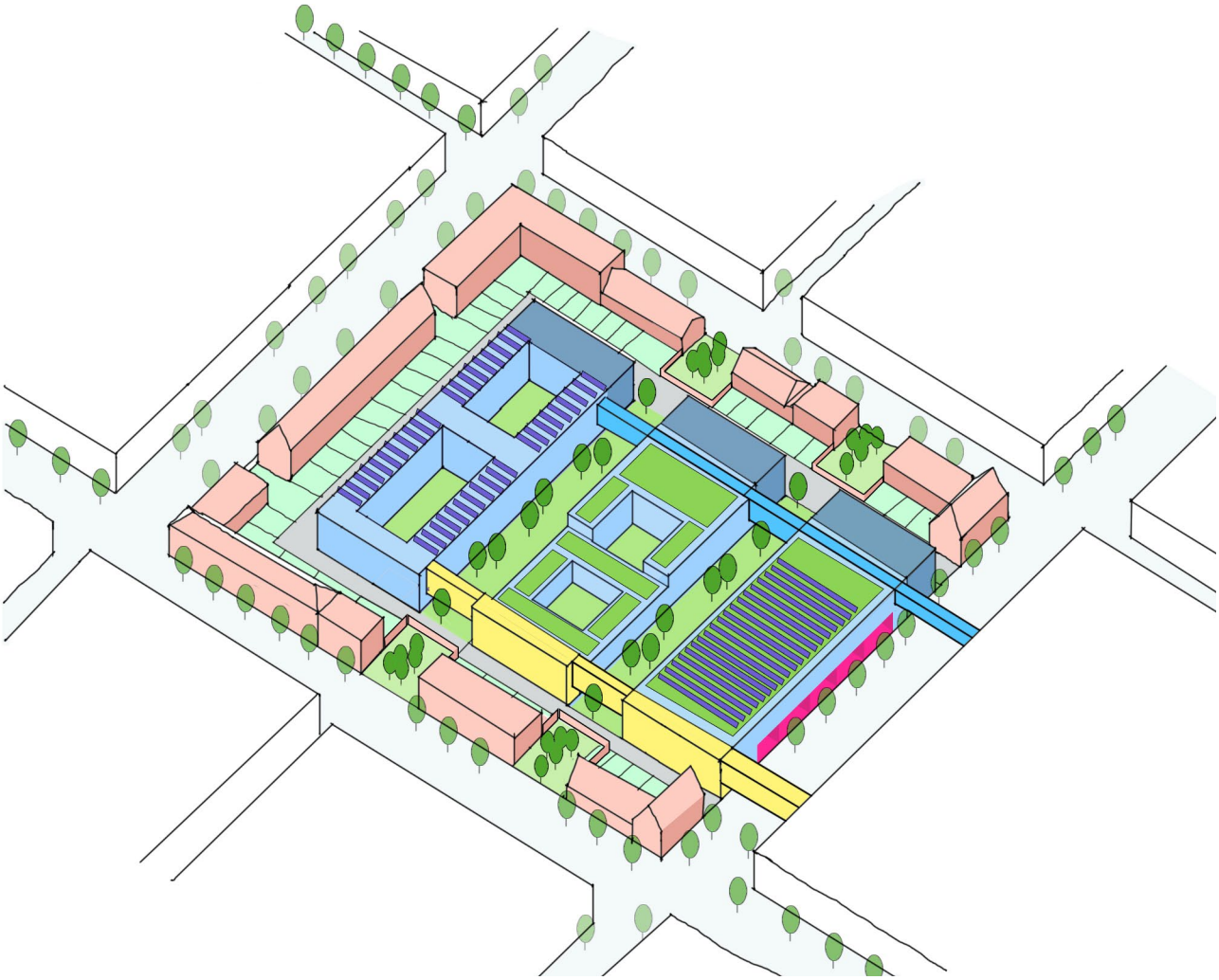
Re-imagining the Hospital

Building Wellness



The whole: more than the sum of its parts

EcoResponsive Environments

mjmedical

BACKGROUND

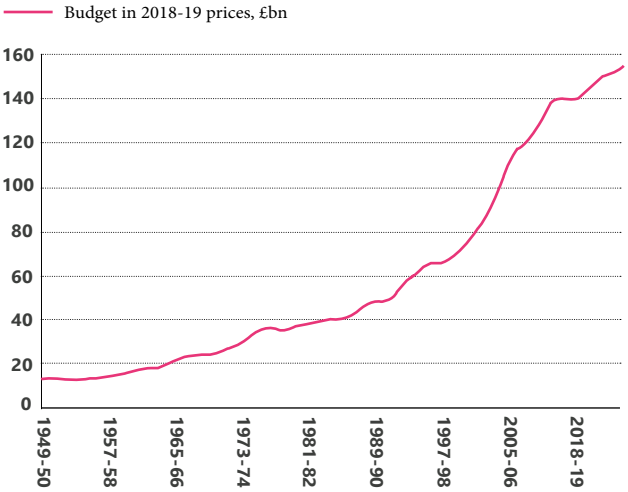
The NHS is facing unprecedented challenges. The Covid-19 pandemic has generated greater demand for healthcare (Fig.1) than any period since the service was founded. A waiting list of 5 million has now to be addressed by increasingly exhausted front-line workers, against the backdrop of more than 10 years of budgetary attrition (Fig.2), in the context of a large-scale reorganisation of the 2012 Health and Social Care Act that many feel was an unnecessary and damaging failure.

To make matters worse, these challenges must be addressed in the context of widening threats to public health. Current ways of life are damaging natural capital's capacity to regulate climate, and are disrupting natural systems in ways that threaten us with future pandemics. In the employment sphere, artificial intelligence is rapidly reducing the demand for all but highly skilled workers; generating a precariat trapped in poverty and low job satisfaction, impacting on the mental health of both individuals and wider communities and leaving many people trapped between endemic loneliness and a pervasive sense of stranger-danger; both worsened by the pandemic experience. Housing too is problematic: 1 in 3 UK people live in poor quality homes, with negative health impacts which are estimated to cost the NHS £1.4bn a year[1].

Compounding this situation, many NHS providers are doing their best to deliver an ever greater complexity and volume of care from a healthcare estate which in large parts is well past its best. Long-term lack of capital investment means that providers are using out of date buildings, no longer fit for purpose and with a huge maintenance backlog[2]. They struggle to deal with the demand for care whilst responding to developments in clinical best practice and in new technologies which are needed to improve care quality. In many instances, they cannot provide their patients with the basic elements of a satisfactory healing environment.

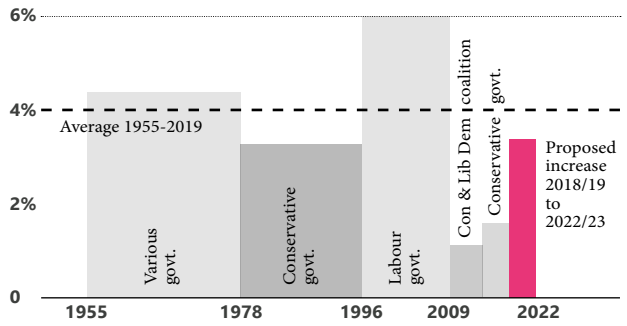
Overall, then, the NHS estate faces a unique confluence of inter-related pressures: a need for extensive investment, a political commitment to provide significant but still limited resources, yet another major organisational restructuring that will significantly affect the way that care is provided and capital investment managed, and the immediate need to continue to respond to the worst pandemic in a century and to recover from its wider impacts on healthcare provision. This is clearly a time which demands new thinking about hospital planning and design.

Fig. 1 How the NHS budget has grown
UK health spending from 1948 to 2019



Source: Institute for Fiscal Studies

Fig. 2 How spending on health has slowed down
Average annual increase in government on health, based on 2019/20 prices



Source: IFS, projected growth for NHS England only

The NHS estate faces a unique confluence of inter-related pressures, demanding new ways of thinking about hospital planning and design.

1 BBC News. 2021. 11 charts on the problems facing the NHS. [online] Available at: <https://www.bbc.co.uk/news/health-50290033> [Accessed 10 June 2021].

2 Publications.parliament.uk. 2021. House of Lords - The Long-term Sustainability of the NHS and Adult Social Care - Select Committee on the Long-term Sustainability of the NHS. [online] Available at: <https://publications.parliament.uk/pa/ld201617/ldselect/ldnhssus/151/15106.htm> [Accessed 10 June 2021].

DESIGN AIMS

This situation calls for new principles for designing and planning new hospitals to support radically improved patient experiences, clinical outcomes, staff wellbeing and integration with wider health and social care, in environmentally sustainable and economically feasible ways. All these specific aspects of hospital performance are tightly interlinked: design decisions that affect any of them will probably affect them all. They also relate primarily to the hospital's effectiveness in treating illness. Ultimately, however, the outcomes of treatment must depend on the patient population's underlying levels of health and wellbeing. For maximum cost-effectiveness, therefore, we need new design ideas that increase hospitals' capacity to treat illness in ways that also help to build a wider wellness (Fig.3).

To develop these new ideas, we need to define both 'hospital' and 'design' in ways that free our thinking from current preconceptions as much as possible. We therefore define 'hospitals' as 'settings for health care' at any scale, and we understand 'planning and design' as 'attempting to transform a current situation into a desired new one'[1].

