ASSESSING THE ADAPTABILITY OF EXISTING HEALTHCARE INFRASTRUCTURES

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- Past, present and future changes in the healthcare environment
- Materials and methods
- Standardisation and flexibility at strategic level to face operational changes
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- Existing tools, datasets, regulations and standards in the UK
- Definition of technical elements and healthcare spaces: opportunities to refurbish
- An appraisal system to assess space adaptability: the refurbishment option matrix
- Conclusions, challenges and opportunities of refurbishment design options
‘Hospitals, like cities, are artifacts. They grow or decay through organised human care and cultivation-or the lack thereof. As such, cities and hospitals are sustainable only to the extent that they exhibit both durability and adaptability—durability at a higher level (e.g., the networks of streets in a city) and adaptability at a lower level (e.g., the buildings that come and go in the street network).’ (Kendall, 2004)

In the UK the NHS is experiencing:

- financial challenges (healthcare provision rising costs);
- capacity crisis (healthcare provision expanding demands).

The main objective is:

- improve quality and raise productivity through improvements in space utilisation, assuring quality and value for money;
- maintain its focus on equitable access to and ethical delivery of healthcare services.

In 2010, the Department of Health set the target to save up to £20 billion by the year 2014 and reinvest them in quality and outcomes.
Combinations of built environment knowledge management frameworks have been investigated and experimental tools have been put in place to face the need to upgrade existing buildings:

SHOPPING CENTRES

SOCIAL HOUSING

OFFICES

HEALTHCARE BUILDINGS

A shift from new build, back to refurbishment has recently started in the healthcare sector:

- can be a cost-effective alternative to redevelopment;
- can provide technical, social and economic benefits;
- can be an energy-resilient option to climate change effects on existing buildings;
- can provide life extension to buildings that are socially desirable and economically viable.
In Europe, new healthcare facilities are being built on new and existing sites to increase the clinical performance, according to projects sanctioned and designed in years prior to the current financial crisis.

Construction industries and healthcare are both subjects and objects and they are undergoing a phase of rapid and substantial changes.
The British National Leadership Network (NLN) for health and social care has summarised the future **health threats** according to their **impact on the healthcare system**.

- patient expectations
- IT - diagnostic tools
- ageing population - chronic diseases
- home care - new working systems
- ageing labour force - changing health professions
- pharmaceutical innovations
- genetics and pharmacogenomics development

*Between 2010 and 2025 healthcare will be dealing with older population and chronic diseases, through the use of innovative technologies.***

To face these rapid and substantial **changes**, strategies need to be put in place to deal with healthcare provision increasing costs in relation to **existing infrastructures** and to **new clinical demands**.
### Materials and Methods

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<th>Action</th>
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<td>Critical literature review</td>
<td>contemporary state-of-the-art of existing space and management frameworks</td>
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<td>Interviews</td>
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<td>Design layout reviews</td>
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<td>Space use observation</td>
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<td>Appraisal system development</td>
<td>accurate knowledge of existing space and feasibility of actions</td>
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Predictions are never straightforward in the healthcare sector.

‘Weeks already affirmed that from the moment of completion at any stage, a hospital building immediately begins to become out-dated on some level as a result of changing institutional needs’ (Nagasawa, 2007)

Even if hospitals tend to be designed and built with a 30 to 60 year lifespan, it is impossible to foresee very far into the future what types of services will be needed.
Future demands and needs should drive the organisational change, in consideration of users, providers, stakeholders and planners.

The problem starts early in the planning stages, at a strategic level, where an intelligent case-specific space management is required to face flexible use and adaptable solutions.

- Within-year variations in hospital utilisation have significant effects on hospital cost management.
- Flexibility depends on the service lifespan of each building component and on its correct upgrade, change or disposal.
- The facility whole life value is related to stakeholder needs and expectations, which lead the investment and disinvestment decisions.
In 2012 the aim is still to design and plan facilities that possess the least constraints as possible, in order to allow future growth and contraction.

‘As the inevitability of growth and change has come to be recognised, views have been expressed during the last few decades which maintain that, wherever it is situated, a hospital is never likely to be complete. As the building will inevitably require alterations and additions during its working life, from the outset, its physical organisation should be conceived with this in mind’. (Cox and Groves, 1981)
‘Planning based on the idea that operational regimes are permanent must fail since all health buildings change constantly’. (Weeks, 1973)

**HOWEVER,**

Buildings are upgraded focusing on immediate short-term specific needs and with available restricted budgets.

