



The Health and Care Infrastructure  
Research and Innovation Centre

# Better health through better infrastructure

2009 Progress Report



## Contents

- 1.0 Who we are
- 2.0 Developing capacity, making an impact
- 3.0 Our vision
- 4.0 Our research





## Welcome

Welcome to HaCIRIC's 2009 Progress Report. *Better Health through Better Infrastructure* offers a chance to reflect on both the achievements of our short history and on the strategy for going forward.

The Centre is now in its third year since foundation. In that time, we have taken enormous strides and have begun to fulfill the imagination and foresight of our funders. We are starting to make a real, measurable impact on the health and care sectors and their supply chains. We have also grown to understand much better the main issues facing our stakeholders and to fashion four key areas upon which to focus our future activity.

HaCIRIC, as Patricia Leahy of the National Audit Office says, is 'bringing innovative, rigorous analysis to the field'. She highlights the useful outputs that are now emerging from all the universities involved.

Our mission – to improve health outcomes through innovative thinking about infrastructure – is bold and creative. It is helping, as Professor Duane Passman of Brighton and Sussex University Hospitals NHS Trust, suggests, 'to take us back to being world class researchers in infrastructure and the built environment'.

This goal is absolutely right for the times, as governments all over the world struggle to create greater value out of tighter budgets. As is clear from this report, HaCIRIC understands the real needs of the sector. It has created the capacity, the vision and the drive to deliver what is needed.

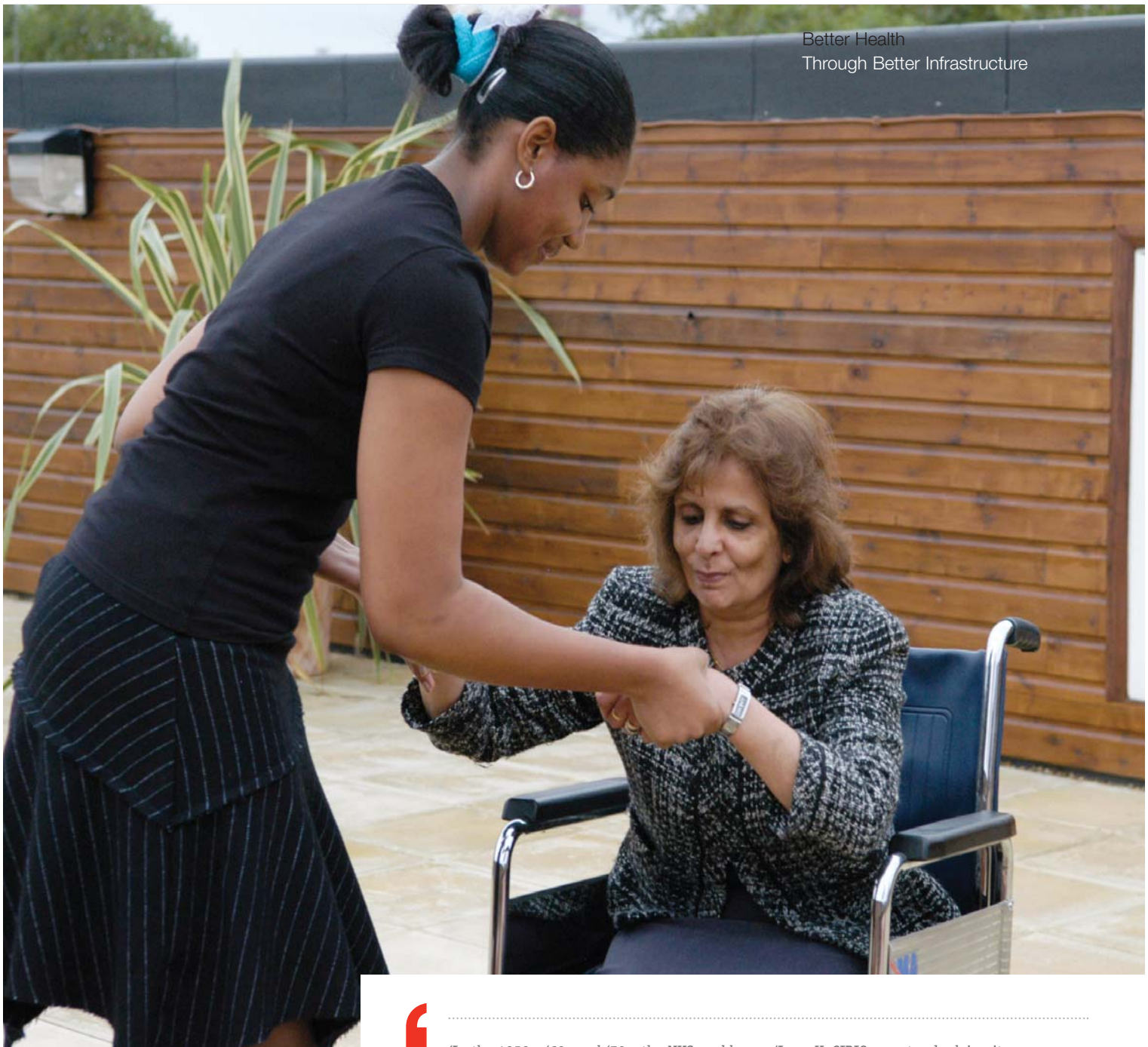
[Professor James Barlow](#)

[Professor Colin Gray](#)

[Professor Michail Kagioglou](#)

[Professor Andrew Price](#)

Co-directors, HaCIRIC



*'In the 1950s, '60s and '70s, the NHS could boast research into infrastructure and the built environment that was world renowned. Experts came from overseas to learn from us how it was done. Then, in the '80s and '90s, funding priorities shifted towards clinical research. As a result, today, we have a potentially world class health delivery system with some world class clinical research supported by an improving infrastructure that is under-researched and therefore not performing optimally.*

*'I have always seen the potential for HaCIRIC to take us back to where we were - world class researchers into infrastructure and the built environment. That's my vision of what HaCIRIC can achieve.*

*'I see HaCIRIC as not only doing its own research but going out and finding innovation, describing it, capturing it and disseminating the learning. We will all benefit from the Centre applying its analytical skills to show what is innovative.*

*'In short, HaCIRIC is not only a research outfit but also a hub of reliable, trustworthy knowledge. I see the Centre translating research into learning that the NHS understands and can use in the practical implementation of policy.'*

**Professor Duane Passman**  
**3Ts Programme Director,**  
**Brighton and Sussex University**  
**Hospitals NHS Trust**

# 1.0

## Who we are

The Health and Care Infrastructure Research and Innovation Centre (HaCIRIC) aims to improve people's health and wellbeing by supporting the development of better health and care infrastructures.

Until recently, healthcare research concentrated mainly on how clinical interventions impact on health outcomes or on how services can be improved.

So our emphasis on the impact of infrastructure represents a significant widening in thinking.

Since it was founded with core funding from the Engineering and Physical Science Research Council (EPSRC) just three years ago, HaCIRIC has become the largest centre of its kind. In a relatively short time, we have pioneered a wide-ranging and integrated programme of research to transform and embed understanding of how buildings, systems, services and health outcomes interact. We are building a global reputation, with an approach that is collaborative, strategic, change-focused and outcome-orientated.

We have successfully forged a single purpose from the cultural and disciplinary diversity of our four parent institutions: Imperial College London and the universities of Loughborough, Reading and Salford.