A BROADER ECONOMIC FRAME

We also need a broad economic frame to guide our thinking about resource-allocation in relation to the opportunities and threats that health and wellbeing currently face. The most useful framework, developed by Kate Raworth, highlights the 'safe and just space' between a 'social foundation' of health and wellbeing, and an 'ecological ceiling' on which human survival ultimately depends[2]. Within this space, Raworth focuses our attention on the need for distributing resources in 'circular' regenerative ways (Fig.4). Within this overall frame, continuing financial restrictions mean that the design ideas we develop must also fit within the normal capital envelope within which hospitals are developed (Fig.5).

MEETING THE CHALLENGES

Research[3] indicates that health systems throughout the world have historically been designed primarily to deal with single, acute and short-term illnesses, leading over time to fragmented healthcare operated by multiple organisations. Such a model cannot meet the demands of modern populations; especially the elderly, many of whom have higher levels of dependency, multiple long-term conditions, dementia and complex co-morbidity. It has become apparent that these systems are becoming increasingly ineffective and inefficient, with escalating costs and poor patient experiences.

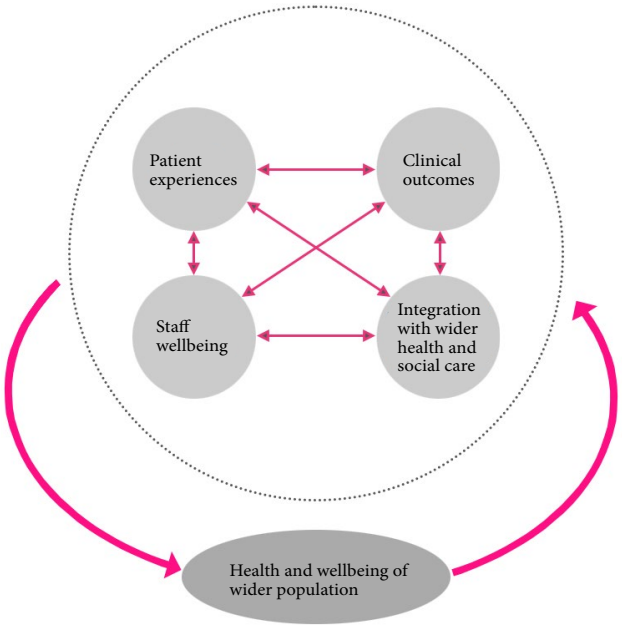


Fig. 3 **We need new design ideas that increase hospitals' capacity to treat illness in ways that also help to build a wider wellness.**

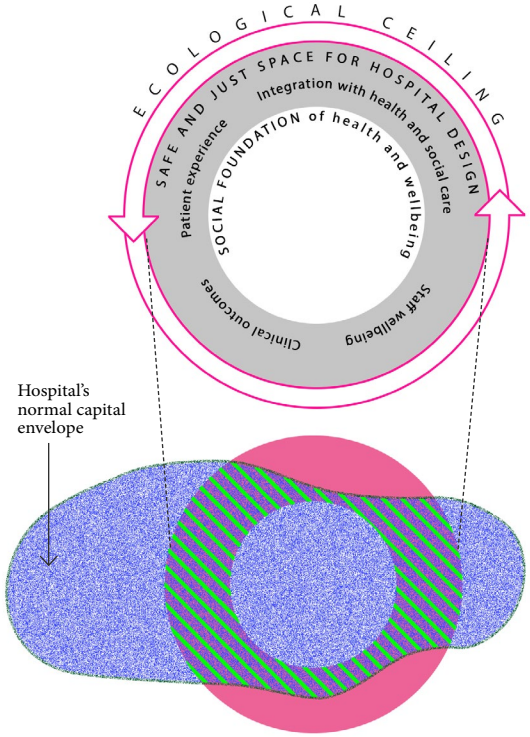


Fig. 4 **'Safe and just' space; Doughnut Economics**

Fig. 5 **Fitting design ideas within the hospital's normal capital envelope**

1 Muller, W, 2001: Order and Meaning in Design, Utrecht: LEMMA, p13.

2 Raworth, K, 2017: Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist, Vermont USA: Chelsea Green Publishing.

3 World Health Organization, 'Innovative care for chronic conditions: building blocks for action, Global Report, pp. 6 (2001), <https://www.who.int/chp/knowledge/publications/icccglobalreport.pdf>.

In the UK, as in many other countries, there is growing agreement that the way forward is to integrate systems of health and social care so that the whole becomes more than the sum of its parts. To date, the NHS has seen integrated care models implemented only as time-limited, geographically-specific or care-pathway-specific pilot projects, often with limited impact on the wider delivery of services. There is now, however, a renewed impetus at national government level to push ahead with the integration of health and social care through a wholesale reorganisation of the NHS into geographically-based Integrated Care Systems, incorporating primary, community and secondary care facilities.

In November 2020, in line with the 2019 NHS Long Term Plan, the NHS leadership set a firm deadline for the roll-out of this programme; targeting the statutory establishment of Integrated Care Systems in England by April 2022. This approach will see the commissioners and providers of healthcare services for a defined regional geographical area collectively planning and integrating care provision to better meet the needs of their population. Opportunities for deeper integration of services to provide preventative, anticipatory and responsive support and care are being explored and developed at unprecedented pace.

INTERNATIONAL EXEMPLARS

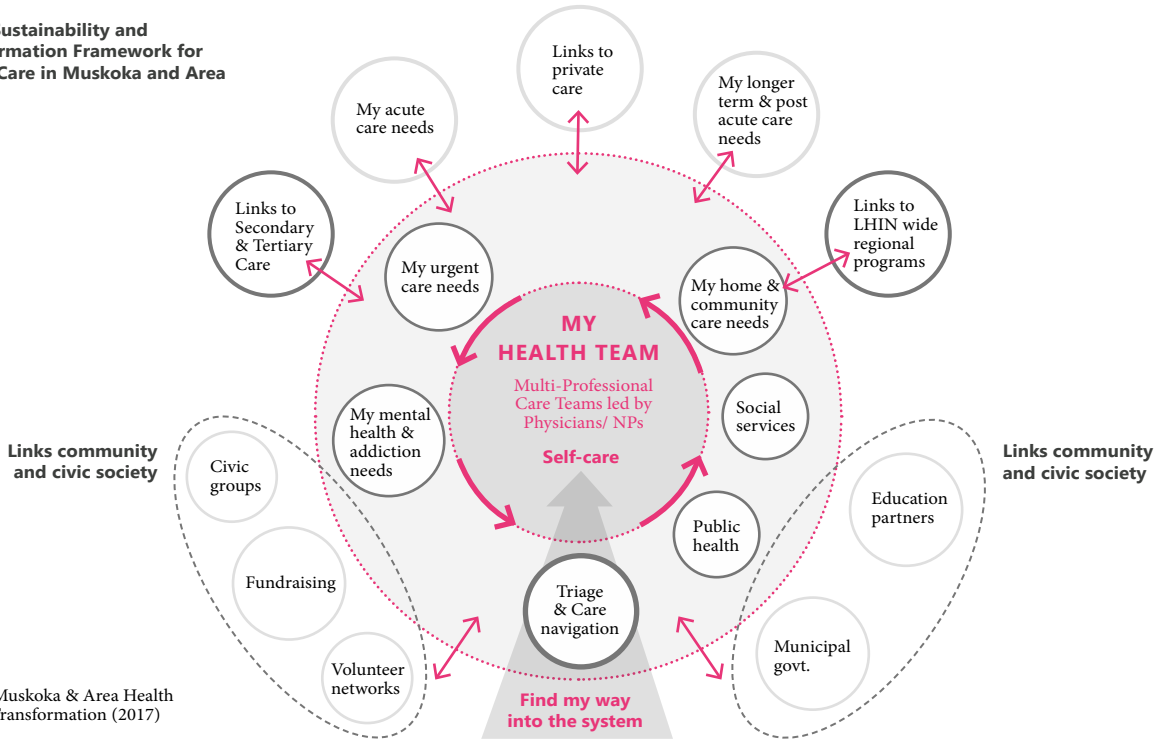
In the context of this ambitious path towards a reorganised NHS it is important to learn lessons from other parts of the world where the provision of integrated services is further advanced. Research[1] has found that in many instances, as in the NHS, the function, use and location of the estate is still largely considered in silos, despite a systemic transformation to an organisational shift towards integrated care. Organisational change, it seems, is necessary but not sufficient for the development of new, more integrated models of health and care delivery. Spatial thinking is also needed.

Some countries, however, are also developing new spatial models which seek to integrate care, improve patient satisfaction, and make effective and efficient use of resources with a renewed focus on wellness and prevention. These models typically incorporate primary care networks, mental health, housing and social benefit support centres, integrated living accommodation for all generations, supported living housing as well as facilities for secondary and acute care. Two very positive examples can be seen in the very different contexts of Muskoka, Canada and Luohu, a district of Shenzhen, China.

