Research Partnerships for Health System Improvement; 2012.

40. Alvaro C. *Methods and Measures in the Evaluation of Healthcare Facilities: A scientist's perspective. . Improving the post occupancy evaluation cycle: Taking the 'P' out of POE*. Session on post-occupancy evaluation approaches and techniques: Perspectives from architects, owners and researchers. 20 February 2013.

41. Empirisoft. MediaLab software 2011.

42. Hagerty BM, Williams A. The effects of sense of belonging, social support, conflicct, and loneliness on depression. *Nursing Research* 1999; 48(4):215-9.

43. McFarland C, Alvaro C. The impact of motivation on temporal comparisons: Coping with traumatic events by perceiving personal growth. *Journal of Personality and Social Psychology* 2000; 79:327-43.

44. Scheier MF, Carver CS. Optimism, coping, and health: Assessment and implications of generalized outcome expectancies. *Health Psychology* 1985; 4(3):219-47.

45. Kusenback M. Streen phenomenology: The go-along as ethnographic research tool. *Ethnography* 2009; 4(3):455-85.

46. Carpiano RM. Come take a walk with me: The 'go-along' interview as a novel method for studying the implications of place for health and well-being. *Health and Place* 2009; 15(1):263-72.

47. Fliess-Douer O, van der Woude LH, Vanlandewijck YC. Development of a new scale for perceived self-efficcacy in manual wheeled mobility: A pilot study. *Journal of Rehabilitation Medicine* 2011; 43(7):602-8.

48. Shumway-Cooke A, Patla A, Stewart AL, Ferrucci L, Ciol MA. Assessing environmentally determined mobility disability: Self-report versus observed community mobility. *Journal of the American Geriatrics Society* 2005; 53(4):700-4.

49. Barnett-Page E, Thomas J. Methods for synthesis of qualitative research: A critical review. *BMC Medical Research Methodology*. 2009; 9:59.

50. Pope C, Mays N, Popay J. How can we synthesize qualitative and quantitative evidence for healthcare policy-makers and managers? *Healthcare Management Forum*. 2006: 27-31.

51. Ministry of Health and Long-Term Care – Local Health Integration System (MOHLTC-LHIN). *Joint Review Framework for Early Capital Planning Stages – Toolkit*; 2010.

52. Ministry of Health and Long-Term Care (MOHLTC). Health Capital Planning Review; 2004.

53. Ministry of Health and Long-Term Care (MOHLTC). *Ontario Health Capital Planning Manual;* 1996.

Walkable communities:
Impacts on residents' physical and social health

Researchers from Texas A&M University studied residents in a newly developed 'walkable community' in Austin, Texas to see how it changed their habits for physical activity and whether it increased social interaction and cohesion in the community

Xuemei Zhu, Zhipeng Lu, Chia-Yuan Yu, Chanam Lee, George Mann at Texas A&M University

Living in a 'healthy community' is everyone's dream. However, today's communities have been increasingly designed around automobiles instead of pedestrians. Such auto-oriented communities have been questioned and criticised for their impacts on residents' physical and social health.

In terms of physical health, a substantial body of evidence has shown that automobile-centred communities with segregated land uses, low density, disconnected street networks, and insufficient pedestrian and bicyclist infrastructure are associated with reduced physical activity such as walking or exercise in outdoor spaces.[1,2] In contrast, walkable communities with mixed land uses, higher density, connected street networks, rich physical activity resources, and pedestrian-friendly designs have been linked to increased physical activity in daily routines.[1-4] This environment-physical activity relationship is especially important in the context that obesity has become a leading public health problem in many parts of the world, and physical inactivity is a significant contributing factor.[5-8] Traditional approaches of promoting physical activity are focused on personal factors and have not been very successful.[9] Recent trends have shifted to a more comprehensive approach, targeting multi-level (personal, social and built environmental) factors.[9] This shift came with the increasing popularity of the socio-ecological theory, which considers human behaviour to be influenced by interactive factors on intrapersonal, interpersonal, institutional, community, and public policy levels.[10] Community environments, in particular, have been increasingly recognised as important intervention venues, which may help promote sustainable, population-level changes toward more physically active lifestyles. However, the actual impacts of moving to walkable communities on residents' physical activities have not yet been sufficiently studied.

In terms of social health, automobile-oriented communities tend to ignore the needs of pedestrians and make everyday life dependent on automobiles, which in turn reduces opportunities for social encounters and interactions in neighbourhoods. Limited studies suggest that walkable communities promote social health by encouraging walking and other outdoor activities, and thereby, facilitating social interactions among neighbours.[11-15] Specific environmental features identified in previous studies include pedestrian-friendly community layout and site design, rich and diverse natural features and opens paces, and mixed land uses providing diverse destinations.[11-15] For example, a US study reported a greater sense of community in Kentlands – a prototypic New Urbanist community with walkable environments, compared to a suburban, automobile-oriented development. Kentlands features diverse natural features and open spaces, pedestrian-friendly community layout, and traditional architectural style, as well as many other walkable environmental features.[13] Another US study in Portland, Oregon found that residents' sense of community was greater in a pedestrian-oriented neighbourhood than in an auto-oriented counterpart, and the perception of pedestrian environment is the most significant predictor of sense of community.[11] Similar results were also found in Galway, Ireland.[15] However, some inconsistencies have also been reported on the impacts of certain design features on the sense of community. For example, a study in Atlanta, Georgia reported a negative association between land-use mix and sense of community.[16]

Growing trends in community development, such as New Urbanism, Smart Growth and Neo-traditional Development all advocate walkability as a guiding principle. The US Green Building Council released the LEED for Neighbourhood Development (LEED-ND) rating system to help guide the development of sustainable and walkable communities. The City of New York released *Active Design Guidelines* for promoting physical activities through design.[17] Recent market studies have also shown growing demands for walkable communities.[18-20] In practice, an increasing number of communities are using 'design' in addition to 'programmes' as the means to promote physical and social health. However, the actual health impacts of such design interventions are understudied.

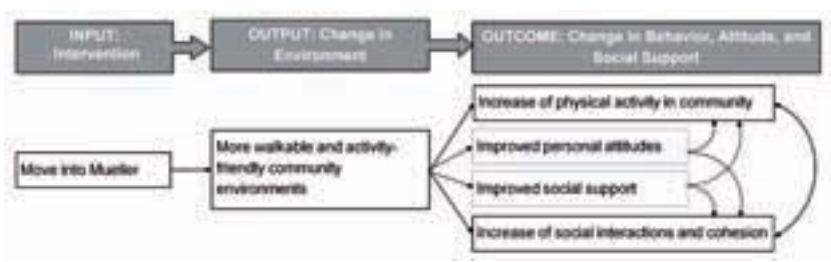


Figure 1: Conceptual framework for the mechanisms through which environmental changes influence physical activities and social interactions and cohesion

Study design

This study addresses these knowledge gaps by conducting a case study of Mueller, Austin, Texas to examine its impact on residents' physical and social health.

Mueller is a LEED-ND certified mixed-use community designed to support walking and other outdoor activities. Based on the previous literature, a conceptual framework (Figure 1) is developed for the hypothesised mechanisms of such impacts:

1. that the increase in community walkability will promote residents' physical activities and social interactions and cohesion both directly and indirectly (by improving relevant personal attitudes and social support—the mediators), and

2. that the resulting increases in physical activity and social interactions and cohesion will mutually reinforce each other.

This study explores whether residents had significant increases in their physical activities and social interactions and cohesion after moving to Mueller and, if yes, how these behaviours changed in terms of types, locations and frequencies. Based on findings from this study, a follow-up analysis will use structural equation modeling to examine the whole model to better understand underlying mechanisms for such behaviour changes.

Study setting

Mueller is the first exemplary project by the City of Austin to use a series of innovative policies to create a model for walkable, sustainable and equitable communities. Developed on the former airport site near downtown, Mueller is planned to house 10,000 residents and 10,000 employees. It includes many activity-friendly design features, such as high-density, mixed-land uses, well-connected street networks with sidewalks, and rich and diverse natural resources and open spaces distributed throughout the community (Figure 2 and Table 1). It is also a mixed-income community with over 25% of the housing units being affordable and indistinguishably incorporated into the community with market-rate units. Table 2 illustrates Mueller's socio-demographic and environmental characteristics, compared to those of the City of Austin. As of May 2013 when this study was conducted, Mueller had about 40% of its property developed, with about 3,500 employees and about 900 single-family households.