The capacities developed in HaCIRIC's critical mass of 23 directly supported researchers, the majority starting out on their careers, promises enduring value to the UK healthcare sector.



*HaCIRIC has the potential to take us back to being world class researchers in infrastructure and the built environment'*

**Professor Duane Passman**

## 1.1 Our work makes a difference

HaCIRIC's research is providing vital help in achieving the Government's priorities: to maximise health outcomes, to improve quality in healthcare, to shift patterns of care between the acute and community sectors, and help to bring the benefits of innovation to patients more rapidly.

Our research areas – involving 40 interconnected projects underway or recently completed – reflect the expressed needs of the NHS, its users and other stakeholders. These range, for example, from the immediate demand to tackle healthcare associated infections in a systematic manner to understanding the potential benefits of telecare for those with long-term conditions.

The Centre's unique capability is particularly important, given the current economic recession, weakness in public expenditure and the drive for efficiency and productivity gains in healthcare. Innovation to deliver infrastructure and redesign is needed now more than ever. It will also help keep the UK competitive in the provision of healthcare services to overseas markets.

Our action research philosophy and our strategy to engage international research collaborators around common priority issues will offer significant benefits to the UK care system. It will lead to improved value for money, better outcomes for patients and staff, and creation of infrastructure that addresses emerging needs.

## 1.2 We aim to help

HaCIRIC enhances the effectiveness of public services and policy at all levels.

The Centre helps:

- **Government** to spot and resolve policy incoherence and irrationality. We identify, for example, how different targets and policies may work against each other. We offer suggestions of when whole system thinking is needed and exemplify where it works.
- **Managers** to streamline institutional relationships, reducing resources required to coordinate multiple organisations when pursuing change in services or infrastructure.
- **Frontline staff** in developing ways to create a better working environment, a safer workplace, fewer clinical errors and buildings that are fit for purpose
- **Users** to have a better experience, where care is high quality and as convenient as possible.

The Centre has disseminated and validated its work with these key audiences through publications and workshops. It has also hosted policy meetings and international conferences, and participated in government and industry inquiries and working parties.



*'The Department of Health's research strategy 'Best Research for Best Health' was published just over three years ago. In this strategy greater emphasis was given to translational research and to innovation.*

*'Additionally, antimicrobial resistance and healthcare associated infection (HCAI) have been recognised as important public health problems requiring improvements in the evidence base. This area is one of very high priority to the Department of Health and to our Ministers.*

*'HaCIRIC's work is helping to build the evidence base in important areas of priority to the Department. Of particular relevance to DH priorities has been the work led by Reading University working with London hospitals on HCAs and work at Imperial College on telecare / telehealth research, including the stroke care project and the work on the Whole System Demonstrators. The important aspect in each of these activities has been that the research effort is focused on breaking down traditional silos and bringing together work on innovation in healthcare services, technologies and infrastructure.'*

**Bill Maton-Howarth**  
**Chief Research Officer, Public Health**  
**Department of Health**

## 1.4 Partnerships are important

There is now significant awareness of HaCIRIC within the UK, the principal market to apply our work for the benefit of the British taxpayer. Around the world, especially the USA, mainland Europe and Australia, we are positioning ourselves as a world-class centre of research and innovation.

### 1.4.1 International Collaboration

The complex nature of a healthcare infrastructure system poses enormous challenges in developing evidence for future effective decision-making. Valuable lessons can be learnt from comparative research on other countries' systems. Consequently we are developing a range of international partnerships:

- A European Centre for Health Assets, initially with three other research institutions (TNO from the Netherlands, SINTEF from Norway, and HUT from Finland).
- HaCIRIC is undertaking its first transatlantic collaborative project with MIT and Harvard Medical School, on stroke care innovation.
- As international co-ordinator for the Rotterdam-based international organisation, Conseil Internationale du Bâtiment (CIB), which develops expertise on technical issues for healthcare clients.
- Dissemination in collaboration with the International Academy for Design & Health.



*MaST LIFT company is responsible for delivering a number of health and social care facilities in the Manchester, Salford and Trafford area under the LIFT public private partnership programme. HaCIRIC is helping us with a benefits realisation project to look at whether we are achieving the benefits that we expect from the facilities we provide.*

*The Centre has helped us to design workshops to estimate the potential benefits of developments. It has generated detailed sampling information to ensure that we have a proper research sample of end users. It has also done some statistical modelling to work out which questions are most useful in assessing the benefits achieved. HaCIRIC has then summarised the information gathered and statistically reviewed the returns.*

*'Of course, we have always assessed whether we have been successful in achieving our goals. But that's been quite a general assessment, understanding whether people value the benefits we attempt to deliver is a very different challenge.*

*'Working with HaCIRIC gives us the opportunity to drill down a great deal further, to challenge some of our assumptions as to what precisely makes a scheme or a building work for users, so that we can justify our choices when we build elsewhere.*

*'My aspiration is to identify a benefits currency – a common currency which allows us to weigh some benefits against other benefits and against disbenefits. We are working with HaCIRIC in conjunction with the Community Health Partnerships team to consider ways in which we might do that. So, once we have gauged satisfaction from a building in terms of people, for example, considering it more welcoming, I want to know why they feel that way. Is it, for example, because of the vase of flowers or because of the extra light from a larger window? This will be really valuable learning and should lead to continuous improvement that lies at the core of the LIFT mission. Importantly, this additional step in our research should enable us to specifically link the scheme cost to the items that maximise stakeholder benefit.*

*'In trying to develop more sophisticated understanding of benefits realisation, HaCIRIC gives us access to a wide network of health and social care professionals. It runs and manages a senior advisory group comprising people from trusts around the country. This allows us to challenge our assumptions and learn from practice elsewhere. So HaCIRIC is supporting real knowledge transfer applied to real issues that we want to tackle.'*

**Clare Postlethwaite**  
**Partnership Director**  
**Manchester, Salford and**  
**Trafford LIFT**

*(Clare Postlethwaite won the CHP Special Achievements Award in the 2009 Annual LIFT Awards in part for her work with HaCIRIC)*



*HaCIRIC is fairly unique worldwide in supporting research that has global importance.'*

**Dr Stan Finkelstein, M.I.T.**

## 1.4.2 UK collaboration

The Centre involves the collaboration of EPSRC sponsored research centres from leading UK research institutions – Imperial College London and the universities of Loughborough, Reading and Salford. Its researchers bring together many disciplines including economics, engineering, architecture, social psychology, management and policy studies.