MUSKOKA, CANADA

In Muskoka, the model of care[2] is a broad-based community effort, centred on 'My Health Team', a primary care led multi-professional team, focusing on wellness care and self-management (Fig.6). The individual, their family and care-givers are at the centre of the service model, supported by the "My Health Team". A new single integrated governance model has been created and is described as the 'Collective Impact' approach - through which a diverse group of individuals from the health, social, community, and local authority sectors come together to deliver; better health

Fig. 6 Sustainability and Transformation Framework for Health Care in Muskoka and Area



Source: Muskoka & Area Health System Transformation (2017)

1 NHS, Long Term Plan, < https://www.longtermplan.nhs.uk>.

2 Muskoka & Area Health System Transformation, 'General Committee Agenda', Bracebridge (2017), pp. 4 < https://bracebridge.civicweb.net/document/18095>.

for the entire population; better care for individual patients; better value for the entire care system and better experience for the individual care providers. Horizontal and vertical service alignment along with strong communication ensures seamless integration between physical health and mental health; easier navigation of the system and no repeated assessment and coordinated access to primary, urgent and acute care services. Digital health and technology-based processes and wearable devices and tools support this model and help streamline the process to bring services closer to home, especially in rural and remote communities.

LUOHU, CHINA

Luohu is one of the ten districts in China's Shenzhen region, with an area of 78.36 km^2 and a population of 1.4 million. With a fragmented health-system, the key strategy was the establishment of an independent healthcare management group to oversee all healthcare in the district[1]. The group developed a health system of five hospitals, one institute of medicine and 23 community health centres restructured into a single Luohu Hospital Group, which is responsible for its funding and management (Fig.7). The Group switched emphasis from curing disease to preventive healthcare, and by reorganizing the 29 facilities the restructure guaranteed at least one regional comprehensive medical centre and one primary medical group in each area of the district, as well as a healthcare centre in each community. The key features of the Luohu model include a hospital management centre, to perform the decision-making functions on behalf of the municipal government, across the entire spectrum of health rather than only across the hospitals. This recalibrates resources from acute, secondary facilities to the community; reflecting a shift to provide healthcare and support closer to home.

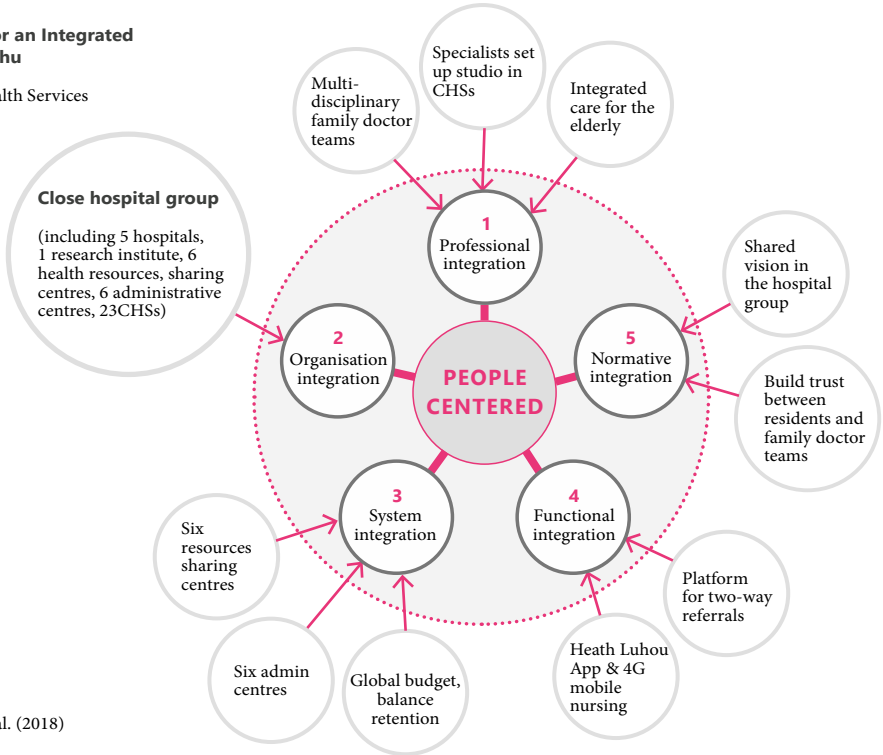
This is translated into the workforce for the system delivery at various levels. For example, the hospital management centre facilitates the principle of integrated personnel management, on the basis of which the doctors, as employees of the Luohu Hospital Group, move freely among the community centres, after one year-training of general practice and health management. Evaluation after the first two years, showed improvement in organisational effectiveness through integrated care. Moreover, new preventive programs resulted in the reduction of disease incidence, and residents were more satisfied with services provided by the new model.

COMMON FACTORS

It is evident from comparative research[2] that successful models of integrated care such as Muskoka and Luohu typically incorporate primary care networks, mental health, housing and social benefit support centres, integrated living accommodation for all generations, supported living housing as well as facilities for secondary and acute care. Common to all the care models reviewed is the extensive and growing use of digital technology, artificial intelligence and Big Data: successful Integrated Health and Care Systems rely on digital information recording and sharing platforms.

Fig. 7 Strategies for an Integrated Care System in Luohu

CSH: Community Health Services



Source: Wang, Xin et al. (2018)

1 Wang, Xin et al., 'The Luohu Model: A Template for Integrated Urban Healthcare Systems in China', International Journal of Integrated Care, 18(4): 3 (2018), pp. 4 <https://doi.org/10.5334/ijic.3955>.

2 Goodwin, Nicholas et al, Handbook Integrated Care, (Oxford: Springer International Publishing, 2017), pp. 3-4.

THE DIGITAL DIMENSION

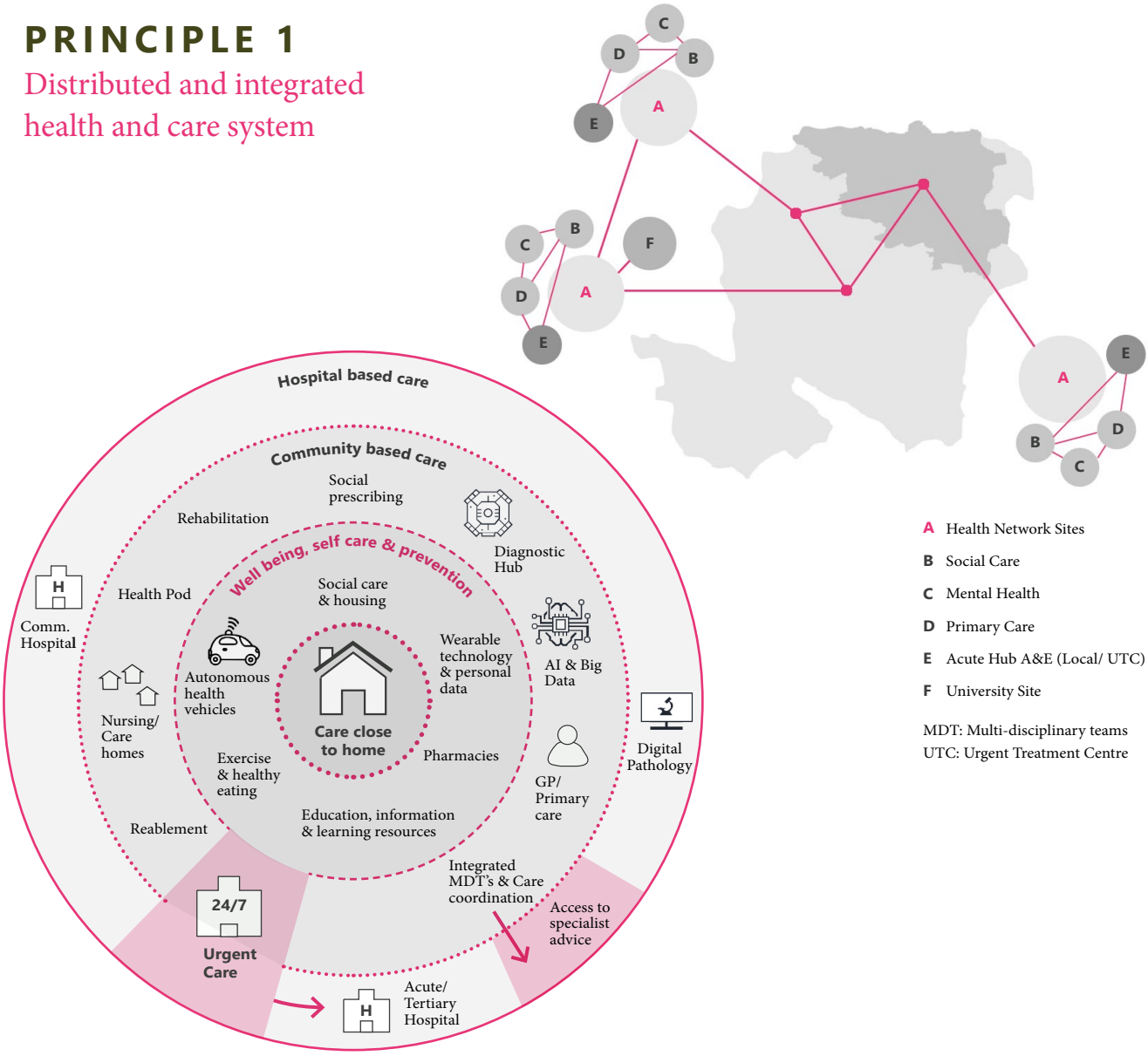
Accelerated by the pandemic, the NHS is already on a path to Digital Transformation[1]. recognizing the need for an integrated and editable patient record to resolve information asymmetry and fragmentation between providers. The development of this essential foundation for building an Integrated Care System is therefore in hand.