Method

Mixed methods, including a focus group (n=13) and an online survey (n=148), were used to triangulate research results in this study. A focus group was conducted first to obtain information about Mueller residents' physical activities and social interactions and cohesion before and after moving into Mueller, and to gain in-depth understanding of the reasons that lead to changes in those behaviours. Focus group results were also used to guide the development of the survey instrument in the following phase. Thirteen participants were recruited at a Mueller Neighbourhood Association meeting. The participants first discussed a series of topics raised by the facilitator, including reasons of moving to Mueller, and comparisons of community environments and behaviours before and after the move. After the discussion, the participants were given a map of Mueller, and asked to use coloured stickers and notes to identify destinations they went to for physical and social activities, and places that caused concerns. Content analysis was used to analyse the focus group data.

Figure 2: Land use map and developed areas of Mueller community (Source: Catellus)

The online survey was designed for an adult from a household to answer questions about himself/herself and the oldest child in the household, if there was one. It asked about the respondent's physical activities and social interactions and cohesion (ie the outcome variables) and the child's physical activities (which were not included in this study), as well as personal, social and built environmental factors that may have influenced these outcomes, before and after moving into Mueller. Most of the questions were retrieved from previously validated questionnaires[23-25] and several new questions were added based on the focus group results. Pilot tests (n=6) were conducted and led to minor revisions of the questionnaire. The finalised survey took 20-30 minutes to complete.

The subjects were recruited through email invitations to Mueller residents (sent by the developer through its listserve) and online messages posted on the Mueller Community online forum.

Table 1: Mueller's activity-friendly environmental features

Activity-friendly location	Activity-friendly neighborhood pattern	Activity-friendly housing
A central urban location with good connections to public transit and other urban amenities	**High density and mixed land uses:** Civic/institutional buildings, offices, commercial areas, town centre, parks, open spaces and diverse housing within walkable distances	Eg front porches and rear garages; garden courtyards; vertical mixed use with offices/shops at street level and living units above; access to parks and open spaces; various types of housing
	Parks and open space: Easily accessible, well-connected and evenly distributed park system (140 acres) with 13 miles of hike/bike paths/lanes	
	Streets: Grid-like, hierarchical and well-connected, with complete sidewalks, buffers between sidewalks and streets, traffic calming, and good maintenance, visual quality and surveillance	

Reminder messages were posted on the Mueller Community online forum one and two weeks after the initial invitation. Email reminders were not sent out as the developer limits such use of its listserve. After the survey results were collected, valid and complete surveys were included in the analyses using SPSS 19. Descriptive statistics was examined first, and then *t*-tests were used to examine the pre-post move differences in outcome variables. Pearson correlations matrix was examined to see if there is any significant correlations between changes in physical activities and changes in social interactions and cohesion.

Focus group results

Thirteen subjects (eight females and five males) participated in the focus group session that was carried out in 2013. Three were over 65 years of age; two were in the 50–65-year age group; seven were in the 30–50-year age group; and one was in the 20–30-year range. In terms of ethnicity, there were one African American, one Asian and eleven white participants. Two participants had young children. Residents' durations of living in Mueller ranged from one month to four years. The content analysis showed increases in physical activity and social interactions and cohesion after moving into Mueller, and the role of some environmental factors in facilitating such changes.

Physical activities. The majority of the participants reported increased physical activities. They reported that environmental features such as complete and well-connected sidewalks, various parks and open spaces, convenient bike routes, diverse destinations, and safety (eg good street lighting for jogging early in the morning) supported diverse outdoor activities, such as walking, bicycling, jogging, golfing (in a golf course nearby) and flying kites, among many others (Figure 3). Several participants reported walking more since moving to Mueller, and one older lady mentioned walking two or three times more since the move. The participants identified many places to walk to, including parks, greenways, business areas, friends' homes, block parties, mailboxes and the hospital in the community. One participant worked in the community and said she walked to and from work. Two residents liked bicycling and one biked to and from work. Several other residents used public transportation or private cars (with much shorter commute distances now and some carpooling with neighbours) to travel to work. Two participants reported a 'no driving in Mueller' rule in their household, and another participant reported a yearly saving of US$1,200 in gasoline for vehicles after moving to Mueller.

Most of the residents were looking forward to the opening of HEB (a chain supermarket), and plan to do grocery shopping without driving. In addition, the back alleys (see the upper right photo in Figure 3) were often used as shared spaces among a small group of neighbours, and were perceived as safe places for children to play in. A young father proudly said that his four-year-old son learned how to ride a two-wheel bicycle in the back alley. He said that the alley had very little through traffic and was safe, which led him to choose this place for teaching his child how to bike.

Social activities and cohesion. Participants also reported increased social interactions and cohesion due to the changes in community environments. Communal facilities such as community mailboxes were reported by several participants as popular places for social interactions. One resident's parents liked to go to the mailbox every day, and often came back with stories about new friends they made and news in and around the community. Another woman enjoyed the location of her house being close to mailboxes, because that's how she knew a lot of her neighbours. Several participants reported that smaller backyards encouraged them to use front porches and community outdoor space more often, and thereby have more opportunities to interact with neighbours. Back alleys also played an important role, as they became semi-public areas with multiple functions: the residents hold block parties there, and children also play in the alleys.

Focus group discussions revealed that Mueller has become a close-knit community even with the current partially completed development status. One participant called it "a sun city with diversity", welcoming people of all ages, ethnicities, income levels, and religions. More importantly, people in Mueller know and help each other. They often share news and exchange favours (eg borrowing tools) with neighbours, pay attention to what is happening in the community, and report concerns, whenever there is any, which had helped to build a safer community.

Map of activities and concerns. Eleven participants used the maps and coloured stickers that were provided to identify their homes, most-liked places for physical and social activities and places of concern.

Table 2: Physical environment and population characteristics of Mueller and the City of Austin

Variables	Features	City of Austin	Mueller community
Physical environment[a] (Mueller's environments represent a departure from typical community developments in the area)	Population density (unit: persons/acre)	Mean: 6.8 (SD: 3.7)	14
	Land-use mix	Mean: 0.45 (SD: 0.24) (range: 0–1)[b]	10,000 employees; 130,000 residents; 366,000 square feet of retail space
	Street connectivity (unit: intersections/100 acres)	Mean: 19.7 (SD: 11.3)	66
	Sidewalk coverage (unit: %)	Mean: 23.7 (SD: 13.7)	Close to 100
	Parks and open space coverage (unit: %)	Mean: 8.9 (SD: 9.6)	20 (each household has greenspace within 600 feet)
Population[c] (Mueller's population is representative of the Austin population)	% of Hispanic or Latino (of any race)	31.4%	35.1%
	White (one race)	68.3%	71.4%
	Population under the age of 18	22.1%	21.9%
	Mean household income	$68,659	$66,923

[a] Physical environmental measures for the City of Austin were based on the authors' previous measures of 74 neighbourhoods (defined as the public elementary school's attendance area) in Austin.[18]
[b] The land-use mix measure describes the evenness of land use distribution based on square footage of residential, commercial and office land use.[21] The value ranges from 0 (single land use) to 1 (a perfectly even mix).
[c] The population information was obtained from the 2010 Census and the 2005–2009 American Community Survey.[22]
SD: Standard deviation

Popular places for physical and social activities included parks, trails, walking paths, waterfront, pool, restaurants, bank, friends' homes and the community central activity areas (eg the hangar for farmer's market). The business area with both big-box retail and small shops received mixed opinions. Commonly mentioned places of concerns were traffic-related. Participants pointed out places that needed safer walking paths and crossing (especially for children), more traffic lights, more speed control and better visibility. A resident stated his safety concerns about the large surface parking in the retail area. One mentioned that big-box retails may not be the type of business they need in Mueller. Another resident thought the community park, Lake Park, should be better maintained.

Survey results

A total of 148 valid responses were collected from the online survey, yielding a response rate of 16.4%. The sample included 67% of females and 11% of Hispanics, and had a mean age of 44. In terms of education level, 5.4% had doctoral degrees; 8.8% had professional degrees; 32.0% had master's degrees; 46.3% had Bachelor's degrees; and 7.5% had other types of lower education. The household incomes were diverse, with 7.5% in the $200,000 or more category, 12.5% between $150,000 and $199,999, 28.3% between $100,000 and $149,999, 8.3% between $80,000 and $99,999, 12.5% between $60,000 and $79,999, 20.8% between $40,000 and $59,999, and 10% in the $39,999 or lower category. Compared to the 2010 Census information for Mueller, female and non-Hispanic populations were somewhat over-represented in this study.