Collaborators include suppliers in the private sector, healthcare providers, government and academia. Among them are:

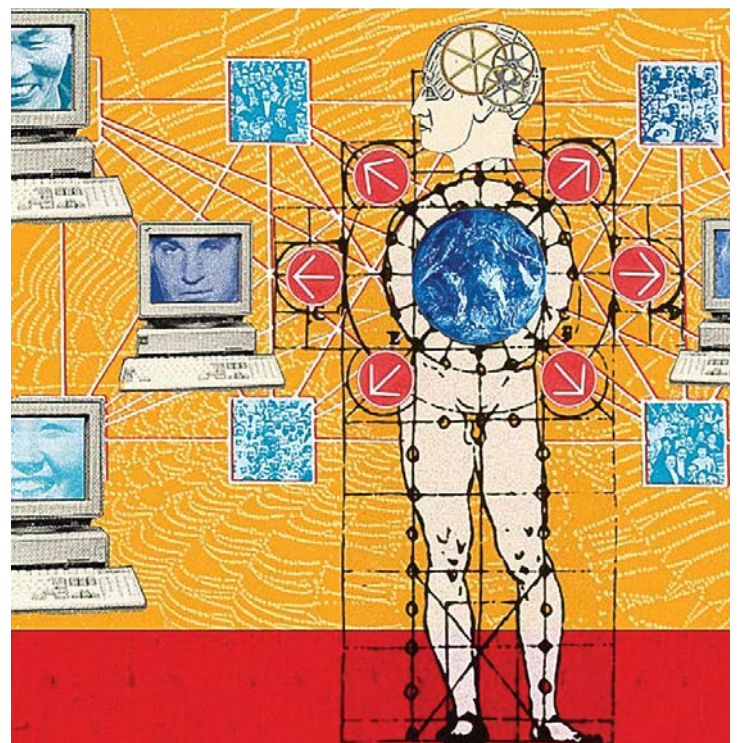
- 3M, Arup, Ashen+Allen, Penoyre and Prasad, Laing O'Rourke, MACE and Wilmott Dixon in the supply sector.
- Leading universities through collaborative research projects, including University College London, Heriot Watt, Lancaster, Southampton and Sheffield universities.
- Research institutes – MARU (Medical Architecture Research Unit) and the National Nursing Research Unit.
- The King's Fund, UCL, Oxford University, Manchester University and the London School of Economics to evaluate the Government's Whole System Demonstrators Programme, which involves using new technologies to reshape services for people with long-term conditions.
- The NHS Institute for Innovation's £10m CLAHRC programme in north west London to transform health service delivery around innovative approaches including new infrastructure and innovative technology.
- A wide network of organisations from NHS acute and primary care trusts in England and Wales, the Department of Health and the Scottish Office.



*'HaCIRIC is fairly unique worldwide in having the opportunity to support research that has global importance. The Centre's portfolio of projects covers lots of important areas that could contribute to system solutions for the healthcare crisis that affects most health economies in the developed world. It is fortunate in having an enlightened funding source in the EPSRC, which recognises the importance of these issues. In the US, none of the agencies in the Federal Department of Health and Human Services has made significant amounts of funding available for researching infrastructure and innovation.'*

*'MIT is currently undertaking a research project with HaCIRIC on stroke care. We see that the Centre not only understands, in the same way as we do, the problems that need to be addressed but that its staff are smart and capable intellectually. The Centre has bright people who are taking a multi-disciplinary approach to deal with these problems.'*

**Dr Stan Finkelstein**  
**Senior Research Scientist**  
**Massachusetts Institute of Technology**



## 2.0

# Developing our capacity, making an impact

HaCIRIC has been in existence for three years. In that relatively short time, the Centre's excellent capacity to examine infrastructural planning and delivery issues has already shown that it can support UK healthcare.

The EPSRC funding has made it possible to develop an extended and integrated programme of research that is cross-institutional and cross disciplinary from groups that might not otherwise have worked together. This includes not just the four core universities, but also a further seven universities collaborating directly in projects with HaCIRIC funding.

We have now successfully recruited our full complement of researchers. We have a portfolio of 40 projects completed or underway involving 23 appointed researchers and the strong collaboration of a significant part of the user community. The majority of our researchers are young, gaining a good grounding in their research, and should provide value to the UK healthcare sector for many years to come.

We are making an impact in the form of publications in leading journals, invitations to participate in policy advisory committees, engagement with the infrastructure supply chain and healthcare trusts, and through our annual conference which now attracts around 75 participants from the UK and abroad. The IMRC grant has also helped leverage over £1million funding from the Department of Health and other sources for HaCIRIC-related projects.

*Until HaCIRIC, I never experienced an organisation that could bring academic rigour to benefits realisation.'*

**Karen Hicks**



*'The National Health Service has identified the importance of benefits realisation in its investment proposals for ten years or so now. However, until HaCIRIC, I never experienced an organisation that could put the academic rigour on that ambition. In that period, many hospitals have been built, on the basis of expected benefits, but I have not seen much published evidence of rigorous evaluation. Now, thanks to the academic approach that HaCIRIC brings to the field, we have an opportunity to prove the benefits of different policies so that the Value for Money debate can have genuine substance.'*

**Karen Hicks**  
**Project Leader,**  
**Laing O'Rourke**



*'I am pleased that HaCIRIC is engaged with organisations like mine to help us to produce better guidance, standards and implementation advice for the NHS in estates and facilities.'*

*'We need information and evidence that can help commissioners, as well as health and care providers, to plan their services and facilities more rationally. HaCIRIC is offering real support because it works at the boundary between estates and clinical delivery.'*

*'Salford University (a partner in HaCIRIC), in particular, has looked at the LIFT programme, and is supporting that programme's efforts to achieve greater value for money. Likewise, the research into healthcare-associated infections, led by Reading University (a partner in HaCIRIC), has the potential to be really powerful.'*

*'A key challenge as findings and evidence come on stream will be how HaCIRIC engages with the wider health community and disseminates learning so that it can achieve maximum impact.'*

**Rob Smith**  
**Director of Gateway**  
**Reviews and Estates and Facilities,**  
**Department of Health**



*I am involved in helping big health systems change. I see HaCIRIC as a crucible for knowledge about health technology and innovation that I need if I am going to help deliver higher quality, more efficient, more accessible healthcare.*

*'HaCIRIC has the networks. It knows the people. It is confident about what it says. I care about judgement that I trust. The Centre is an interlocutory between the evidence that is out there and what I need.*

*'There is terrific resistance to innovation adoption in healthcare from parochial and political interests. Nevertheless, HaCIRIC's time has come because the days of conventional hospitals will soon be over, given the nature of finances, market forces, the pipeline of technology and changing public sentiment. HaCIRIC's understanding of systems and technology is hugely valuable as we move to the next stage. It will help us weather the storm that is coming.'*

**Professor Laurie McMahon,  
Director of Strategy and Futures  
Organisation,  
LOOP2**

## 3.0 Our vision

We seek to create and develop a Centre that is:

- **World-class**, recognised and respected both in the UK and internationally for the quality of its research, the skills of its staff and the magnitude of its impact.
- **Sustainable**, with sufficient momentum, skilled staff and funding so that it continues to achieve its short, medium and long-term goals.
- **Challenging**, to help shake up conventional thinking.
- **Collaborative**, involving long-term, embedded engagement with key partners in the NHS, Government, the supply chain and academia.
- **Strategic**, tackling key issues in a systematic and timely way.
- **Practical**, focused on real life problems, alongside the contributions to theoretical knowledge.

### 3.1 How we work

Working towards these medium and long-term goals demands that we emphasise some key features:

- **Innovation** should be embedded as everyday practice in healthcare organisations.
- **Strategic coherence** is desired where there may be many stakeholders, diverse organisations and multiple ambitions.
- **Future thinking** is necessary so need is anticipated and infrastructure is flexible to new demands.
- **Quality of experience** for patients and staff is paramount, achieving better choice of what is provided and where.