The digital platform allows healthcare to be integrated spatially with the demographics of the region's population: wearable devices, big data and AI will refocus on health at home and therapeutic support in healthcare settings as close as possible to the patient. This will be beneficial not only in terms of the patient experience but also in terms of improving clinical outcomes through the provision of a co-ordinated delivery of health and care. It will also impact positively on the climate emergency and on air pollution, by reducing the amount of travel necessitated by current models of care.

The care pathway is therefore kept in the community or at home as far as possible; whilst secondary care is provided when needed, supported by technology, such as telemedicine and wearable devices, and local multi-agency support is coordinated through a dedicated 'health and wellness manager'. All this suggests that the future hospital will no longer be focused on a single geographical location, but will be disaggregated to offer the population more accessible, tailored and focused care and support. This generates our first and largest-scale design principle:

PRINCIPLE 1

Distributed and integrated health and care system



1 NHS, Digital Transformation, < https://www.england.nhs.uk/digitaltechnology/>

IMPLEMENTATION

Research suggests[1] that the optimal implementation of this first principle depends on the spatial demography of the region concerned. Where the population is dispersed through villages and small towns, services are best distributed through a geographically-spread 'hub and spokes' approach. Where the population is concentrated in large centres, however, integration is best achieved by concentrating services in larger health campuses. Both approaches are relevant to the UK context with its mix of city or urban conurbations and more widely-spread rural communities.

This first principle suggests an agenda for creative NHS thinking at the regional scale. In the short term, however, it seems likely that this scale of thinking will be overwhelmed by the speed of decision-making required by the government's current Health Infrastructure Plan (HIP) published in September 2019, outlining proposals to redevelop 40 hospitals - later increased to 48 - and to change the way capital investment is allocated and managed.

Whilst the HIP programme was desperately needed even prior to the pandemic, Covid-19 has increased both the extent and urgency of the changes required. Many NHS Trusts are therefore racing forward with business cases for their capital development plans, in order to secure HIP allocations, with little time to digest new ideas that have large-scale implications. It is therefore important to draw out smaller-scale design principles to start rethinking NHS real estate bottom-up, to create distributed Integrated Care Systems incrementally, at the neighbourhood scale.

MOVING TO THE NEIGHBOURHOOD SCALE

Even when they form well-distributed systems at the regional scale, most hospitals have negative impacts on wellness at the neighbourhood scale. Typically, even the best-distributed hospitals are only loosely integrated with other neighbourhood activities (Fig. 8, 9, 10, 11), which nudges people away from the physical exercise of active travel: it just seems easier to take the car. To build wellness, however, we need neighbourhood design that counters the obesity epidemic by fostering more active lifestyles.

At a closer focus, large impermeable hospital footprints put off pedestrians and cyclists by forcing them to make detours (Fig.8): blocks larger than 200 metres square will definitely have this car-dependent impact[2]. To avoid this, we have to look for opportunities to break down the hospital block size to walkable dimensions.

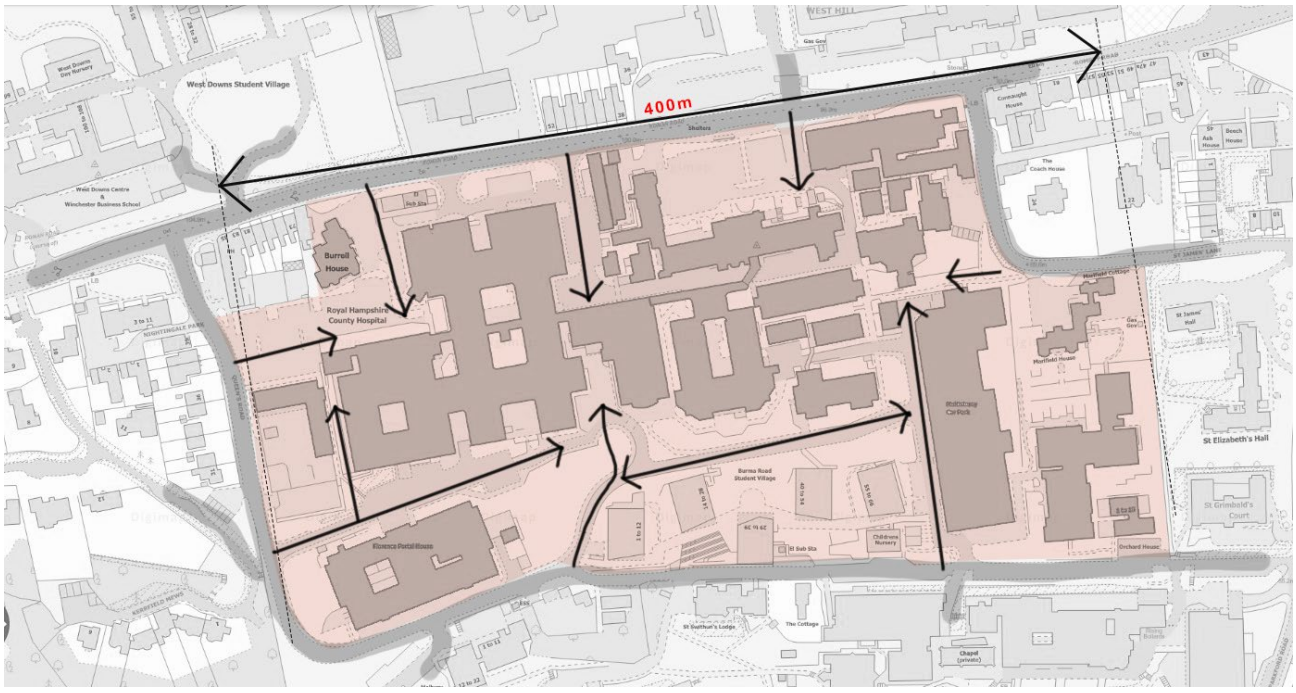


Fig. 8 Typical organisation of hospital sites with large impermeable footprints that discourage walking and cycling.

1 Lambert, Victoria, Inside the hospital of the future <www.telegraph.co.uk/wellbeing/future-health/hospitals-of-the-future/> [accessed 15 June 2021].

2 Sevtsuk, A. et al. (2016), Pedestrian accessibility in grid layouts: the role of plot, bock and street dimensions, in Urban Morphology 20(2): 89-106.

Several recent examples show how this can be achieved in the design of new hospitals, with bridges linking departments across a permeable street system. In the case of alterations to existing facilities, the starting point is to seek opportunities to create new streets through the site in the course of renewing outdated building stock. These considerations generate our second design principle:

Walkability, however, requires more than just walkable-sized blocks. In these times of post-pandemic stranger-danger, we need reassurance to feel safe in using the streets without the protection of our cars. 'Eyes on the street' from people in adjoining buildings help to keep us feeling safe[1], but there is a problem here: most of the activities inside hospitals are too private to offer many eyes on

PRINCIPLE 2

Walkable blocks

St. Olavs with bridges linking hospital departments across a walkable street system.

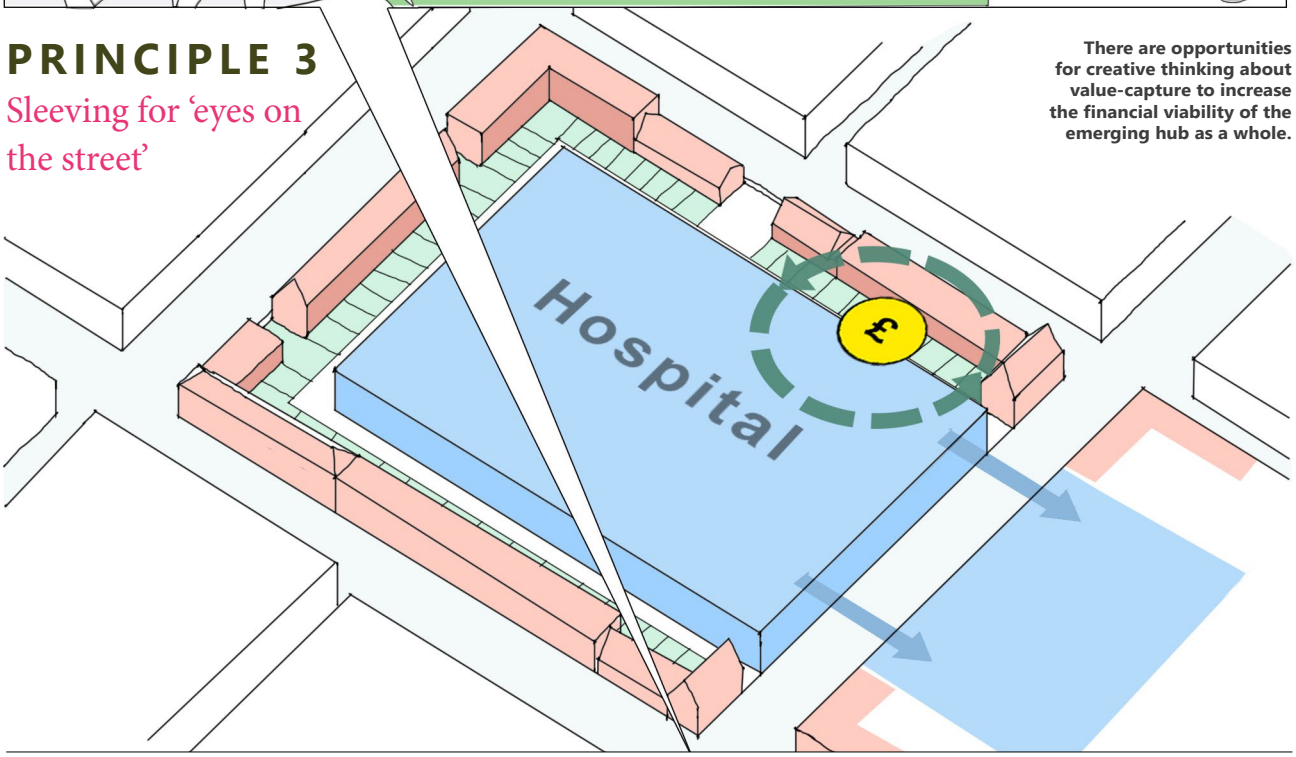
1 Gehl, J (2010), Cities for people, Washington: Island Press, Chapter 2: Senses and Scale

the street. Of their nature, to maintain patient dignity, hospitals themselves are essentially introverted buildings. To provide eyes on the street, therefore, hospitals have to be 'sleeved' behind other activities such as housing, which can help convert the introverted hospital silo into an outward-facing wellness hub.