It is extremely difficult to manage efficiently hospital space utilisation *over time* and *in space*. When a space becomes unsuitable or needed, the entire clinical process delivery needs to be re-thought and all the adjacencies need to be re-organised according to the new needs.

*Scale, scope and distribution need to be identified early in the planning stages.*
Scale of provision:
- social, clinical, environmental and technological drivers of change;
- relationship between economic efficiencies and scale of sites;
- services integration among separate geographical locations in smaller sites;
- (optimum hospital scale) function of patient access, economies of scale and volume.

Scope of flexibility:
- daily change in hospital utilisation (procedures, types of care, settings);
- rise of new clinical needs after the infrastructure project is handed over;
- beds and spaces utilisation/occupancy over periods of time.

Distribution of space:
- variability in demand for hospital services and variation in occupancy;
- additional space for the increase of variability of hospital services;
- reduced space after the decrease of delivery of hospital services (elective and short-term);
- first building cost and whole-life transformation costs.
Existing Tools, Datasets, Regulations and Standards in the UK

**BUILT ENVIRONMENT INTEGRATED KNOWLEDGE MANAGEMENT FRAMEWORK**

### Data Reference
- HES
- ICD-10
- OPCS-4
- A&E Clinical Codes
- HRGs

### Existing Tools
- ADE2 Evolution
- BREEAM
- ASPECT
- PATH
- SHAPE
- PAM

### Datasets
- SCENARIO GENERATOR
- ADB
- NHS Outcomes Framework Indicators
- HIA

### Regulations
- Code of Practice for prevention of biofoul ground water
- Health Technical Memorandum 03-01: Specialised ventilation for healthcare premises
- Health Technical Memorandum 07-01: Safe management of healthcare waste

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The complexity of a healthcare infrastructure can be described through the technical elements that build it.

These technical elements can be grouped per type:

- **Location** - location of the space.
- **Site and adjacencies** - situation of the space and relation with the spaces adjacent to it.
- **Size and typology** - size and architectural typology of the space.
- **Construction elements** - structure of the space and its main construction elements.
- **Materials** - construction materials mainly used in the space.
- **Covering and finishes** - internal coverings and finishes of the space.
- **Technical systems** - systems in use in the space and their compliance to national regulation.
- **Fittings** - furnishings, decorations and objects of art contained in the space.
- **Equipment and installations** - clinical equipment and installations both fixed and removable.
The space is always defined in shape and size, which have to be precisely designed, but may need to be retained, refined or transformed over time as healthcare services evolve.

These spaces can be the grouped per acuity:

- **At high acuity level** (hot) - spaces have rigid constraints (planning, construction, installation, upgrade). They must fulfil clinical, technical and operational requirements to allow clinical procedures and interventions.

- **At medium acuity level** (medium) - spaces have some constraints (planning, construction, installation, upgrade). They must fulfil clinical, technical and operational requirements, but they allow change/shift of clinical procedures and interventions among spaces.

- **At low acuity level** (cold) - spaces have no constraints (planning, construction, installation, upgrade). They must fulfil technical and operational requirements in order to support clinical procedures and interventions within adjustable spaces.
If future healthcare infrastructures are to be designed without departmental constraints, this will result in enhanced space use, as it could be adapted and reused more time and cost effectively.

A higher level of space adaptability will result into a higher space design performance, thus in an increased healthcare infrastructure value.

Healthcare services will be provided in the available space that can best accommodate them, their evolution and their change, offering the fewer constraints in term of planning, construction, installation and upgrade.

The need for an alternative solution to new design may reside in refurbishment as a cost-effective and time-efficient strategy to improve healthcare infrastructure adaptability.
The Refurbishment Option Matrix (ROM) is intended as an appraisal system against which decision makers, care providers, care commissioners, Trusts, designers, building contractors and stakeholders can review the spatial consistency of a healthcare infrastructure and define whether a refurbishment process is the best option to improve clinical service delivery within a wider regional reconfiguration or national transformation.
The ROM is a high level strategic planning framework targeted at different users:

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<tr>
<th>Role</th>
<th>Support/Target</th>
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<tr>
<td>Decision makers</td>
<td>Support strategic decision in delivering healthcare service provision</td>
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<tr>
<td>Trusts</td>
<td>Evaluate the state of the estate and undertake operational decisions in healthcare service provision</td>
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<tr>
<td>Designers</td>
<td>Plan and design effectively for long-term adaptability</td>
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<tr>
<td>Stakeholders</td>
<td>Put in action their investment strategy and choose their best long-term option</td>
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Each clinical space organised per acuity with size, shape, technical constraints