Physical activity: After moving to Mueller, 70.5% of the respondents had much or somewhat higher levels of physical activity, and 51.6% reported much or somewhat better health. Details about specific types and frequencies of physical activities are listed in Table 3. *T*-test results showed that all physical activity variables, except the number of days per week with at least 30 minutes of physical activity and time spent on biking per day, had significant ($p<0.05$) increases after moving to Mueller. Meanwhile, time spent in a car reduced by 90 minutes per week. It is worth noting that the time spent on walking in community after moving to Mueller had a mean of 123 minutes (29 minutes per day and 3.9 days per week), which is already very close to the public health guideline for the level of physical activities needed for adults to obtain significant health benefits – at least 150 minutes of moderate-intensity or 75 minutes of vigorous-intensity aerobic physical activity per week, or a combination.[5]

The locations of physical activities were examined for their percentages of use and the corresponding pre-post move differences (Figure 4). Neighbourhood streets and sidewalks were the most popular places for physical activity in both pre-move communities and Mueller. About 80% of Mueller residents used them for physical activities. Compared to those in previous communities, the percentages of Mueller residents using neighbourhood streets and sidewalks, parks or trails/paths in a park, greenways/trails/paths not in a park, homes, and natural green spaces or places near water features for physical activities were higher by 18%, 43%, 38%, 22% and 10%, respectively. In contrast, the percentage of residents using gyms or fitness facilities for physical activities was 18% lower, likely because of the rich outdoor venues that are freely available in Mueller.

HASSELL has been designing healthcare environments for over 25 years. Our extensive portfolio encompasses a diverse range of projects from small scale facilities to large complex acute hospitals and specialist services.

Our global network of integrated Architecture, Landscape Architecture and Interior Design studios provide a flexible, specialist resource focussed on developing a holistic response to every healthcare environment.

Working across geographically diverse markets provides us with a broad understanding of different cultures, climates and construction practices ensuring our response is appropriate and sensitive to context.

Project_ Oncology Centre, King Hamad University Hospital,Kingdom of Bahrain

Australia | China | Hong Kong SAR
Singapore | Thailand | United Kingdom

www.hassellstudio.com

HASSELL

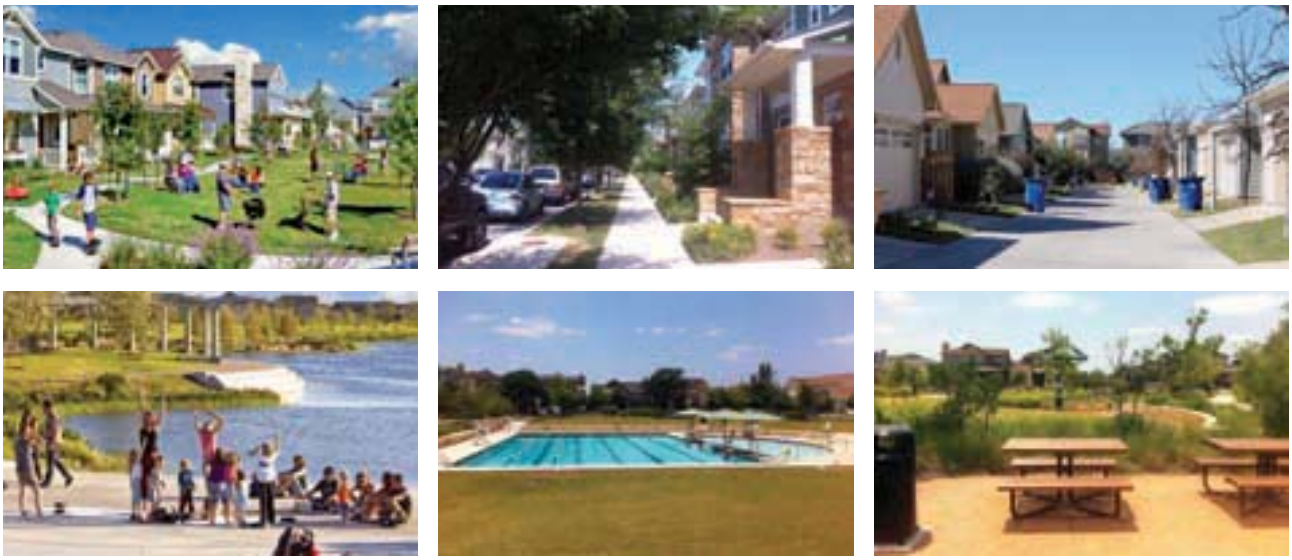


Figure 3: Focus group participants reported environmental features supportive of physical and social activities, such as sidewalks, parks and open spaces, bike routes, diverse destinations, communal facilities, front porches and back alleys shared by small groups (Source: Tom McConnell (images on left), Xuemei Zhu (all other images))

Social interactions and cohesion: Results also showed that social interactions and cohesion increased significantly after the participants moved to Mueller (Table 3). They 'say hello to neighbours', 'stop and talk to neighbours', 'socialise with neighbours in home or restaurant', and 'ask for help from or exchange favours with neighbours' for 10.1, 7.4, 2.5, and 2.9 more times per month, respectively. Their perceptions of being in 'a close-knit neighbourhood' and neighbours being 'countable to help in case of need' were 3.3 and 2.1 points higher respectively, on a five-point scale.

Correlations between increases in physical activity and increases in social interactions and cohesion: The increase in walking in community correlated significantly with the improved perception rating for 'neighbours being countable to help in case of need' (correlation=0.243, p value=0.012) and with the increase in the frequency of 'saying hello to neighbours' (correlation=0.315, p value=0.001).

Conclusion

This study has several limitations. First, the survey was conducted online and may not have reached some of the residents who do not use computers and internet frequently in their daily lives. Second, the sample size was relatively small and subject to non-response bias (eg female and non-Hispanic populations being over-represented; residents who were more interested in this topic being more likely to respond to the survey). Third, the pre-move data were collected retrospectively, and were limited to possible recall errors. Finally, the analysis in this paper was limited to bivariate tests, and did not explore the impacts of multi-level factors on changes in physical activity and social interactions and cohesion.

Despite these limitations, this study contributed important knowledge about the 'actual' health impacts of moving to a walkable community on residents' physical and social health. This is an important yet understudied area with significant policy implications. The results from this study provided solid evidence that residents did improve both physical activities and social interactions and cohesion after moving to the walkable environment in Mueller, Austin, Texas. Increased walking in the community correlated with improved social interactions and the perception of social cohesion. The findings also showed a significant reduction in driving among residents, suggesting important environmental benefits that walkable communities can bring by reducing fuel consumption and environmental pollution.

These findings also provided preliminary results that can guide the next step of this study, which is to run a full structural equation model to test the hypothesised mechanisms about how environmental changes influence physical activity and social interactions and cohesion, directly and indirectly through improving relevant personal attitudes and social support.

Authors

Xuemei Zhu PhD is an assistant professor in the Department of Architecture, Center for Health Systems & Design at Texas A&M University; Zhipeng Lu is a lecturer in the Department of Architecture at Texas A&M; Chia-Yuan Yu is a PhD candidate in Urban and Regional Sciences at Texas A&M; Chanam Lee is an associate professor in the Department of Landscape Architecture and Urban Planning at Texas A&M; and George Mann is a professor in the Department of Architecture, Center for Health Systems & Design at Texas A&M.

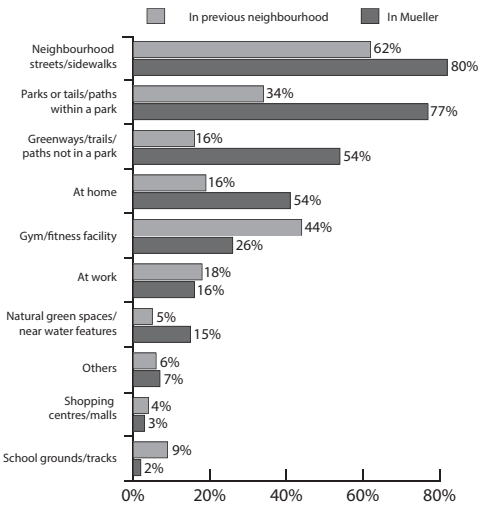


Figure 4. Percentage of respondents reporting certain locations of physical activity before and after the move

aurecon

Globally, a rapidly growing and aging population is converging and bringing with it an ever increasing community expectation of improved access to quality focussed and efficient healthcare services.

Aurecon's global health experience is unparalleled. Our skilled and experienced multidisciplinary teams are committed to developing innovative solutions that take into consideration the full project life cycle. Our solutions are evidence based, outcomes focussed and incorporate the latest healthcare knowledge and trends.

Commitment to partnering with our clients and our ability to meet demands on fast-track construction projects has made us an industry leader in the health sector.