*The HaCIRIC International Conference 2009 included excellent presentations and opportunity for dialogue. It is on the way to becoming the pre-eminent forum for improving healthcare infrastructures through innovation.'*

**Neil MacConnell**  
Vice President of Strategic Development and Renewal,  
Providence Health Care, Vancouver, Canada

### 3.2 Professional practice

We have a vibrant, creative team. Our professional practice reflects the values we seek to embed within the organisations that we partner and support. Our working practices seek to ensure we are:

- **Strategic**, avoiding short-term, 'quick fixes'.
- **Outcome-orientated**, gathering and learning from all forms of evidence.
- **Impact focused**, engaging with people who can make a difference, be it at a policy level or in front-line delivery.
- **Collaborative**, building a community of people, who, though from different disciplines, understand each others' work, thanks to strong communications.
- **Communicative**, disseminating our findings and listening to our stakeholders.
- **Supportive of new ideas**. Our 'Peer Assist' process for evaluating and sanctioning research is designed to nurture fresh thinking and mentor talent.
- **Independent**: We receive public funding and some private sponsorship, but do not work on behalf of commercial clients.
- **Urgent**, establishing around 40 projects, with 23 researchers across the four universities in little more than 30 months.

## 4.0 Our research

The complexity of health and social care provides enormous challenges in developing the evidence to support effective decision-making about investment in new services, technologies and infrastructure. We aim to create new knowledge and decision support tools to take up these challenges in partnership with leading national and international partners.

### 4.1 Priorities

It is vital to target our resources at the questions that matter to society and which allow best use of HaCIRIC's strengths. HaCIRIC has therefore identified four **core collaborative areas** for research (CCAs). These concentrate on acknowledged issues in policy and practice. They ensure a more integrated approach to researching and delivering innovation in healthcare services and infrastructure.

### 4.2 Core collaborative areas (CCAs)

Our four CCAs address a set of related issues:

- how innovation can be stimulated,
- how its implementation and spread can be managed more effectively, and
- how better understanding of its impact and value can improve decision making.

The four CCAs are:

- 1 Stimulating innovation through finance and delivery models
- 2 Managing change and innovation
- 3 Innovation impacts – outcomes and processes
- 4 Design and decision making



*HaCIRIC is bringing innovative, rigorous analysis to the field. I see very useful outputs from all of the universities and from them working together.'*

**Patricia Leahy, NAO**



*'At the NAO, before HaCIRIC was created, we perceived a big gap in the evidence needed for sound policy and decision-making on healthcare infrastructure and service provision.*

*'Now, HaCIRIC is bringing innovative, rigorous analysis to the field. I see very useful outputs from all of the universities and from them working together, which informs our work on value for money in this field. For example, we are already using work by the Centre on the operational performance of PFI hospitals and this has certainly been helpful to us.*

*'The Centre is developing insights and new tools that will help a wide range of stakeholders in the healthcare field. For example, the benefits realisation research and toolkit being created in Salford will allow local and central bodies to decide, on firm evidence, what to do both at a detailed and strategic level. Up until now, there have been no rigorous framework or tools. So this is a good example of how HaCIRIC's work is really meaningful.*

*It will enable people to do what the guidance asks them to – identify the benefits that they want, work out how to achieve them and who is responsible, track expected benefits and other impacts, and measure them. In addition, it will encourage continuous improvement through feedback loops.*

*'It is ambitious to develop a virtual research centre - it's bound to take time for parties to understand each other's work and motivations. There has been a necessary period when a lot of investment has been needed on the ground. And it is still a relatively early stage for such an impressive, ambitious programme. But I see it as well-placed now to develop faster. I see things really taking off and important results yielding from the work.'*

**Patricia Leahy,**  
**Director of Public Private Partnerships Studies,**  
**National Audit Office**

## 1 Stimulating innovation through finance and delivery models

This area of work looks at how procurement, contractual and financing models – along with targets and incentives - influence innovation in healthcare infrastructure and services.

It examines how new procurement models can promote innovation and achieve continuous improvement, and how policy targets and incentives can be more effectively used. We are learning how the use of public sector demand can secure innovative solutions and products. There is more understanding about the role of lead users in stimulating innovation. We are also recognising how patterns of supply chain liability can influence innovation and performance.

Our initial studies on adaptability and innovation in healthcare facilities and performance of PFI and non-PFI hospitals explored how funding models impact on design and performance outcomes. We have also completed a project on the four-hour emergency access programme as a system innovation, which sheds light on how a government target can impact on a whole system. This project is revealing how best to use levers to stimulate change across the care system.

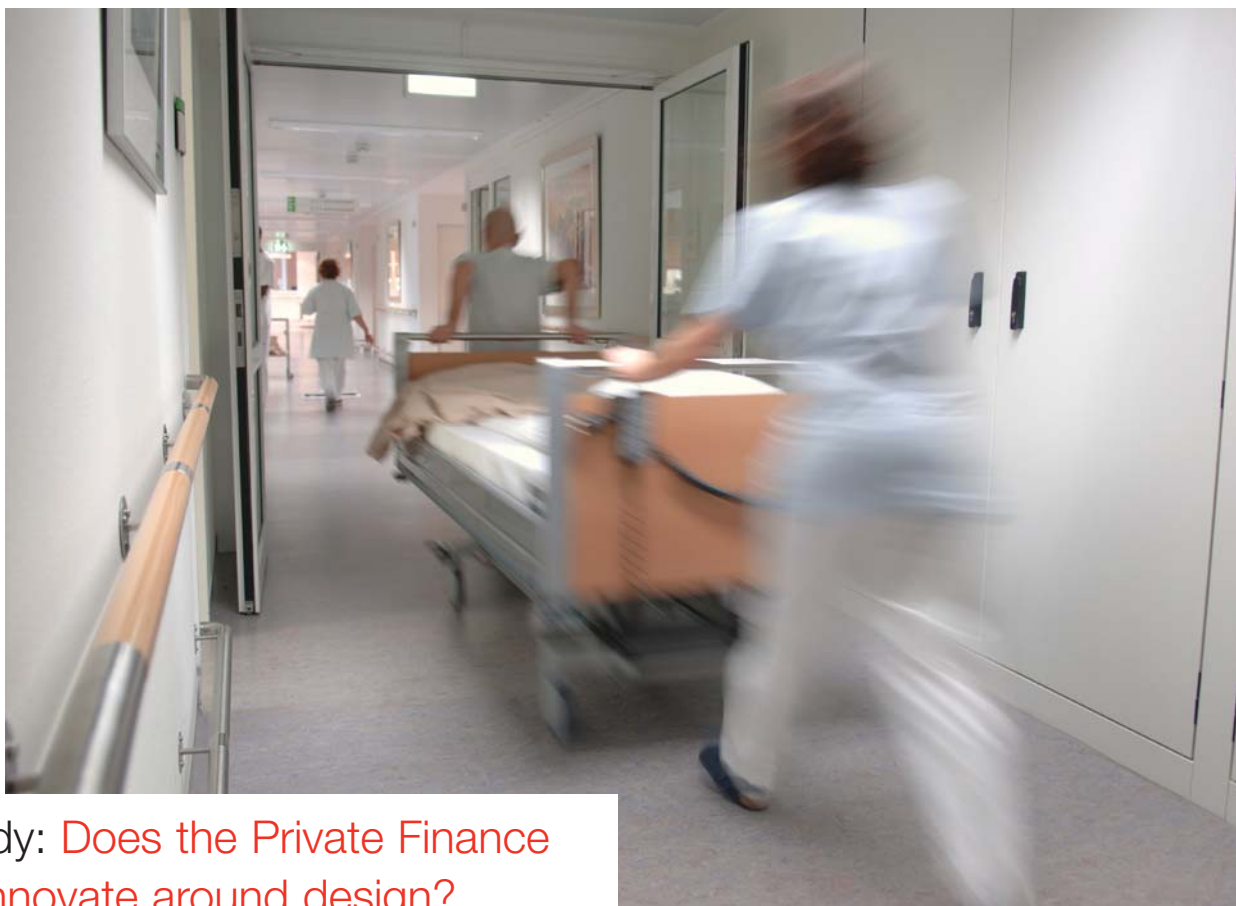
This research has developed into a portfolio of new studies. They explore how financial structures, procurement methods and incentives lead to the diffusion of innovation in construction supply chains. They also look at how power in decision-making can influence the generation and/or adoption of innovative processes and products. Some of this research is being carried out in other European countries, looking at how EU structural aid impacts on the delivery of innovative healthcare infrastructure.