These more street-related activities offer the emerging hub a double advantage: unlike the introverted hospital edge, they create economic as well as social value from their street-edge location. There is a great deal of evidence to show that long thin strips of land alongside streets are highly efficient in property-development terms[1], so two birds can be killed with one stone here. As well as providing space for activities that benefit wellness-building - which might range from social housing to encourage recruitment of young doctors and nurses through to special needs housing to reduce problems of bed-blocking through to training spaces to help disadvantaged youngsters into work - there are opportunities for creative thinking about value-capture to increase the financial viability of the emerging hub as a whole. As these ideas are developed further, they will require intense debate to ensure that the economic tail does not start to wag the health and wellness dog. Taken together, these factors generate our third design principle:

PRINCIPLE 3

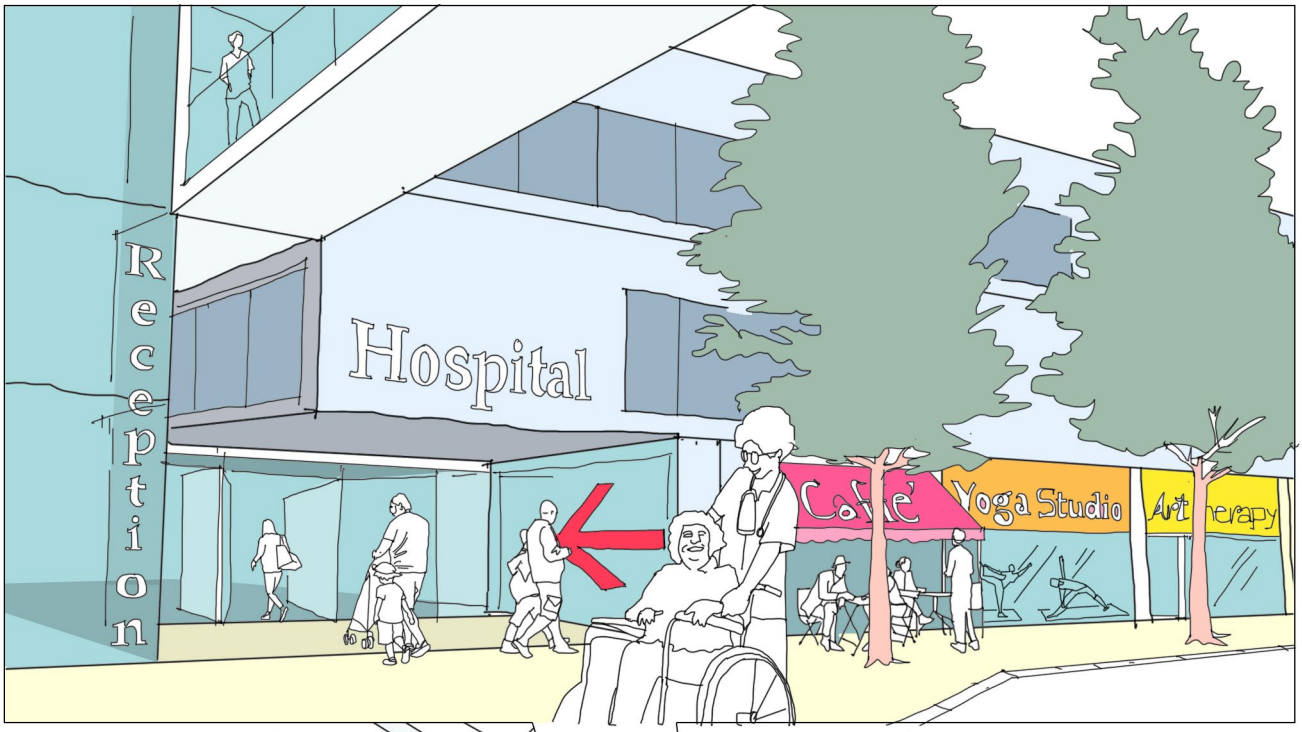
Sleeving for 'eyes on the street'



There are opportunities for creative thinking about value-capture to increase the financial viability of the emerging hub as a whole.

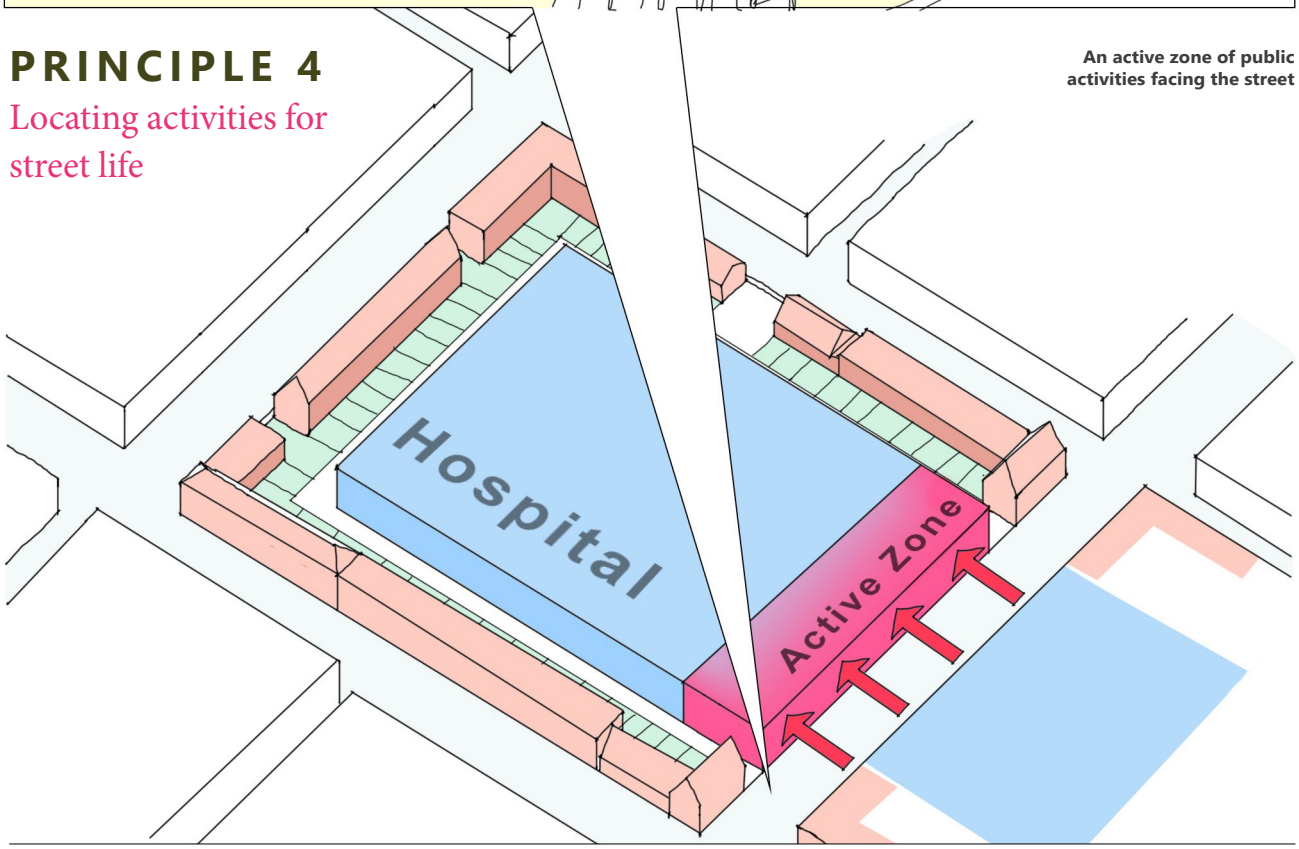
1 March, L and Steadman, P (2020, 1971) Geometry of Environment, and Berghauser-Pont, M. and Haupt, P (2007) The relation between urban form and density, in Urban Morphology, 11(1), 62-65.