- Business and infrastructure advisory
- Programme and project management
- Principal consulting
- Building Services
- Building Structures
- Building Sciences
- Environmentally sustainable design
- Information and communications technology

For more information contact

Matthew Skeen Competency Leader, Health
T +61 7 3020 8742
E matthew.skeen@aurecongroup.com

Leading. Vibrant. Global.
www.aurecongroup.com

Table 3: Descriptive statistics of and *t*-test results about the pre-post move differences in physical activity and social interactions and cohesion

Variables	Descriptive statistics		Results of *t*-test for pre/post differences (Post-move value – pre-move value)			
	Pre-move mean (SD)	Post-move mean (SD)	Mean difference	*t*	Degree of freedom	P value
Days/week with 30+ minutes of physical activity	3.6 (1.9)	3.5 (1.7)	-0.2	-1.05	147	0.295
Travelling in private car						
Days/week	6.0 (1.6)	5.7 (1.6)	-0.4	-2.54	140	0.012
Minutes/day	40.8 (25.0)	27.8 (17.7)	-12.6	-6.26	142	0.000
Minutes/week[a]	253.4 (178.9)	163.9 (120.2)	-90.1	-6.3	140	0.000
Total biking						
Days/week	0.5 (1.16)	0.9 (1.5)	0.4	3.8	146	0.000
Minutes/day	34.7 (18.2)	30.9 (17.2)	1.8	0.5	21	0.653
Minutes/week	15.2 (37.4)	28.8 (58.4)	13.5	3.9	144	0.000
Total walking						
Days/week	3.4 (2.1)	4.35 (2.21)	1.0	5.6	144	0.000
Minutes/day	26.8 (14.7)	29.8 (15.2)	3.7	2.8	121	0.006
Minutes/week	99.7 (97.4)	140.0 (115.5)	39.1	4.8	138	0.000
Walking in community						
Days/week	2.4 (2.2)	3.9 (2.2)	1.48	7.48	144	0.000
Minutes/day	27.0 (14.5)	29.1 (14.5)	4.10	3.45	99	0.001
Minutes/week	74.7 (91.2)	123.0 (105.5)	47.7	5.59	142	0.000
Times of social interaction per month						
Say hello to neighbours	10.9 (9.2)	21.1 (9.8)	10.1	11.6	146	0.000
Stop and talk to neighbours	5.6 (6.7)	13.2 (9.1)	7.4	9.5	146	0.000
Socialise with neighbours	1.9 (3.9)	4.9 (5.9)	2.9	5.6	146	0.000
Seek help from and exchange favours with neighbours	1.5 (2.1)	4.0 (5.2)	2.5	6.2	145	0.000
Social cohesion[b]						
Neighbours could be counted to help in case of need	2.3 (8.9)	4.4 (0.9)	2.1	3.0	147	0.004
This is a close-knit neighbourhood	0.8 (12.3)	4.3 (0.9)	3.4	3.4	147	0.001

[a] The online survey collected information about the number of days per week (continuous variable) and the number of minutes per day (categorical variable with ranges of 1–10, 11–20, 21–30, 31–40, 41–50, 51–60 and 60+) spent on each type of activity. The number of minutes per week was calculated by multiplying the number of days per week with the midpoint value of the time range (or a value of 65 for the '60+' category) for the number of minutes per day.

[b] Social cohesion variables were measured on a five-point Likert scale, by asking the respondent about how much he/she agreed or disagreed with the statement (1 = strong disagree, 5 = strongly agree).

References

1. Sallis JF, Glanz K. Physical activity and food environments: solutions to the obesity epidemic. *Milbank Q* 2009; 87(1):123-54.

2. Dannenberg A, Frumkin H, Jackson R. Making Healthy Places: *Designing and building for health, well-being, and sustainability*. Washington, DC: Island Press; 2011.

3. Durand CP, Andalib M, Dunton GF, Wolch J, Pentz MA. A systematic review of built environment factors related to physical activity and obesity risk: implications for smart growth urban planning. *Obes Rev* 2011; 12(5):e173-82.

4. Humpel N, Owen N, Leslie E. Environmental factors associated with adults' participation in physical activity: a review. *American Journal of Preventive Medicine* 2002; 22(3):188-99.

5. US Department of Health and Human Services. *2008 Physical Activity Guidelines for Americans*; 2008 [cited 9 July 2011]. Available from: www.health.gov/paguidelines

6. Ogden CL, Carroll MD, Curtin LR, McDowell MA, Tabak CJ, Flegal KM. Prevalence of overweight and obesity in the United States, 1999-2004. *JAMA* 2006; 295(13):1549-55.

7. US Department of Health and Human Services. *The Surgeon General's Vision for a Healthy and Fit Nation*. Rockville, MD: Office of the Surgeon General; 2010 January.

8. World Health Organization. *Obesity and Overweight*. 2013 [cited 15 June 2013]. Available from: www.who.int/mediacentre/factsheets/fs311/en

9. Sallis JF, Cervero RB, Ascher W, Henderson KA, Kraft MK, Kerr J. An ecological approach to creating active living communities. *Annual Review of Public Health* 2006; 27:297-322.

10. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. *Health Education Quarterly* 1988; 15(4):351-77.

11. Lund H. Pedestrian environments and sense of community. *J Plan Educ Res* 2002; 21(3):301-12.

12. Nasar JL, Julian DA. The psychological sense of community in the neighbourhood. *Journal of the American Planning Association* 1995; 61(2):178-84.

13. Kim J, Kaplan R. Physical and psychological factors in sense of community – new urbanist Kentlands and nearby orchard village. *Environ Behav* 2004; 36(3):313-40.

14. Kuo FE, Sullivan WC, Coley RL, Brunson L. Fertile ground for community: inner-city neighbourhood common spaces. *American Journal of Community Psychology* 1998; 26(6):823-51.

15. Leyden K. Social capital and the built environment: the importance of walkable neighbourhoods. *American Journal of Public Health* 2003; 93(9):1546–51.

16. Wood L, Frank LD, Giles-Corti B. Sense of community and its relationship with walking and neighbourhood design. *Social Science & Medicine* 2010; 70(9):1381-90.

17. New York City Department of Design + Construction. *Active Design Guidelines*. [cited 15 June 2013]; Available from: www.nyc.gov/html/ddc/html/design/active_design.shtml

18. Sobel LS, Anderson W, Shipman J. *Market Acceptance of Smart Growth*. Washington DC: US Environmental Protection Agency; 2011. EPA 231-R-10-001.

19. Handy S, Sallis JF, Weber D, Maibach E, Hollander M. Is support for traditionally designed communities growing? Evidence from two national surveys. *Journal of American Planning Association* 2008; 74(2):209-21.

20. Levine J, Inam A. The market for transportation-land use integration: do developers want smarter growth than regulations allow? *Transportation* 2004; 31(4):409-27.

21. Frank LD, Schmid TL, Sallis JF, Chapman J, Saelens BE. Linking objectively measured physical activity with objectively measured urban form: findings from SMARTRAQ. *Am J Prev Med* 2005; 28(2 Suppl 2):117-25.

22. US Census Bureau. *American FactFinder* [online database]; 2011 [cited 21 July 2011]. Available from: http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml

23. Forsyth A, Oakes JM, Schmitz KH. Test-retest reliability of the Twin Cities Walking Survey. *Journal of Physical Activity and Health* 2009; 6(1):119-31.

24. Bassett DR, Jr. International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 2003; 35(8):1396.

25. Durant N, Kerr J, Harris SK, Saelens BE, Norman GJ, Sallis JF. Environmental and safety barriers to youth physical activity in neighbourhood parks and streets: reliability and validity. *Pediatr Exerc Sci* 2009; 21(1):86-99.

Gardens in healthcare facilities: **Steps toward evaluation and certification**

Restorative outdoor spaces are desirable in healthcare facilities, but there is no consistent approach to their definition or evaluation. This paper charts the move towards formalisation and certification

Clare Cooper Marcus, Hon ASLA, MA, MCP, University of California, Berkeley, and Naomi Sachs, MLA, ASLA, EDAC, Texas A&M University

Landscapes that promote health and wellbeing, often referred to as 'healing gardens', are increasingly being incorporated into healthcare facilities throughout the world as an essential design component. This is due in no small part to a growing body of evidence on the health benefits to patients, visitors and staff, as well as the financial benefits to the organisation. Along with empirical research on the efficacy of such spaces, there is also sufficient evidence to inform decisions about design specifics, such as what elements, configurations and programming in outdoor spaces can elicit the best possible outcomes.