### Core projects:

- Adaptability and innovation in healthcare facilities
- Comparative analysis of performance of PFI and non-PFI hospitals
- Financial structures and procurement methods, and their impact on innovation in infrastructure delivery
- The impact of project organisational structures on innovative practices in healthcare infrastructure procurement processes
- Incentivisation and innovation in construction supply chains
- Impact of EU structural aid on the delivery of healthcare infrastructure (collaborative project with European Centre for Health Assets and Architecture).





## Case Study: Does the Private Finance Initiative innovate around design?

The Private Finance Initiative (PFI) has been used for almost all hospital building schemes in England since 1997. It was primarily seen as a way of renewing NHS facilities faster than would be the case under conventional public funding models, while the long-term contracts would ensure that facilities are well maintained over their lifetime. But a key driver was also the perceived benefits of PFI in injecting innovation into the health sector.

As one health minister put it, PFI is 'much more than a new hospital building programme ... It has to become the principal mechanism for getting new design solutions into the NHS, not just in buildings but in processes too'. The Treasury stated in 2000 that innovation is a key principle in PFI for delivering the ambition of good design. The use of PFI within the NHS has been highly controversial. Research and official reports focus almost entirely on its financial characteristics, especially its long-term cost to health service operators. With the support of the Howard Goodman Fellowship, HaCIRIC carried out the first detailed study of the relationship between PFI and innovation in the design of healthcare infrastructure to enable adaptability to future demands.

We selected six hospitals built under pre-PFI delivery models (during the 1970s and early 1980s) and seven PFI schemes as case studies, all planned during the first wave of the PFI programme and therefore subject to the same policy and economic environment.

PFI has almost certainly brought forward a high volume of new infrastructure – probably higher than would have been the case under traditional funding models. However, despite concern over the potential future impact of changes in the demand for services, and a desire to include a degree of adaptability in schemes, there was very little innovative thinking in design solutions. The PFI consortia were concerned to minimise exposure to possible risks and their clients – the hospital trusts – were highly price sensitive and unwilling to pay for innovations that often involve additional short term costs. Nor was it evident that PFI had promoted more collaborative ways of working, which often leads to more innovation during the development and construction phases.

Looking at the pre-PFI schemes, it was clear that, while far from perfect, the different planning, financing and development model when they were built had resulted in considerable design and construction innovation. Greater integration among multidisciplinary staff in regional hospital boards and their close ties to individual hospitals not only allowed an in-depth understanding of healthcare needs and infrastructure requirements but also close collaboration between infrastructure planners and infrastructure users. This resulted in forward-looking solutions, designed to accommodate future changes easily without disruption to clinical operations.

The project findings have been published in the leading journals, *California Management Review* and *Research Policy*.

## 2 Managing change and innovation

This area of work aims to ensure that HaCIRIC's mission of 'innovation as normal business' becomes a reality. So we have developed projects to understand how to support better the adoption, spread and sustainability of innovations in healthcare services and infrastructure systems. We want to understand how innovative capacity can be maximised and translated into better healthcare for patients.

This CCA extends our existing work on how stakeholders with differing needs and expectations influence innovation. Our projects focus on the challenges of diffusing innovation across a landscape that is populated with multiple organisational stakeholders and professional groups. We want to know how to introduce, embed and sustain complex innovations so they become part of everyday practice.

So we are learning about strategic decision making and the role that organisational ownership and identity can play in increasing innovation capacity. We are examining the challenges of top down, centrally managed innovation programmes, comparing them with more organically grown, localised innovation projects.

Our initial research on evidence and innovation explored the factors influencing the uptake of telecare. This is a key vehicle for achieving whole system change and integration, and an important part of the emerging health and social care infrastructure in the UK.

Following this work, the Department of Health invited us to form a consortium (with UCL, the King's Fund, Oxford University, Manchester University and LSE) to evaluate the government's Whole System Demonstrators (WSD) programme. Our role is to investigate the adoption and sustainability of telecare technologies and services implemented under the WSD as well as in other localities.

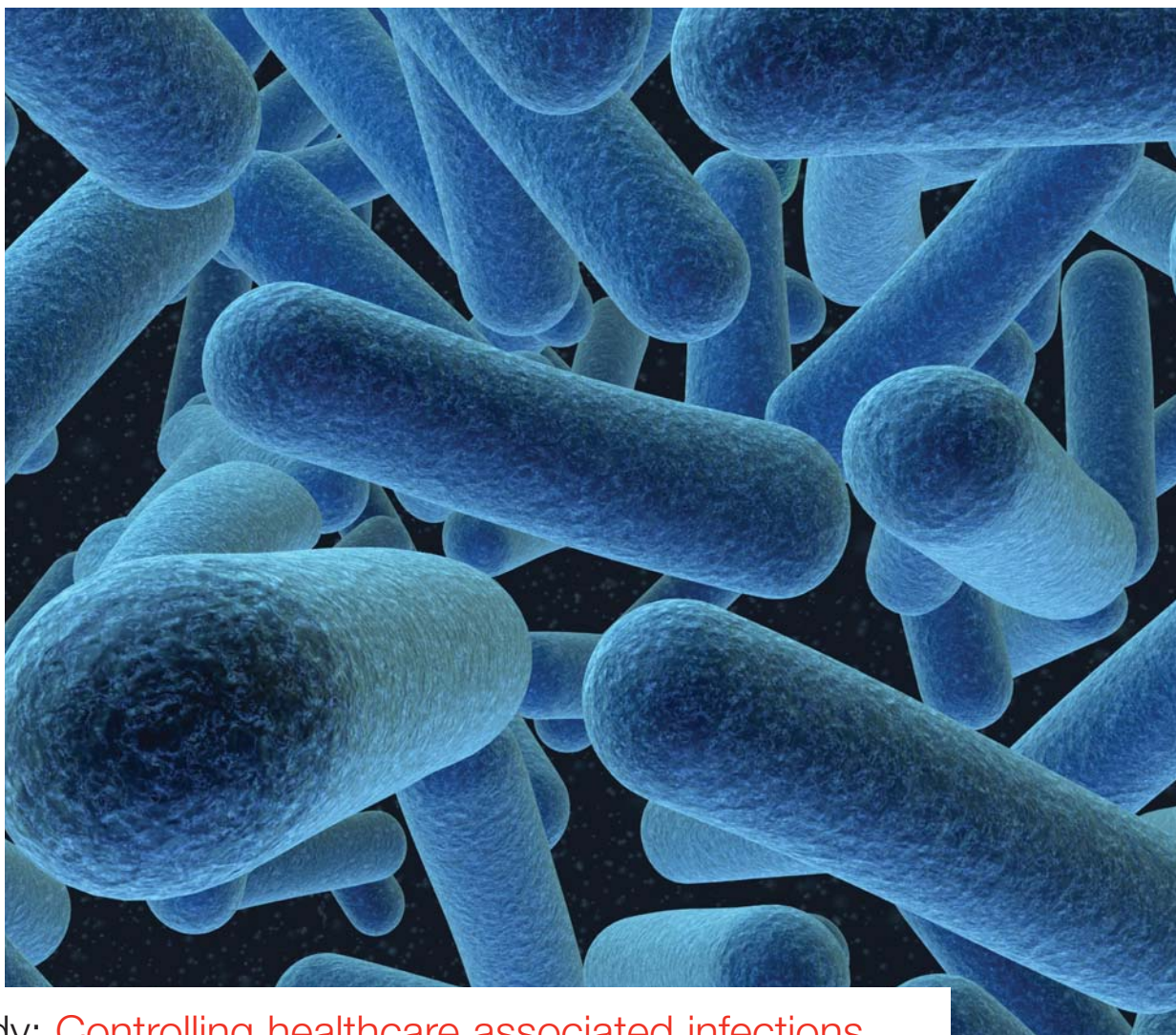
We are also involved in a major care service transformation programme, the North West London Collaboration for Leadership in Applied Health Research and Care (CLAHRC). This brings together local stakeholders to trial innovations in service delivery for people with acute and chronic care needs. Our role within the CLAHRC consortium is to investigate the ability of the programme to stimulate, accelerate and sustain innovation.