Protected by its sleeve, the hospital itself now occupies land within the block, with its own private road access distinct from the public street system, and with only one street edge of its own. For the liveliness of the street system as a whole, we have to maintain eyes on the street along this edge[1]. On the ground floor, therefore, this is where we locate public entrances; together with activities such as shops, cafe or gym, or studios for yoga or art therapy, that are valuable both for the hospital itself and for the wellness of the wider community. Activities such as spaces for hospital staff, which benefit from contact with everyday normality, can then take advantage of overlooking the street from upper levels. These considerations generate our fourth design principle:



PRINCIPLE 4

Locating activities for street life



An active zone of public activities facing the street

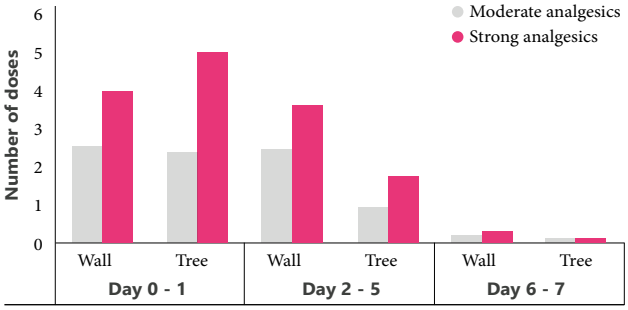
1 Bentley, I. et al(1985) London: Architectural Press.

Since the 1980s, it has been well-known that hospital patients recover faster with views of nature than with views of brick walls, and we now know that green settings also reduce the levels of pain relief which have to be administered[1] (Fig.9). Green experience helps maintain and develop wellness too: evolving in natural environments, it is unsurprising that humans have developed the basic affinity with other natural systems that we call biophilia[2]. Because they help reduce stress[3], green surroundings make for more harmonious, trusting relationships with others[4]; enabling us to develop cultural capital in the process. Wherever possible, therefore, our neighbourhood wellness hub should take advantage of opportunities for incorporating natural elements (Fig.10).

Since biodiversity benefits from connecting green elements to create geen corridors[5], the most cost-effective way of harnessing biophilia is by creating highly-connected tree-planted streets; where possible reinforced by exposed rainwater drainage swales. This has the further wellness advantage, in times of climate emergency, of reducing urban heat island impacts through evapotranspiration; reducing the dangers of summer heat stroke (Fig .11), particularly for elderly people. Small-leaved trees and hedges can also significantly filter our current illegal levels of particulate pollution from cars' brakes and clutches, which seems set to continue into the age of the electric car and is currently responsible for some 40,000 premature UK deaths each year[6].

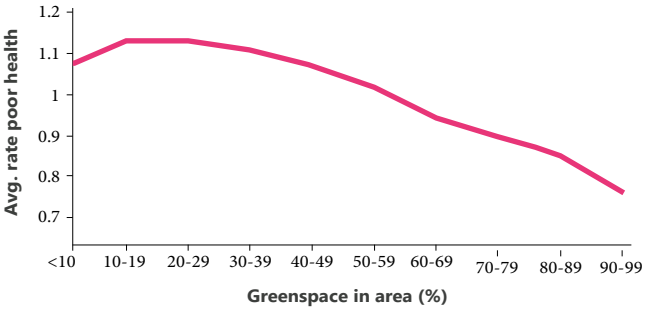
To maximise the connectivity of the system as a whole, to encourage the multisensory experience of birds, butterflies and pollinators, we can design these green corridors to pierce the hospital sleeve; flowing through into the internal spaces of the hospital itself. Where green corridors penetrate the sleeve, we can create small street-related pocket parks for well-surveilled children's play and informal gatherings. Within the hospital itself, green corridors about 20 metres wide allow internal spaces such as wards to experience natural spaces whilst maintaining their own privacy[7].

Fig. 9 **Analgesic doses per patient for wall or tree view**



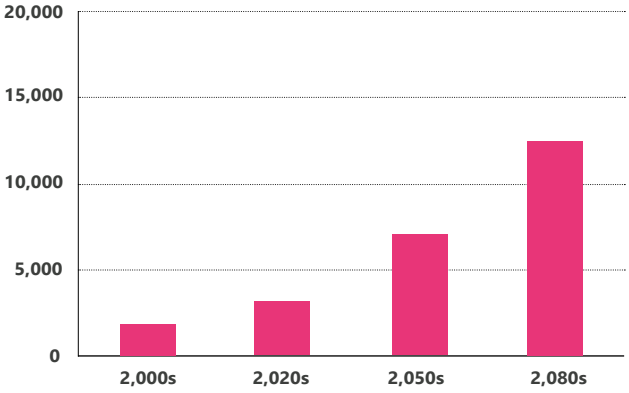
Source: Ulrich (1984).

Fig. 10 **Relationship between poor health and greenspace**



Source: Mitchell & Popham (2007). Greenspace, urbanity and health.

Fig. 11 **Heat-related deaths in the UK per year for all ages placing pressure on NHS services.**



Source: Hajat S. (21014). Epidemiol Community Health.

Air pollution from cars and vans racks up health bills of nearly £6bn every year in the UK

Source: Brand, Christian & Hunt, Alistair. (2018).

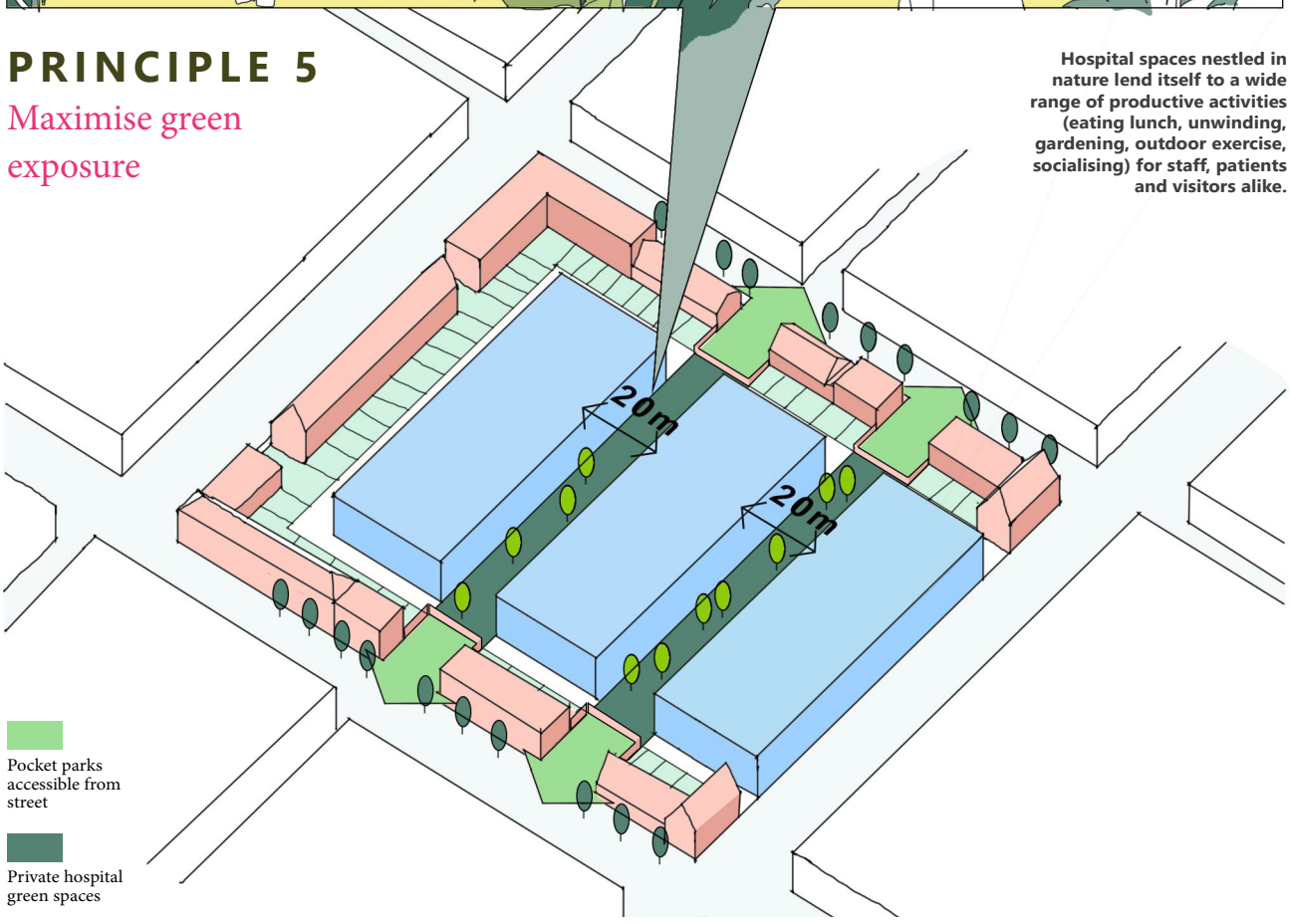
1. Ulrich,R.S. (1884), 'View Through a Window may Influence Recovery from Surgery', in Science, Issue 4647, 420-421.
2. Wilson, E.O. (1985), Biophilia, Cambridge, Mass: Harvard University Press.
3. Gidlow, C.J. et al. (2016), 'Natural Environments and Chronic Stress Measured by Hair Cortisol', in Landscape and Urban Planning, 148, 61-67.
4. Sullivan, W.C. et al. (2004), 'The fruit of urban nature: Vital neighbourhood space' in Environment and Behaviour, 36 (5): 678-700.
5. Forman, R.T.T. (1995), Land Mosaics: the ecology of landscapes and regions, Cambridge: Cambridge University Press.
6. Brand, Christian & Hunt, Alistair. (2018). The Health costs of air pollution from cars and vans. 10.13140/RG.2.2.25409.86886.
7. Assets.publishing.service.gov.uk. 2021. [online] Available at: <https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/957205/National_Model_Design_Code.pdf> [Accessed 18 June 2021].