Knowledge of the space available and foresight long-term healthcare service options

Detailed picture of the existing and available spaces per area, per region and per Trust

Clear evidence of the built environment, the service costs and the population demands
The ROM is a high level strategic planning framework for different scales:

- **At a higher level**: to offer strategic decision options across different healthcare settings
- **At a lower level**: to support operational decisions in reorganising service delivery within a healthcare setting and a building
- **At the strategic level**: to predict feasible scenario options to manage organisational decisions
g- **At the operational level**: to assess infrastructure constraints to suggest practical solutions for healthcare services provision
An Appraisal System to Assess Space Adaptability: the ROM

**ELEMENTS grouped per TYPE** on the x-axis

**SPACES grouped per ACUITY** on the y-axis

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An Appraisal System to Assess Space Adaptability: the ROM

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<thead>
<tr>
<th>Location</th>
<th>Site Adjacencies</th>
<th>Size &amp; Typology</th>
<th>Construction Elements</th>
<th>Construction Materials</th>
<th>Technical Systems</th>
<th>Fittings</th>
<th>Equipment &amp; Installations</th>
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</table>

- **HIGH ACUITY SPACE**
- **MEDIUM ACUITY SPACE**
- **LOW ACUITY SPACE**

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An Appraisal System to Assess Space Adaptability: the ROM

HIGH ACUITY SPACE

INEFFICIENT (LOW EFFICIENT)

HIGH ACUITY SPACE

LOW ACUITY SPACE

EFFICIENT (HIGH EFFICIENT)

LOW ACUITY SPACE

MEEDIUM ACUITY SPACE
An Appraisal System to Assess Space Adaptability: the ROM

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>SITE ADJACENCIES</th>
<th>SITE &amp; TOPOLOGY</th>
<th>CONSTRUCTION ELEMENTS</th>
<th>CONSTRUCTION MATERIALS</th>
<th>TECHNICAL SYSTEMS</th>
<th>FITTINGS</th>
<th>EQUIPMENT &amp; INSTALLATIONS</th>
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**SCQRE**

**DESCRIBE**

each available space

adaptability against benefits and risks

**APPRAISE**

options to accommodate changes

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The users will be enabled to take action through a defined set of feasible options and to select the optimum solution for them, at a specific time, in an exact setting, with definite long-term aims and short-term actions.

Short, medium and long-term investment or disinvestment recommendations will suggest refurbishment options, varying from simple interventions to very complex reorganisations, till new design solutions, when changes in the infrastructure are required.
With refurbishment likely to increase due to the current financial challenges and increasing spatial constraints, a more accurate **understanding of existing infrastructures** is required in order to put in place long-term strategies and whole-life adaptable spaces.

The research findings have led to the development of the ROM as a **case-specific appraisal system** for policy-makers and design teams, to achieve more responsive healthcare infrastructures in short, medium and long-term service reconfigurations.
• **Evaluating all feasible options** and managing a structured refurbishment approach is the way to lead to an effective management of changing circumstances through the building whole life-cycle and successful development of a refurbishment decision making process.

• The ROM can evaluate space against **financial, social and environmental risks** and **benefits**. Spatial, functional, aesthetic flexibility will be evaluated against financial, social, service value to verify opportunities for and constraints to healthcare space reconfiguration.

• Spaces can be designed to **minimise constraints** and **maximise adaptive reuse** of healthcare buildings, to different specialities belonging to the same or similar acuity level. In this case, the constraint is related to the clinical service rather than the built environment.

• In new design projects the ROM can offer the chance to add feasibility studies for **future expansion or contraction**, so that options are evaluated far before the real needs arise.

• In refurbishment design projects the ROM can offer valid solutions to **clinical service transformations** now and over future, for whole-life cycle healthcare infrastructure value.
The validation of the Refurbishment Option Matrix appraisal system is currently on-going on one hospital site.

The challenge is to integrate this appraisal system within the strategic business case, and to keep it throughout the whole healthcare infrastructure life, to offer the chance to decide to refurbish the available space according to the higher level of efficiency it can provide.

Further case studies will offer the opportunity to set a methodology of action widely applicable and to become a data collection and management tool for healthcare infrastructures.
THANK YOU FOR YOUR ATTENTION