Unfortunately, this information often does not make it from research to practice. While acceptance of the need for restorative gardens and other ways to connect people with nature shows great progress, the implementation – how gardens are designed, constructed and maintained – has been accomplished with varying degrees of success. In order to bring about the best outcomes, decision makers need tools that can help them translate existing research into good design. A set of design guidelines in a forthcoming publication by Cooper Marcus and Sachs[1] will help to educate and inform practitioners. The guidelines will also become the basis for: 1) development of a set of essential components to be incorporated into a standardised evaluation, in the form of an audit tool, of existing spaces, and 2) a certification programme comparable to the US Green Building Council's (USGBC) LEED for Healthcare.[2] The objective of this paper is to present a set of necessary steps that will lead to a potential evaluation process and certification of restorative gardens, and to discuss why at this time such a process should be considered.

Some definitions

Professionals and lay people use many different terms for outdoor spaces that promote health and wellbeing. Though 'healing gardens' is the most commonly used, others include landscapes for health, restorative landscapes, therapeutic landscapes, restorative gardens, therapeutic gardens, wellness gardens and rehabilitation gardens. For this paper, the authors use the term restorative garden(s) and healing garden(s) interchangeably, which they define as 'an outdoor (and sometimes indoor) space designed for a specific population, a specific site and a specific outcome'. The authors also use the term 'access to nature', which they define as any type of sensory contact with nature. Access to nature includes both visual (being able to see elements of nature from indoor and outdoors) and/or physical (touch, smell, sound, taste) contact. Use of the term 'access to nature' asserts the need for all members of a design team, and not just the landscape architect, to design for nature contact throughout the entire project.

Acceptance of restorative gardens

Restorative gardens and other means of connecting people with nature – via outdoor gardens, views of nature, indoor plants and gardens, natural materials and other forms of biophilic design – have long been considered 'the icing on the cake': amenities that often were either not included at all, or were the first thing to be eliminated from a project when the budget began to tighten. In a short

Steven Wells

Figures 1 & 2: The courtyard at Austin Health's Royal Talbot Rehabilitation Centre in Melbourne, Australia, was originally just weedy grass. It now offers far more sensory interest for patients, visitors and staff

period of approximately 20 years, people's opinions of gardens in healthcare facilities have evolved from a general, intuitive sense that 'nature is good for us' to increased acceptance, based on both quantitative and qualitative evidence, that the inclusion of opportunities for nature contact is an essential design element.

Decision makers at myriad facilities recognise that connection with nature increases not only positive health outcomes for consumers (patients and their families) and staff but also for the facility's bottom line. In surveys conducted by the Center for Health Design, one-third of respondents reported that they 'always' implemented healing gardens in their designs.[3,4]

Beyond self-regulation

In the US, provision of access to nature and restorative gardens has now evolved beyond action taken by individual stakeholders. The *Green Guide for Health Care* (GGHC) was the sector's first sustainable design rating system, a toolkit that integrated health principles and practices into the planning, design, construction, operations and maintenance of healthcare facilities. The 96-credit GGHC system includes credits such as SS-9.1, 'Connection to the Natural World – Outdoor Places of Respite', and SS-9.2, 'Exterior Access for Patients'. The GGHC was accepted by the USGBC, reformatted as a LEED product, and launched in 2011 as LEED for Healthcare.[2] Like the GGHC, the Sustainable Sites Initiative (SITES) was modelled on the LEED rating and accreditation system. SITES focuses on general outdoor environments. The programme creates voluntary national guidelines and performance benchmarks for sustainable land design, construction and maintenance practices. From its inception in the early 2000s, SITES recognised the salutary value of landscapes through its Human Health and Well-being credits. The USGBC is now a stakeholder in the initiative and anticipates incorporating SITES guidelines into the LEED Green Building Rating System in the near future.[5]

In the 2014 *Guidelines for Design and Construction of Health Care Facilities*, a new key element in the physical component of the Environment of Care section will be 'access to nature'. This is momentous, because access to nature has previously appeared only in the Appendix as a 'should' rather than in the body of the text as a 'shall'.

Michiko Kurisu

Figure 3: Studio Sprout's Jacqueline Fiske Healing Garden at Jupiter Medical Center in Florida; tall bamboo and lush planting creates feelings of enclosure as well as mystery, and seating invites people to sit and rest

The intent of the guidelines, adopted by 42 of the 50 US states, is to identify the minimum requirements for the design of new or renovated healthcare facilities. The authorities having jurisdiction (AHJs) use the guidelines as a basis for design approval. Drawings are only approved, and the project can only go forward, if the guidelines' minimum standards are met. Other regulations are following suit. For example, in the latest Recommended Standards for Newborn ICU Design, 'Access to Nature and Other Positive Distractions' is standard number 25: "When possible, views of nature shall be provided in at least one space that is accessible to all families and one space that is accessible to all staff. Other forms of positive distraction shall be provided for families in infant and family spaces, and for staff in staff spaces."[6]

But what about quality?

Clearly the message is getting through about the restorative benefits of nature. This is an important and exciting step. But now new issues and question arise: What kind of nature? What kind of restorative gardens? What sorts of spaces, and elements within those spaces, will be the most beneficial for patients, visitors, and staff? Sadly, designers and clients are often unaware of the research available suggesting what is essential if a garden is to be truly restorative. Outdoor spaces designated as 'healing' often lack such basic necessities as shade, comfortable seating, places for privacy or enough greenery to even be perceived as a garden. Components that have become popular, such as labyrinths, are incorporated without consideration for their appropriateness to the site, understanding of their meaning, or potential users' ability and energy levels.

One of the most frequently recurring reports by garden users about why they visit a garden, and how they feel about it, is that it offers an opportunity to 'get away'. It serves as a much-needed contrast to an indoor environment that is often sterile, alienating and frightening. And yet all too often, the outdoor spaces provided do not offer the escape that people so desperately need.

One assumes it would not occur to a designer of a cancer care clinic or a new emergency department not to consult the latest evidence-based design literature, or at least the minimum standards. In fact, in most cases it would not be awarded the contract unless it had done so. In the case of healing or restorative gardens, this is generally not so. A designer may be hired because she or he has previously created successful parks, office plazas or corporate headquarters – and it is assumed that a healthcare garden is not very different, despite that fact that it may be serving a user group with very specific needs, such as those with cancer, post-traumatic stress disorder or Alzheimer's disease. Some

Nick Merrick

Figure 4: The lush, peaceful courtyard at Scottsdale Healthcare in Arizona (by Ten Eyck Landscape Architects) contains native and drought-tolerant plants and a sculptural fountain. The yellow 'walls' light up at night

professionals are continually hired to design restorative gardens because their resume states that they have done several already, regardless of whether or not the existing gardens have been particularly successful.

In most cases, problems arise when designers and clients are not sufficiently familiar with the essential requirements for restorative gardens. In some cases, the research is known but ignored due to cost concerns. Sometimes the space is designed by a professional not trained in garden design. Landscape architects are the only professionals with enough training and experience in the planning of outdoor space, planting design, detailing and so on to design a restorative garden. A landscape architect must be on the design team from the project's inception. Even within the landscape architect profession, many are not equipped to design spaces for healthcare facilities. Roger Ulrich,[7] whose research spearheaded the movement towards incorporation of nature and evidence-based design in healthcare facilities, put it succinctly when he wrote: "Regardless of whether a garden might garner praise in professional design journals as 'good design', the environment will qualify as bad or failed design in healthcare terms if it is found to produce negative reactions. These points imply that the use of the term 'healing' in the context of healthcare gardens ethically obligates the garden designer to subordinate or align his or her personal tastes to the paramount objective of creating a user-centered, supportive environment."

Success of restorative gardens is critical for many reasons. First, a well-designed, well-constructed and well-maintained garden promotes the best health outcomes. Second, such a garden will bring a positive image to the facility and all of the stakeholders involved. Third, every successful restorative garden is powerful testimony to restorative gardens, and access to nature, as a whole. On the other hand, an unsuccessful restorative garden – whether it was not well designed or has fallen into disrepair – conveys the message that provision of access to nature is not something worth spending precious budget dollars on.

The next step: guidelines

The world is in the midst of a giant healthcare design and construction boom. There is a critical need for evidence-based, or research-informed, guidelines to aid in the design of outdoor spaces that facilitate health. Design guidelines for restorative gardens appeared first in the late 1990s with the publication of Clare Cooper Marcus and Marni Barnes' *Healing Gardens: Therapeutic benefits and design recommendations*[8] and Martha Tyson's *The Healing Landscape: Therapeutic outdoor environments*.[9] The culmination of recent work by Cooper Marcus and Sachs[1] will appear in a co-authored book, *Therapeutic Landscapes: An evidence-based approach to designing healing gardens and restorative outdoor spaces*. The heart of the book is a set of design guidelines. While there is not a vast amount of research on restorative gardens based on post-occupancy evaluations (POEs), there are sufficient repeated findings from these – as well as from less formal evaluations, plus existing audits and best practice – to suggest what is essential in the design of a successful outdoor space in a healthcare facility. In *Therapeutic Landscapes*, one chapter features a comprehensive set of design guidelines applicable to all types of healthcare facilities. This is supplemented by guidelines in the eight following chapters on facilities for particular patient groups.