These green spaces also provide opportunities for local volunteers to engage in therapeutic gardening activities; in the process providing fresh produce for the hospital kitchen. These considerations generate our fifth design principle:

PRINCIPLE 5

Maximise green exposure

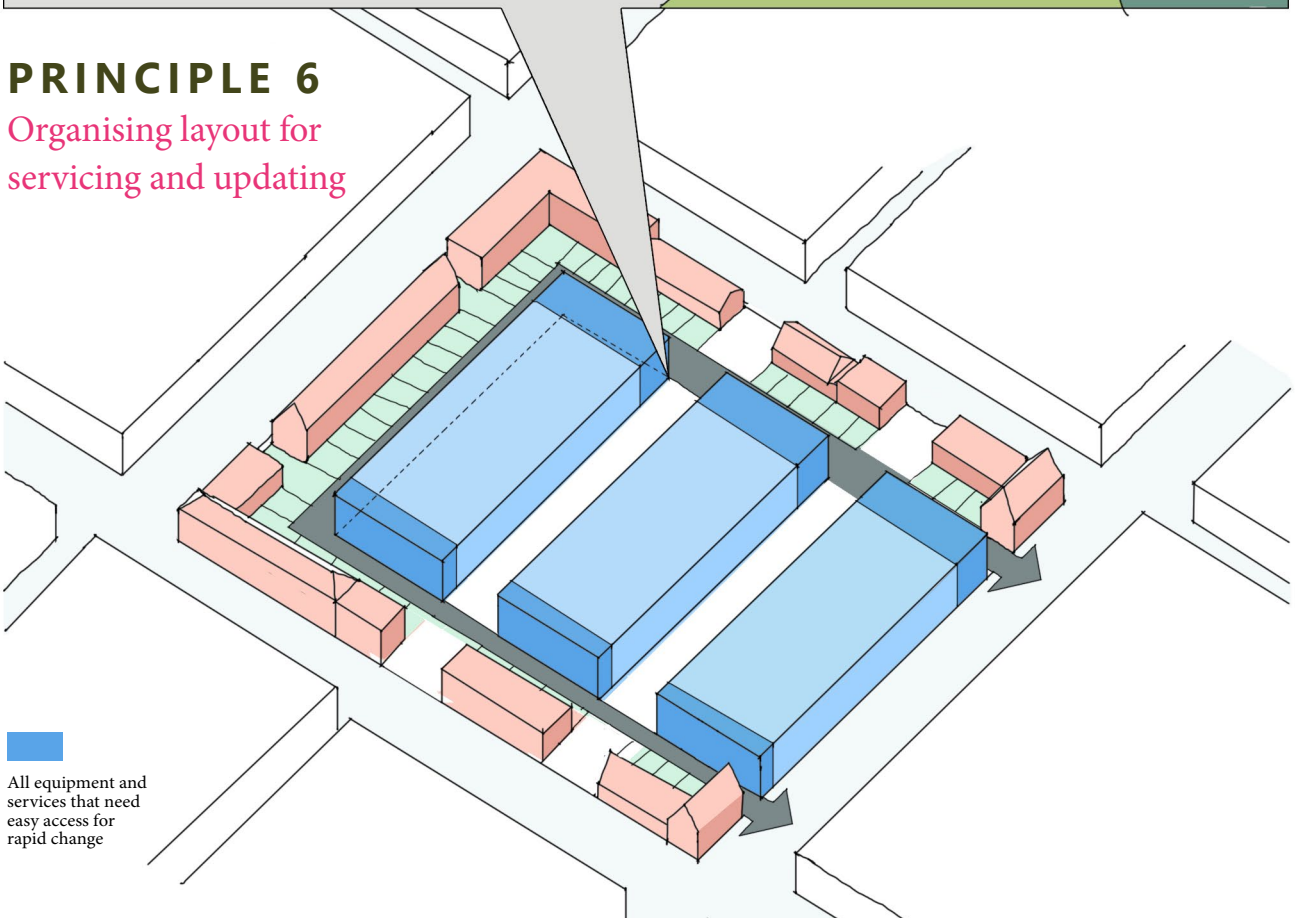
Hospital spaces nestled in nature lend itself to a wide range of productive activities (eating lunch, unwinding, gardening, outdoor exercise, socialising) for staff, patients and visitors alike.



The quality of clinical outcomes, patient experience and staff efficiency all depend partly on fast-changing technological innovation. Together with the facilities management department, handling deliveries and the hospital's complex waste-disposal system, all equipment and services that need easy access for rapid change are located next to the hospital's private access roads within the block. This generates our sixth principle:

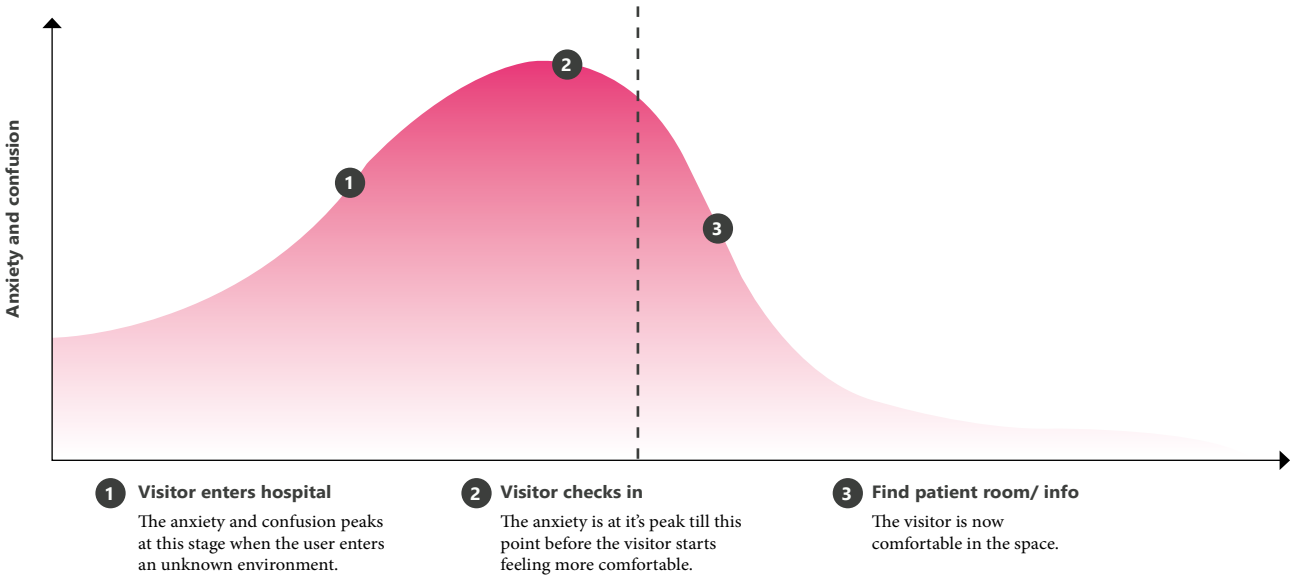
PRINCIPLE 6

Organising layout for servicing and updating



All equipment and services that need easy access for rapid change

Fig. 12 **Designing an indoor wayfinding system for hospitals**

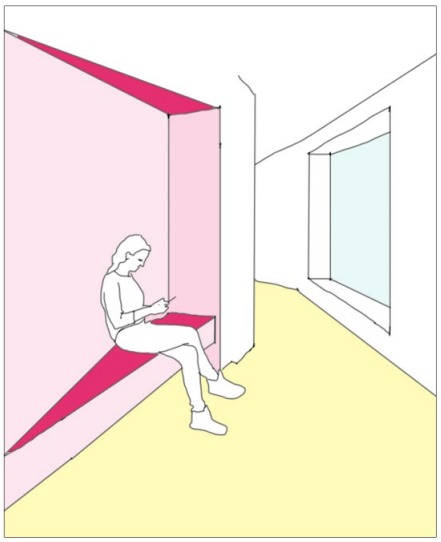


Source: Yang H. (2021). Emotional Journey within a hospital.

Hospitals have complex internal circulation requirements. People are there for very different reasons: some work there every day; others are unfamiliar with the place; many are very stressed. Legibility and psychological atmosphere are key design considerations[1] (Fig.12).

The overall aim of the system is to provide privacy and dignity for patients, together with easy horizontal and vertical access between departments, separately for staff and for visitors. To make this work, we organise separate main systems of horizontal and vertical access for staff and for visitors, giving access to opposite ends of a central zone of clinical spaces for diagnosis, treatment and rehabilitation, which are located between the green corridors. Each of these clinical zones then has its own internal circulation, linking between the main staff and visitor systems.

The main staff system, frequently used to move between departments, gives rise to many unplanned encounters between staff members. Research suggests that these offer opportunities for impromptu discussions that are important for the effectiveness of the system overall[2,3] (Fig.13). We therefore design them with subspaces to facilitate these.