Other HaCIRIC projects are also shedding light on managing change and innovation across parts of the healthcare service and infrastructure systems. They include our work on Scotland's four-hour emergency access programme and our new projects on the control of health associated infection and on the impact of moving to single room hospital accommodation.

### Core projects:

- Evidence and innovation – adopting and diffusing a complex innovation in care services
- A comprehensive evaluation of the implementation and impact of telecare and telehealth across health and social care – the Whole System Demonstrator (WSD) evaluation (collaborative project with UCL, the King's Fund, Oxford University, Manchester University and LSE)
- An organisational analysis of North West London Collaboration for Leadership in Applied Health Research and Care (CLAHRC)
- Scotland's four-hour emergency access programme as a system innovation.





## Case Study: Controlling healthcare associated infections

In October 2008 HaCIRIC launched a new multi-disciplinary, cross-institutional research programme on controlling healthcare associated infections (HCAI) such as *Staphylococcus aureus* (MRSA) and *Clostridium difficile*. The cost of HCAI to the NHS in 2000 was estimated to be as high as £1bn a year, with potential avoidable costs of around £150m annually. Estimates suggest that, at any one time, 9 per cent of all in-patients have an infection associated with their care in hospital.

One strand of the programme investigates the efficacy of the routine cleaning currently undertaken in hospital wards to reduce transmission of HCAI. Cleanliness on hospital wards is currently assessed using subjective methods, primarily visual inspection. The research compares routine subjective assessment with objective methods such as quantitative microbiological data and uses a hygiene surveillance tool – 3M Clean-Trace – to evaluate the cleanliness of high contact surfaces and the general hospital ward environment.

Another strand of the programme tests the hypothesis that the physical design of healthcare facilities influences user behaviour and that such behaviour might promote or mitigate the spread of healthcare associated infection.

The research identifies the contribution – if any – of people's movement to the spread/cross contamination of spaces. The project will integrate its findings with other studies to provide a holistic view of this complex area. A third strand of the programme aims to develop a design audit tool to identify and implement control of infection measures in briefing, design development and construction, and in managing the operation of hospital facilities.

The specific objectives are:

- To identify areas with greatest risk of infection, and the patterns and sources of infection in hospitals.
- To explore the role of different stakeholders in planning facilities and their impact on design decisions.
- To examine the impact of organisational drivers on key design and management factors and their influence on the decisions regarding infection and control measures.
- To evaluate the impact of design on clinical and facilities management, and on behavioural practices.
- To develop an audit tool to formulate infection control measures. It is envisaged that the impact of the research will be of immediate national and international importance, contributing to reduced HCAI.

### 3 Innovation impacts – outcomes and value

This area of work develops new ways to capture the potential and realised value delivered by innovative infrastructure and services. It fosters a better understanding of the relationship between health outcomes and innovation in infrastructure and services. This knowledge is critically important for planning services and infrastructure.

Preliminary research has been undertaken about the effects of the built environment on health outcomes and mental health and wellbeing. These reviews have found considerable evidence linking healthcare environments to patients' health outcomes. However, the causes of the correlations remain unclear.

This has led to new projects on the impact of therapeutic design of healthcare environments and the design of flexible healthcare space in relation to patient care, clinical recovery, privacy and operational efficiency. These projects are using modelling and simulation to collect and utilise evidence relating to the impact of aesthetics, ventilation, acoustics, energy, lighting and thermal comfort.

We now have a portfolio of projects designed to observe closely significant innovations that have been introduced to health services, operations and provisions. This includes work looking at benefits realisation, to develop a more intuitive brief and then to follow the process through to delivery and post occupancy evaluation. There are also three interconnected projects, bringing together HaCIRIC and external collaborators, to explore the impact of the built environment and user behaviour on healthcare associated infection.



#### Core projects:

- Effects of the built environment on health outcomes
- Mental capital and wellbeing: the effect of the physical environment on mental wellbeing
- Nurturing an evidence-based learning environment (collaborative project with University of Sheffield)
- Innovative design of well-performing built healing environments.
- The design of sustainable healthcare infrastructure to improve resilience and adaptation
- Healthcare facilities: the environment, user behaviour and hospital associated infection (collaborative project with UCL)
- Objective assessment of hospital ward cleaning using hygiene surveillance and continuous improvement process tools
- Design guidelines for controlling hospital associated infection (collaborative project with MARU, London South Bank University)
- A 'before and after' study of the impact of moving to single room hospital accommodation: workforce implications, and staff and patients' experience of care in a new physical environment (collaborative project with National Nursing Research Unit, Kings College London)



## Case Study: Exploring the effects of the built environment on health outcomes

Every day, thousands of people experience the pressure of a hospital environment. Inappropriate surroundings can aggravate anxiety, depression, stress and emotional exhaustion, among other effects. In order to create environments that support and enhance the healing process, we need to understand how the physical characteristics of healthcare environments affect health.

This project identifies which characteristics, features and aspects of the built environment affect health outcomes. It also investigates how designers can use information linking the built environment and health outcomes to develop better healthcare facilities.

The research – published as a HaCIRIC working paper – found considerable evidence linking healthcare environments to patients' health outcomes; however, the causes of these correlations remain unclear. This project developed a framework mapping existing research that links the characteristics of the built environment to health outcomes.

The recommendations from the research include:

- There is a substantial amount of information available in relation to the impact of the built environment on health outcomes. However, there is little information regarding how an evidence-base could be used to inform designers. The development of more “transparent” tools for managing information could be useful for future developments.
- Due to the number of variables associated with the built environment and health outcomes, and the complex relationships between them, cause and effect relationships are not clear. Therefore, it is necessary to develop a theoretical framework that considers not just isolated elements of the built environment (e.g. light, ventilation, colour) but also design compositions.
- Further investigation is needed to understand how knowledge management tools and techniques can be applied to inform designers about the existing evidence-base related to links between health outcomes and the built environment.
- There is a need to build an evidence-base about how changes in the operation of healthcare facilities can improve healthcare delivery.
- Further research is required to investigate how evidence supports existing theories of building design.