Guidelines are an important step in aiding designers and clients to make good decisions. However, are they enough? There is a need for designers and clients to be more accountable for what they provide. Two important and related tools are needed now, and both can easily grow out of the guidelines already created and the research upon which they were based: first, a tool for systematic evaluation, and second, a certification programme.

Evaluating restorative gardens

It is important to consider why and how some healing gardens succeed and others fail. Landscape architecture, like other design professions, has been lax in evaluating built work. Unless this happens in a consistent way, designers cannot learn from past mistakes and the profession cannot move forward. It is true that a systematic evaluation costs money. This suggests the need for a line item in the budget for a garden that covers an evaluation – and fine-tuning – one to two years after implementation. Evaluation is an opportunity to learn, to improve an existing space and to add to the fund of knowledge about design.

Post-occupancy evaluation

There are several ways of evaluating the success (from the users' perspective) of a therapeutic healthcare outdoor space, regardless of whether or not it is specifically labelled a healing or restorative garden. The most comprehensive method is a diagnostic POE, where the goals of the original design and how they were translated into physical form are compared with how the space is now used (or not used). Use (by whom and for what) is recorded by an objective measure such as activity mapping, stop-frame filming and the like. The users' feelings about the space are recorded via subjective measures such as interviews or surveys to find out

what they like or don't like, how often they visit, impediments to use, recommendations for change and so on. The use of multiple methods to provide reliable findings is essential. A diagnostic POE – the most in-depth form of POE – is ideally carried out by a team consisting of one or more social scientists familiar with the methods and one or more healthcare garden designers, but not the designers of the garden being studied or anyone responsible for it in any way. This avoids possible bias. Together these two basic categories of data – behaviour-mapping providing objective information about use, and interviews providing subjective information about motivation and feeling – offer a good overview of the success and/or shortcomings of the garden being studied.

An unbiased evaluation of a restorative garden two or three years after construction can document how well the intent of the garden and the needs of its users were understood, how well the original goals of the design were translated into physical form, how well the garden serves the users it was intended for (as well as those it was not planned for), how well the planting is doing, how well the space is being maintained, and what changes in physical design, maintenance, or policy need to be implemented. Ideally, the results of any kind of POE are compared with the designer's and client's original intentions, maintenance or construction changes since the garden was opened, changes to the use of adjacent buildings, and changes of policy regarding who may use the garden, hours the garden is open or similar issues. Particularly important would be the evaluation of a garden based on evidence-based design with specific desired outcomes. A series of POEs of similar types of gardens can provide valuable information on exemplary gardens that can serve as models of user-oriented design, as well as outdoor spaces intended to be therapeutic that have failed to live up to their promise.

To date, some of the most useful POEs of hospital gardens have been conducted by landscape architecture or psychology students as research at masters or PhD level[10-12] or by academics.[13,14] Very few have been conducted or commissioned by the designers or clients. The usual reasons are that the POE is time-consuming, there is no line item in the budget to cover the cost, or the designer does not have the skills to carry out such a study. A less comprehensive and less costly POE, referred to as an indicative POE, can be conducted in a short time span (a few hours to a few days) and can include interviews with the staff and/or the designers and a walk-through evaluation.[15] Of all of the types of POEs, the indicative POE is the closest to an audit.

Audits: an alternative to POE

Audits are, in general, less expensive and less time-consuming than POEs. An audit tool is a scored checklist of elements and qualities that should, ideally, be incorporated into a restorative garden. Unlike a POE, an audit is a process for evaluating only the finished built work and whether it meets minimum standards. This form of evaluation can reveal a great deal about how well design details have been implemented – including suggesting areas in need of change – but reveals nothing about who uses the space or their motivations or the initial goals of the client, designer, and other stakeholders. An audit is usually conducted by three or four individuals who are knowledgeable about therapeutic garden design, but who were not involved in the original programming, design, and construction process. They evaluate the garden separately and then their scores are averaged to avoid any bias.[16]

Cooper Marcus first developed a simple audit tool in 2006 for students on field trips to hospital outdoor spaces. Elements that were considered potentially important were organised and worded so that students could focus on one feature after another as a way to make their visit more instructive than a random wandering through and taking pictures. This initial attempt was followed in 2008 by a more systematic, research-based Alzheimer's Garden Audit Tool (AGAT) for gardens at dementia care facilities,[16] and later by audits for evaluating gardens for the frail elderly, gardens at children's hospitals and at general acute care hospitals. In the latter case, Cooper Marcus and Barnes were hired by a Chicago area landscape architecture firm (Hitchcock Design Group) that specialises in healthcare design. The firm wanted to know how well its designs were functioning. Existing research for each of these types of outdoor space was drawn upon to create a series of qualities and features that, theoretically, should be present. These elements and qualities were scored in each of six gardens being evaluated on a 5-point scale: 0 – Not applicable; 1 – Feature not present or quality missing; 2 – Feature or quality poorly provided; 3 – Feature or quality moderately well provided; and 4 – Feature or quality very successfully provided. Four people evaluated each garden separately and the results were averaged to avoid bias. The 2008 consultant report on the post-occupancy evaluation of six Hitchcock Design healing gardens resulted in some elements being eliminated from the audit tool since they were too difficult to evaluate (for example, 'The garden is culturally appropriate'). In 2012–13 the AGAT tool was adapted and improved by Alzheimer's Australia, and its Dementia Therapeutic Garden Audit Tool will be tested

Mike Wert

Figure 5: The Cloister Garden at St Mary Medical Center in Langhorne, Pennsylvania, by Carter van Dyke Associates, has been designed to be inviting all year round

St. John's Rehab Hospital | Toronto, Ontario, Canada
Farrow Partnership Architects in joint venture with Montgomery Sisam Architects
Photograph: Tom Arban

Cause Health

Farrow Partnership is leading the way to lift the burden of chronic disease. We are dedicated to cause health by healing the built environment.

www.farrowpartnership.com

Farrow

for reliability (www.enablingenvironments.com.au).

Potential audit tool: acute hospitals

The authors are now working with colleagues to refine the audit tool developed in 2008. It is organised under two broad headings, similar to the guidelines in *Therapeutic Gardens*: What is essential (required), and what is desirable but not essential (recommended).[1] At this point it seems appropriate to create such a tool for evaluating a healthcare outdoor space that serves the broadest possible variety of users – an acute care hospital with a range of patient types, staff and visitors. Once this tool is tested, others could be developed for more specific populations and spaces.

The added benefit of a standardised audit tool is that, as audits are performed and information is gathered, we begin to build a database and a collection of case studies of existing built works, something that is sorely lacking in the scholarship of healthcare design. The more that healthcare gardens can be evaluated and documented, the more examples will be available for clients and designers to use as models.

The audit tool is at a preliminary stage of development. It will be developed around a scoring system consisting of two parts: benchmarks (essential features or qualities supported by research and/or best practice) and credits (elements that are desirable but optional, supported by extensive observation, best practice and common sense, but not yet by research evidence).

Organisation of the audit tool will likely be in the following categories:

- **Visual and physical accessibility:** for example, garden is visible from well-used indoor spaces such as lobby, waiting room; doors and thresholds to garden are easily navigable
- **Safety, security, and privacy:** for example, clear boundaries or sense of enclosure; places for people to retreat on their own or with others; adequate lighting
- **Emotional and physical comfort:** for example, covered seating area at garden entry; comfortable seating throughout the garden; mitigation of extreme weather; quiet location
- **Nature distraction/engagement:** for example, high ratio of greenery to landscape; rich sensory details; seasonal interest; sight and sound of water; wildlife

Figure 6: Interior gardens, such as the Thea and James Stoneman Healing Garden at the Dana-Farber Cancer Institute in Boston, designed by Carol R Johnson Associates, are ideal for those who cannot venture outdoors

- **Social connection and support:** for example, semi-private seating clusters; close proximity to nursing units, waiting rooms, staff break rooms
- **Physical movement and exercise:** for example, level, non-glare pathways; appropriate traction; destination points
- **Sense of control:** for example, moveable seating; variety of walking loops; places to sit in sun or shade
- **Adequate maintenance:** for example, garden approach to be regularly well maintained.

The essential next steps will be to refine the audit tool by testing for validity and reliability among people using it, as well as across various different sites and to propose the weighting of various elements. Then, compare this with other audit tools developed for different kinds of indoor and outdoor spaces. These will include the Seniors Outdoor Survey for Staff (SOS-1) and Seniors Outdoor Survey for Research (SOS-2) developed by Susan Rodiek[17]; the US Department of Transportation Walkability Checklist;[18] and the three audit tools described by Ian Forbes in the April 2013 issue of this publication:[19] the Achieving Excellence Design Evaluation Toolkit (AEDET), A Staff and Patient Environment Calibration Toolkit (ASPECT) and the dementia Evaluation Audit Tool (EAT). Sachs is conducting a literature review to locate other existing audit tools that could potentially be used as models.

The third step will be to consider how the proposed audit process can become the basis for the certification of restorative gardens. Testing the audit tool will likely reinform the original *Therapeutic Landscapes* guidelines. In other words, this is not a one-way process, but rather an iterative series of steps that will lead to the best method(s) to both guide and assess healing gardens. At the same time that the audit is being developed and tested and the guidelines are being refined, a certification programme will be developed. While guidelines, evaluations and audits can help designers and clients understand what they should do (or should have done), only certification can hold designers and healthcare facilities to certain (minimum) standards.

Steps to certification

The logical procedure culminating in a viable restorative garden certification programme should follow a sequence of: research • evidence-based design guidelines and standards • audit tool • refine guidelines as needed • certification. Ideally, research will continue to be conducted throughout the entire process.

A secondary benefit with certification would be the validation of the initial guidelines. As certification carries more weight than recommendations, it has the potential to reinforce design guidelines. One informs and strengthens the other. Furthermore, once guidelines are tested through an audit process and formalised








Commercial | Education | **Health** | Hospitality | Industrial | Residential | Retail | Transport | Workplace

Architecture
Interior Design
Planning

"A leading global architecture and design practice, Woodhead is committed to creating life-enhancing healthcare solutions which benefit patients and carers. Our focus is on design excellence and environmentally sustainable design solutions delivered with outstanding service."

www.woodhead.com.au

woodhead™

Figure 7: In this hospital outdoor space, the sharp, angular paths create glare and many dead ends, and the backless metal benches are uncomfortable to sit on

Figure 8: This outdoor space at a hospital in Texas creates an artistic 'designer' statement but offers little for patients, visitors or staff

into a certification programme, they can be incorporated as details for other certifying and regulatory bodies such as LEED, SITES and the Joint Commission.

At this point, the issue of certification, which will most likely be voluntary, raises many questions: Does the same group of people develop both the audit and the certification programme? How will both be developed, tested and implemented? Who will administer the certification process? What is the incentive for a client or designer of a restorative garden to have it certified? Will it encourage a design-to-a-minimum or checklist mentality? Should certification be a one-time event or should it be renewed?

Despite all these challenging issues, it is clear that healthcare facilities are used to being credentialed and may welcome a method for evaluating their gardens. Staff and patients are attracted to facilities with high-quality environments, including outdoor spaces, and a credential document will give designers a common language as to what are healing or restorative gardens.

A useful first step may be to institute a healing or restorative garden award category to be added to those administered by the International Academy for Design & Health (IADH) or by the American Society for Landscape Architects (ASLA). This would help to focus attention on what is good design in this important component of the healthcare environment. While we certainly do not have all the answers regarding these steps towards a consistent approach to evaluation and certification, it is time for us to carry the hard work that has been done thus far to the next level to ensure the best possible outcomes for all involved.

Authors

Clare Cooper Marcus, Hon. ASLA, MA, MCP is professor emerita at the Departments of Architecture and Landscape Architecture, University of California, Berkeley. Naomi Sachs, MLA, ASLA, EDAC, is the founding director of the Therapeutic Landscapes Network and a PhD student in Architecture at Texas A&M University's Center for Health Systems and Design.

References

1. Cooper Marcus C, Sachs NA. *Therapeutic Landscapes: An evidence-based approach to designing healing gardens and restorative outdoor spaces*. Hoboken (NJ): John Wiley and Sons; forthcoming 2013.
2. LEED. *LEED for Healthcare*. Washington, DC: US Green Building Council; c2013 [accessed 26 May 2013]. Available from: www.usgbc.org/leed/rating-systems/healthcare
3. Taylor EM. *Survey of Design Research in Healthcare Settings: The use and impact of evidence-based design*. Martinez, CA: Center for Health Design; 2009.
4. Taylor EM. *Survey of Design Research in Healthcare Settings: The use and impact of evidence-based design*. Martinez, CA: Center for Health Design; 2010.
5. Sustainablesites.org. Austin, TX: The Sustainable Sites Initiative; c2013 [accessed 26 May 2013]. Available from: www.sustainablesites.org
6. White RD, Smith JA, Shepley MM. Recommended standards for newborn ICU design. *J Perinatol* 2013; 33:S2-S16.
7. Ulrich R. Effects of gardens on health outcomes: Theory and research. In: Cooper Marcus C, Barnes M, (eds). *Healing Gardens: Therapeutic benefits and design recommendations*. New York: John Wiley and Sons; 1999. p27-86.
8. Cooper Marcus C, Barnes M (eds). *Healing Gardens: Therapeutic benefits and design recommendations*. New York: John Wiley and Sons; 1999.
9. Tyson M. *The Healing Landscape: Therapeutic outdoor environments*. New York: McGraw Hill; 1998.
10. Pasha S. Barriers to garden visitation in children's hospitals. *HERD*. Forthcoming.
11. Sherman SA, Varni JW, Ulrich RS, Valcarne VL. Post occupancy evaluation of healing gardens in a pediatric cancer center. In: Wagenaar C (ed). *The Architecture of Hospitals*. Rotterdam, Netherlands: NAi Publishers; 2006. p330-42.
12. Sorensen KT. *Effect of Time Spent in a Hospital Garden on Satisfaction with Hospital Care* [dissertation]. Urbana, IL: University of Illinois at Urbana-Champaign; 2002.
13. Cooper Marcus C, Barnes M. *Gardens in Health Care Facilities: Uses, therapeutic benefits, and design considerations*. Martinez, CA: Center for Health Design; 1995.
14. Davis BE. Rooftop hospital gardens for physical therapy: a post-occupancy evaluation. *HERD* 2011; 4(2):14-43.
15. Anderzhon JW, Fraley IL, Green M. *Design for Aging Post-occupancy Evaluations*. Hoboken, NJ: John Wiley and Sons; 2007.
16. Cooper Marcus C. Alzheimer Garden Audit Tool. In: Rodiek S, Schwarz B (eds). *Outdoor Environments for People with Dementia*. New York: Haworth Press; 2008. p179-91.
17. Rodiek S. Seniors outdoor survey for providers (SOS-P); Seniors outdoor survey for researchers (SOS-R). College Station, TX: Center for Health Systems & Design; 2013. Available from www.accesstonature.org/resources.html
18. Federal Highway Administration, National Highway Traffic Safety Administration. *Walkability Checklist*. Washington, DC: US Department of Transportation; 2013 [accessed 26 May 2013]. Available from http://katana.hsrc.unc.edu/cms/downloads/walkability_checklist.pdf
19. Forbes I. From POE to design-in-use: benchmarking for health facility evaluation tools. *World Health Design* 2013; 6(2):50-57.

Further reading

Cooper Marcus C. Post occupancy evaluation. In: Hopper LJ (ed). *Landscape Architectural Graphic Standards*. New York: John Wiley and Sons; 2007. p. 57-63.

Fgiguidelines.org. Dallas: Facility Guidelines Institute; c2013 [cited 2013 May 26]. Available from: www.fgiguidelines.org

Heath Y, Gifford R. Post-occupancy evaluation of therapeutic gardens in a multi-level care facility for the aged. *Activities, Adaption and Aging* 2001; 25(2):21-43.

Care for Design | Design for Care

Montgomery Sisam Architects strive to
normalize the healing environment to positively transform
the healthcare experience for patients, families and staff.