## 4 Design and decision making

Decisions on new healthcare services often seem to be made with little evidence of their potential impact on building service performance, occupancy, patient wellbeing and care outcomes. We need more integrated approaches to planning healthcare infrastructure and services.

A number of projects are underway that shed light on how different stakeholders value innovations. Through these we are developing better ways to capture, quantify and integrate stakeholder perceptions of 'value' so that decision making and planning can be improved. These projects include a major stream of work on benefits realisation, focusing on ways to capture stakeholder values more effectively and use these to inform decisions around investment in innovative infrastructure. Research on stakeholder value for money is helping to apply notions of value in design theory to healthcare project management, strategic asset management and master planning.

A project on adopting complex care service innovation is also showing how the perceptions of different professional groups influence decisions to adopt innovations.

Another series of projects looks at how to improve coordination between different levels in the care system (social, primary, secondary). It examines how the planning of infrastructure can be better linked to services. Work on strategic asset management is analysing the implications for primary care trusts of the 'world-class commissioning' agenda.

Our research into care pathway and infrastructure changes in day surgery explores the relationships between capital development and service delivery, care pathways and service improvement.

A third series of projects explores how modelling, simulation and visualisation (MSV) in decision making can influence investment, planning and design choices for infrastructure and service innovation.

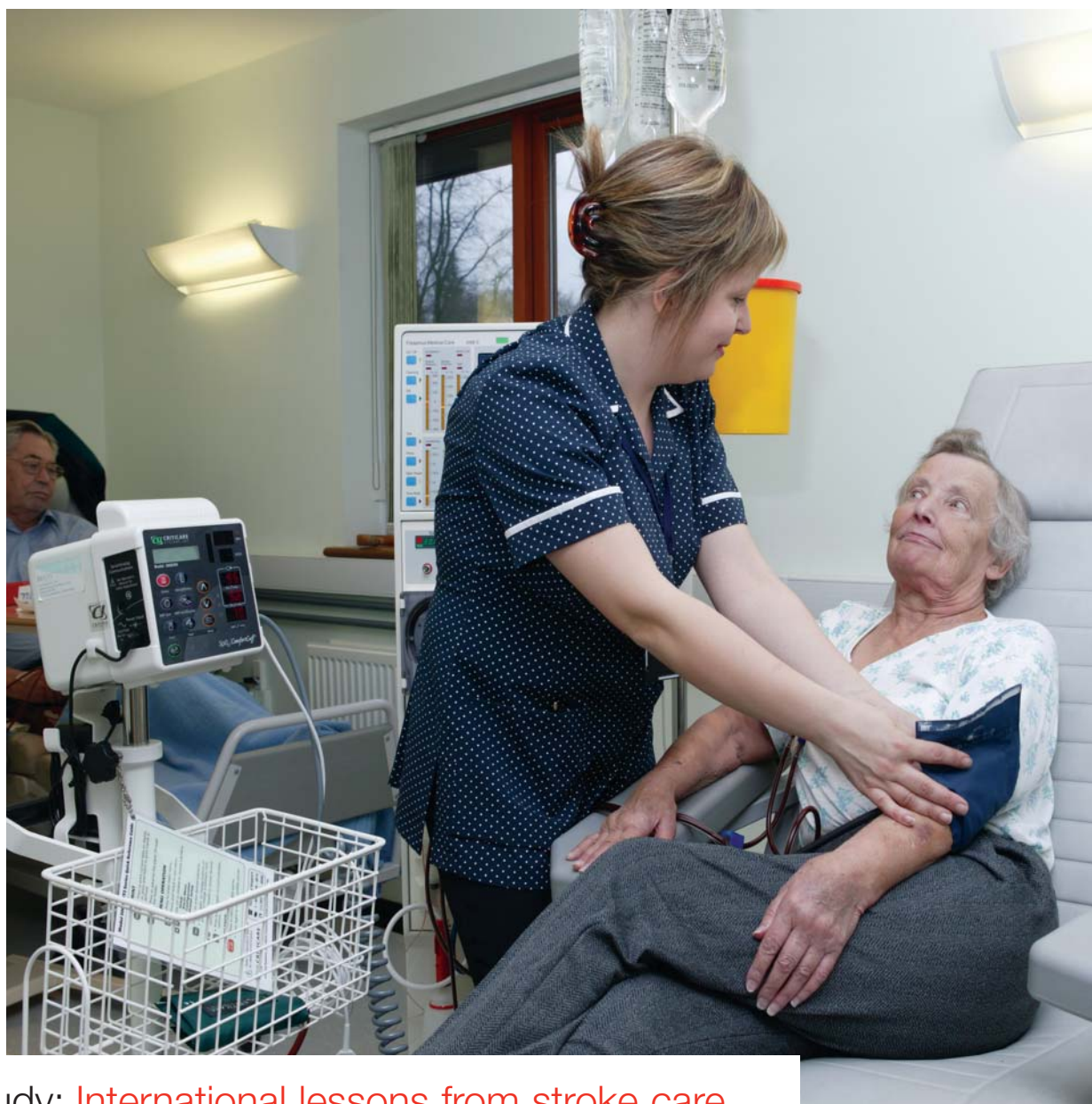
Our project on improving the therapeutic design of healthcare environments assesses existing facilities through the use of MSV so that their energy use, thermal comfort and air quality is optimised. A study on space optimisation of healthcare infrastructure uses physical models and construction related information technologies to develop new approaches to evidence based design, focusing on acute hospitals and community hospitals.

Earlier work on modelling service innovation in stroke care is now being developed in two ways. First, in collaboration with MIT and Harvard Medical School, we are examining the causes and consequences of differences in care for stroke patients in the UK and US.

Second, a project (with the University of Southampton) starting later in 2009, will investigate how modelling and simulation can help different professional groups from the care services to develop a shared understanding so they can make better planning decisions.

### Core projects:

- Stakeholder value for money: a new approach to briefing, design decision making and community engagement
- Design for flexibility and change within health service providers
- Benefits Realisation – BeReal
- Benefits quantification (collaborative project with Heriot-Watt University).
- Strategic asset management and integrated service provision within the healthcare sector
- Care pathway and infrastructure changes for improvement in day surgery performance in an NHS Acute Trust
- Improving the effectiveness of the design front end by considering the operations of healthcare facilities
- Lean project delivery
- Improving the therapeutic design of healthcare environments through modelling, simulation and visualisation
- An integrated approach to space optimisation of healthcare infrastructure
- Modelling service innovation in stroke care
- The use of simulation tools in healthcare planning: visual practices, modelling process and stakeholder engagement
- Assessing transport implications of healthcare reconfiguration using GIS.
- Efficient and convenient Primary Care (collaborative project with MARU-London Southbank University, the Princes Foundation and Department of Health).



## Case Study: International lessons from stroke care

There are big differences in stroke care between countries. In the US, for example, there is a stronger emphasis on quick treatment in the acute phase. There is a wider use of thrombolysis, which can only be given safely within three hours of the stroke. This may partly explain differences in mortality - the death rate from stroke is 19 per cent in the US, while it is 40 per cent in the UK. In contrast, the UK is strong on rehabilitation after stroke, which contributes to the differences in hospital stays for stroke: in the UK it is about 27 days, while in the US, under Medicare, it is just 6.5 days.

'Stroke care is a fertile ground for new work in the UK, not only because it is a major cause of disability and death, but because the Government's Stroke Strategy, published in 2007, has made the case for overhauling practice to improve treatment and outcomes. People in the UK are open to new approaches to a condition that has historically been seen as a chronic condition.

That's why HaCIRIC is collaborating with colleagues in Imperial as well as in Harvard and MIT to look at how care is provided to stroke patients in the UK, US and potentially in New Zealand. We are comparing those two or three systems in terms of cost effectiveness and outcomes as well as trying to understand the cultural differences that underlie the different ways in which stroke care patients are treated.

Our goal is to investigate configurations of stroke care and make recommendations for improvements in treatment in all three countries.

We should gain insights into how incentives in the various systems influence treatment patterns and be able to recommend measures to improve care.

# HaCIRIC's journey

## 2006

### Where we came from



#### Research impact

- Regular publications in built environment journals, occasional publication in innovation studies, management and health services journals

#### Industry impact

- Limited impact on innovative procurement and outcomes

#### Policy impact

- Developing relationship with Department of Health on a project specific basis and through input into policy formulation

#### Reputation

- Institutional reputation through existing Innovative Manufacturing Research Centre (IMRC) work

#### Research capacity

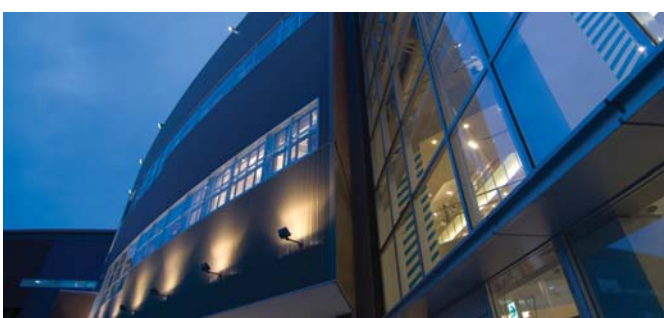
- Dispersed between institutions and existing IMRCs working on related topics

#### Collaboration

- Project specific and longer term relationships with built environment partners

#### Intellectual domain

- Mainly disciplinary-based: technology and innovation management, construction management, health policy





2009

Where we are now



- Increasing publications in innovation studies, management and health services journals, user focused policy and implementation reports
- Input into MSc and PhD programmes in each institution

- Increasing dissemination of lessons on procurement processes for innovation to supply chain.
- Establishing agenda on benefits realisation and evidence based design on healthcare outcomes

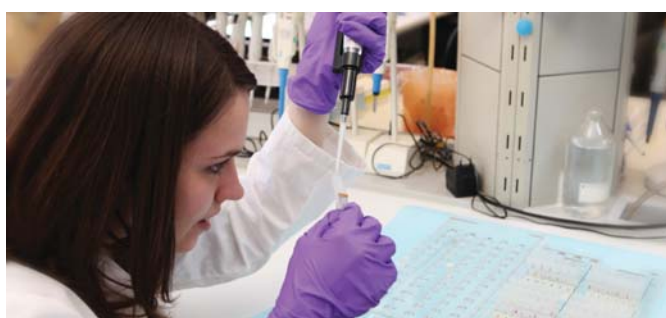
- Regular input into Department of Health and NHS policy process in healthcare technology and innovation management, and facilities procurement and management

- Increasing national and international profile for HaCIRIC

- Integrated HaCIRIC programme with collaborating institutions
- Vibrant, interdisciplinary team developing new methods and tools

- Growing focus on strategic partnerships with supply chain partners and NHS
- Joint projects with other universities in UK and US
- Emerging 'European HaCIRIC'
- Bridge for new relationship between Department of Health and EPSRC

- Becoming more interdisciplinary around these fields



2013

Where we are going



- Regular publication in top journals in the field
- High impact policy and implementation reports
- Training and masterclass material, information and practice guides at all levels
- MSc and PhD programmes by HaCIRIC and partners

- Major impact on business performance via new procurement models, common decision models, tools for simulation/visualisation of new practices, evidence base for integrated planning/briefing
- Establishing a HaCIRIC spin off to assist industry

- The main organisation for strategic policy advice and direct input into policy formulation in the field

- Established international reputation for HaCIRIC
- International conference is the 'must attend' annual event

- World leading interdisciplinary team
- Focused research and knowledge transfer activity
- Establishing international research capacity through HaCIRIC academic and industrial networks

- Deep level collaboration with strategic partners from supply chain and government
- HaCIRIC-type organisations internationally
- HaCIRIC is main UK coordinator of healthcare infrastructure research

- Leading interdisciplinary research in these fields



## HaCIRIC's Executive Team

The Centre has four co-directors, drawn from the four partner universities:  
Imperial College London, University of Reading, Salford University and Loughborough University.



**James Barlow** is a professor of Technology and Innovation Management at Imperial College and a director of HaCIRIC. James' research focuses on the adoption of innovation in complex sectors of the economy. He is especially interested in construction, housing provision and healthcare.

---



**Colin Gray** is a professor of Construction Management at the University of Reading and a director of HaCIRIC. His research interests include production engineering, computer simulation, knowledge-based planning and construction, knowledge transfer and healthcare infrastructure.

---



**Mike Kagioglou** is a professor of Process Management and the director of The Salford Centre for Research & Innovation (SCRI) and HaCIRIC. His academic interests include healthcare infrastructures, process management and operations, knowledge management and benefits realisation.


---



**Andrew Price** is a professor of Project Management at Loughborough University and a director of HaCIRIC. His current research includes innovative design and construction solutions for healthcare infrastructure, continuous improvement and sustainable urban environments.

**Imperial College  
London** HaCIRIC  
**Imperial College Business School**  
Tanaka Building  
South Kensington Campus  
London SW7 2AZ  
UK  
T: +44 (0)20 7594 3084

---

 **University of  
Reading** HaCIRIC  
School of Construction and Management Engineering  
**The University of Reading**  
Whitenights  
PO Box 219  
Reading RG6 6AW  
UK  
T: +44 (0)118 378 7181

---

 **University of Salford**  
A Greater Manchester University HaCIRIC  
School of the Built Environment  
**The University of Salford**  
4th Floor Maxwell Building  
Salford  
Greater Manchester  
UK  
T: +44 (0)161 295 3178

---

 **Loughborough  
University** HaCIRIC  
Department of Civil and  
Building Engineering  
**Loughborough University**  
Ashby Road  
Loughborough  
Leicestershire LE11 3TU  
UK  
T: +44 (0)1509 222627

---

 **Engineering and Physical  
Sciences Research Council**  
Polaris House  
North Star Avenue  
Swindon SN2 1ET  
UK  
T: +44 (0)1793 444000

# The Health and Care Infrastructure Research and Innovation Centre

HaCIRIC seeks to improve people's health and well-being by supporting development of better health and care infrastructures.

We are creating a Centre that aims to be:

- World class
- Sustainable
- Collaborative
- Strategic
- Practical



T: +44 (0)20 7594 3084  
E: [haciric@imperial.ac.uk](mailto:haciric@imperial.ac.uk)

[www.haciric.org](http://www.haciric.org)