MontgomerySisam

PROJECTS FROM THE TOP CLOCKWISE St. John's Rehabilitation Hospital, in joint venture with Farrow Partnership; Ronald McDonald House Toronto; McMaster Children's Health Centre, Planning, Design and Compliance, in joint venture with Perkins+Will; Centre for Addiction and Mental Health, Phase 1B, Design Exemplar by C3, the joint venture consortium (KPMB Architects, Montgomery Sisam Architects, and Kearns Mancini Architects) / Planning, Design and Compliance by C3+Cannon Design / Design, Build, Finance and Maintain by Stantec Architecture (Architect of Record)
CONTACT Montgomery Sisam Architects Inc. T 1.416.364.6079 F 1.416.364.7723 www.montgomerysisam.com

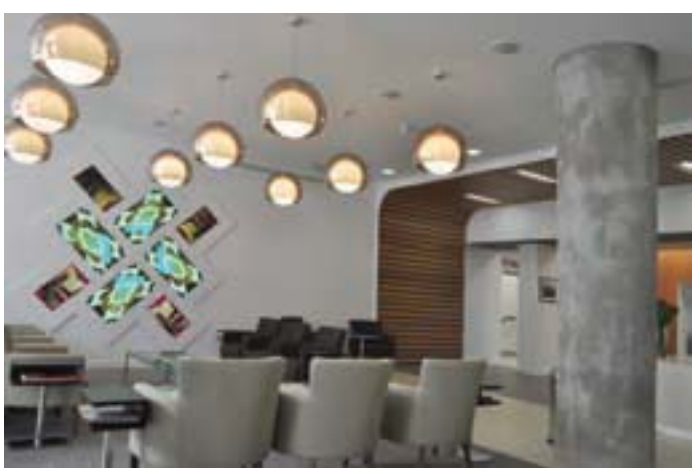
Ambient **healing**

The UK's Montefiore Hospital is using sound and art installations from musician Brian Eno to create a feeling of welcome and serenity for both patients and staff, as ***Veronica Simpson*** reports

Art in hospitals rarely excites much media interest but in April 2013 a burst of publicity exploded around two installations at the newly opened £35m Montefiore Hospital in Hove, on the UK's south coast. Newspapers and broadcasters gushed over the arrival of rock and ambient music star Brian Eno's sound and art installations in the reception area and in a dedicated 'Quiet Room' in the basement. "Brian Eno is helping to improve the nation's health," declared *The Independent* newspaper. In fact, these sensory installations are part of a broader intention to generate a feeling of welcome and serenity throughout this hybrid building. A handsome late Victorian furniture depository turned 1970s insurance company office building, it has been given yet another incarnation by architectural firm IBI Nightingale, as a flagship private hospital for client Spire Healthcare, the UK's second biggest private healthcare provider.

Welcoming patterns

Eno's '77 Million Paintings for Montefiore' is encountered in the plush, thickly carpeted lounge area of the reception and enhances the intended impression of being in a boutique hotel or luxury spa lobby rather than a hospital. An ever-shifting pattern of sound, images and colours drawing on hundreds of Eno's past sketches and paintings plays across eight rectangular flat-screen panels with simple white wood frames. These are clustered together in a diagonal and asymmetrical pattern against the wall. The images on the screens are mostly abstract – Aboriginal-style finger paintings or simple geometric-shape arrangements – but occasionally decorative patterns reminiscent of Islamic art emerge. Generative software ensures an almost infinite variety to the display (you'd have to sit there for 100 years in order to see the same arrangement, apparently). Sometimes the pictures and colours overlap, giving the appearance of richly layered batik textiles, but always the hues shift and evolve at a slow, meditative pace – around 10 seconds per image – accompanied by the gentle 'ping', 'tinkle' and 'bong' of the ambient soundtrack.



Images from Brian Eno's '77 Million Paintings for Montefiore' in the hospitals reception area shift at a slow, meditative pace, accompanied by an ambient soundtrack

Downstairs in the Quiet Room, a much more minimalist version awaits. Eno has been quoted as saying: "Music does something to you that says 'be quiet and listen'." He uses this power to dramatic effect in this darkened room, filled only with four comfortable armchairs, a lamp and one large screen, on which a fixed Mondrianesque outline of one square and two rectangles plays host to a series of very gradual colour shifts, while Eno's soundtrack slowly chimes and bloops in the background.

It's his use of space and tone that really sets Eno apart from other ambient music doodlers – the way he allows each note to resonate, drawing out the qualities of sound as it fades in a way that heightens attention but quietens the mind. And his light paintings do much the same. The wash of light and colour and the slow choreography of hues with sound are viscerally affecting. During a BBC Radio 4 news recording for the *Today* programme, a patient was encountered emerging from this Quiet Room.

He had been in there to reflect on his diagnosis with a severe form of cancer, and yet there he was, enthusing about the calming effect of this room: "It's instant," he said. "Every place should have one. It's wonderful."

There were plenty of challenges in converting this tricky structure, with its staggered floorplates, steep internal ramps and fixed service cores, into an ergonomically efficient and welcoming hospital and one intended to work particularly well for staff as well as patients. But many of the problems posed by the building's past have been turned into assets, resulting in ample, high-ceilinged and substantially daylit bedrooms, surgeries, consulting rooms and reception area. Project architect and studio associate director Richard Ager embraces the idea of the building as 'serene'. He says: "It's a simple way of describing the calm, tranquil spatial experience we were hoping to evoke. The Brian Eno artworks accentuate this intention exceptionally well."

The IBI Nightingale designed Montefiore Hospital was once a Victorian furniture depository

The Eno connection actually emerged from IBI Nightingale's efforts to involve Spire staff quite intensively in the consultation process. One of Spire's leading surgeons, Robin Turner, had encountered Eno's original '77 Million Paintings' installation at the Brighton Festival when Eno was its guest director in 2010. Turner witnessed the calming effect it had on its viewers – some of whom remained in the gallery for hours – and it occurred to him how beneficial such installations could be in hectic healthcare settings. He happened to know Eno's manager lived nearby, and it was during design consultations for the Montefiore that the connection was made. Eno, for his part, welcomed the commission. His interest in using music to beneficially impact on stressful environments is well documented, following the release of his *Music for Airports* album, which has actually been transmitted over the sound system at New York's La Guardia and elsewhere.

Patients and staff both seem delighted with the resulting scheme. Consultant surgeon Sandeep Chauhan says: "It's an incredibly efficient building and genuinely nice to come to. I've never been in an environment before where the inpatients don't want to go home." He and other staff regularly come to the tranquil reception area for quiet chats and meetings. Robin Turner (who admits to unwinding between patients by playing Eno's smartphone app Bloom) likes to simply sit and contemplate the art and soundscape when he can. "It's much more restful having sound with vision – which is in effect just colour and light. It's almost deconstructed. There's nothing to focus on. It focuses on you."

Living elements

These installations feel almost like living elements, in the way that they gently morph and glow and pulse. With one at the most public part of the building and one hidden away, deep in its core, they convey a sort of enduring heart or 'spirit' to the building, a calm, uplifting physical presence that lives on in your memory for days after a visit. What this could mean in terms of reducing anticipatory fear and anxiety to people having to make repeat visits to the facility – for cancer treatment or physiotherapy after hip or knee replacements – is worth investigating. In fact, the hospital is planning a piece of research into the physiological effects of these artworks, working with Diane Waller, professor of art psychotherapy at Goldsmiths University.

Jacqueline Poncelet, an artist with a strong track record in healthcare arts, as well as a current commission from Oxford's John Radcliffe Hospital, says it would be impossible to compare what an art work like this could achieve in the calm of a well-funded private hospital with the impact it might have in a busy, cash-strapped, state-funded one: "You would be doing everyone a disservice to compare the two," she says. But she does think what this artwork says about how art can contribute to wellbeing in healthcare settings is "very exciting".

In the minimalist Quiet Room, colours shift to Eno's relaxing background chimes and bloops

Veronica Simpson is an architectural writer

Project: Sunshine Hospital Inpatient Building, Victoria, Australia.

Silver Thomas Hanley is an international architectural practice with over 35 years of experience delivering innovative health care design solutions on time and on budget that represent exceptional value for money for our clients. Silver Thomas Hanley specialises in the full range of health care design services including architecture and interior design, master planning, spatial planning and feasibility studies.

A national practice, Silver Thomas Hanley is headquartered in Melbourne with offices in Sydney, Brisbane and Adelaide and associated international offices in Canada, the Middle East and South East Asia. With an extensive health care portfolio, our projects range from successfully completed community based projects, research and teaching facilities to large, complex tertiary university hospitals and international health facility master plans.

STH.COM.AU

silver thomas hanley
HEALTH ARCHITECTURE

ARCHITECTURE | INTERIOR DESIGN | MASTER PLANNING | SPATIAL PLANNING | ACUTE HEALTH | FEASIBILITY STUDIES

How do you deal with constantly increasing performance requirements? How do you ensure the optimal utilization rate of your radiology department with its highly qualified employees and the associated cost-intensive modalities? How do you continuously ensure the satisfaction of your referring physicians?

Act on Radiology analyses the processes within your radiology department or practice based on a model specifically developed for the workflows of a radiology department. With the evaluation, we reveal opportunities for improvement and weigh their impact on your processes. Act on Radiology is the first model to sustainably improve your radiology processes in a target-oriented way.

Assess. Change. Treat. Act on Radiology.

Answers for life.