'Corridors are essential to the informal communications that occur within clinical teams who are collaboratng in the delivery of high-quality patient care. thus, it is necessary to reframe the value of the corridor as an essential functional space that supports the delivery of care within a health facility'.

Fig. 13 **Example of hospital corridor nook (not to scale).**
Source: Sketch adapted from Carthey, J. (2008).

1 Yang H. (2021). Emotional Journey | Service Design Tools. [online] Available at: <https://servicedesigntools.org/tools/emotional-journey> [Accessed 15 June 2021].

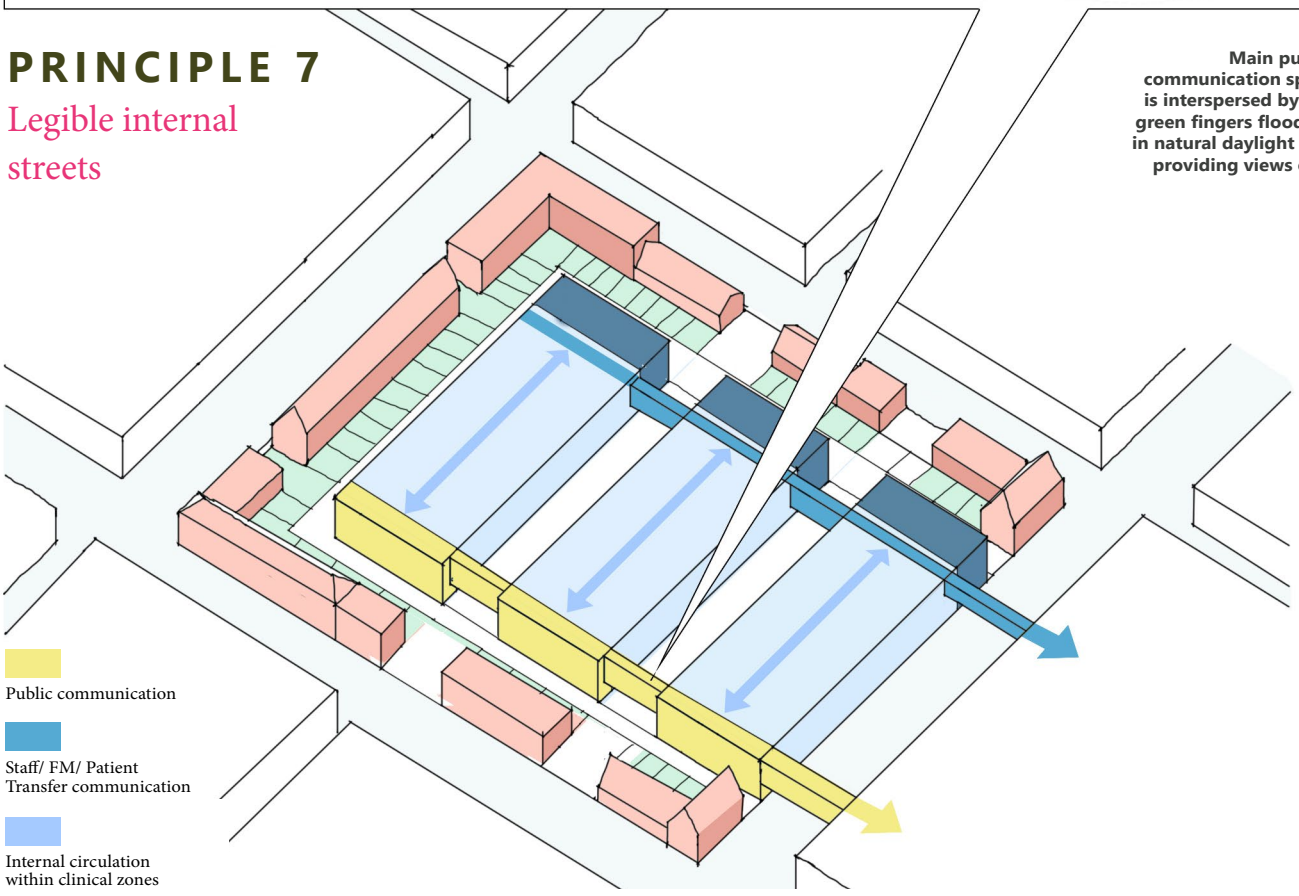
2 Hertzberger, H. (2015), Architecture and Structuralism: The Ordering of Space, Rotterdam: NAI, page 80.

3 Carthey, J., 2008. Reinterpreting the Hospital Corridor: "Wasted Space" or Essential for Quality Multidisciplinary Clinical Care?. HERD: Health Environments Research & Design Journal, 2(1), pp.17-29.

The main public system is used by people who are often highly stressed and anxious. As well as being directly legible, therefore, they offer a sequence of sensory experiences designed to create a low-stress balance between boredom and over-stimulation. Here too we have subspaces allowing settings for reflection, somewhat out of the main flow. These considerations generate our next design principle:

PRINCIPLE 7

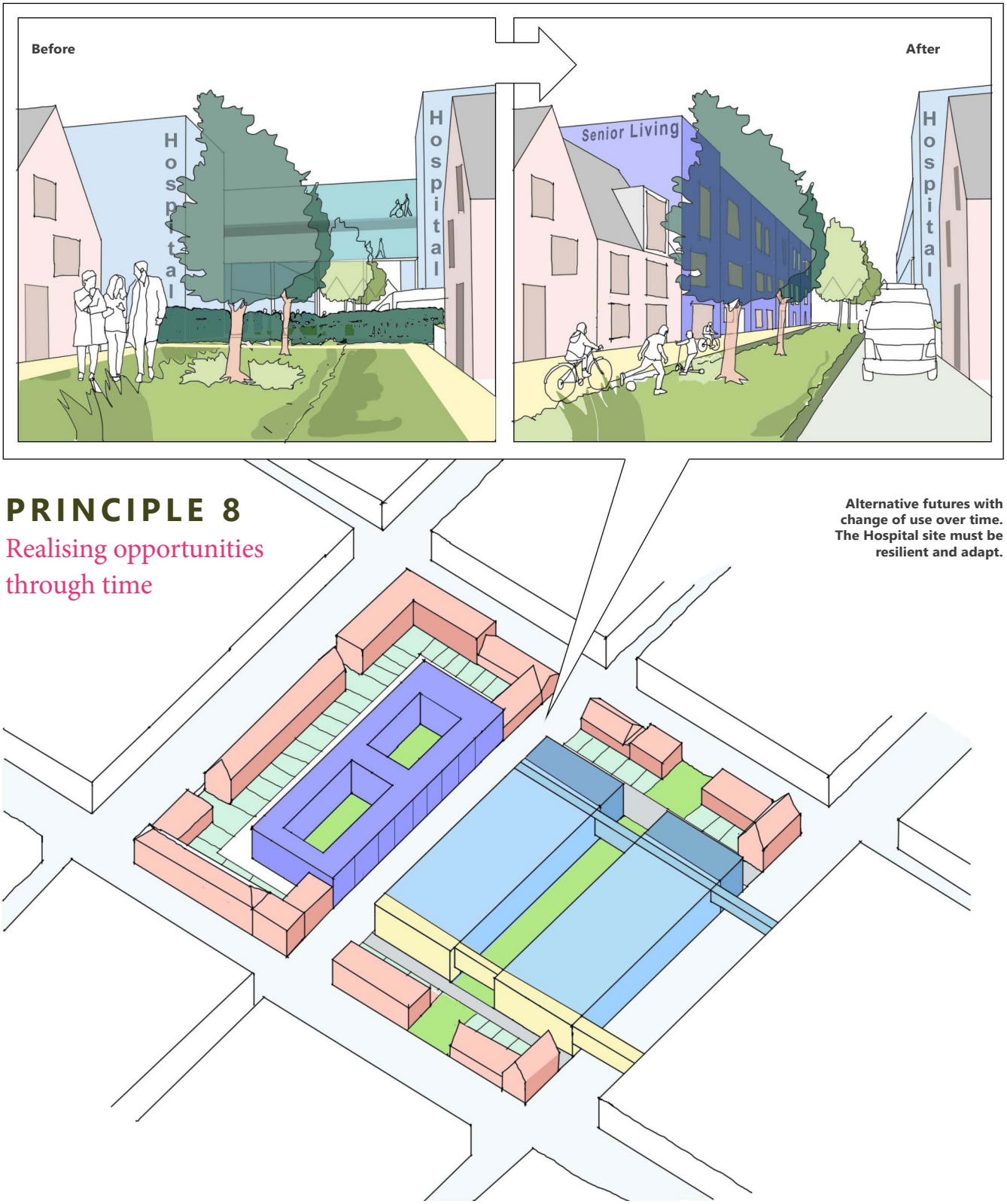
Legible internal streets



Main public communication spine is interspersed by the green fingers flooding in natural daylight and providing views out.

To benefit patient experiences, clinical outcomes and staff wellbeing, hospitals must be able to adapt to changing health and care demands and technical services over time. As the move towards greater distribution of services within the region gathers pace, the balance of space-requirements between hospital facilities and related housing and other services is likely to change from time to time.

Our typology allows NHS real estate to stay connected with opportunities as they evolve. At the block scale, green courtyards can become new green streets, allowing hospital elements to accommodate more outward looking activities such as housing, teaching or research facilities. This generates our eighth principle:



PRINCIPLE 8

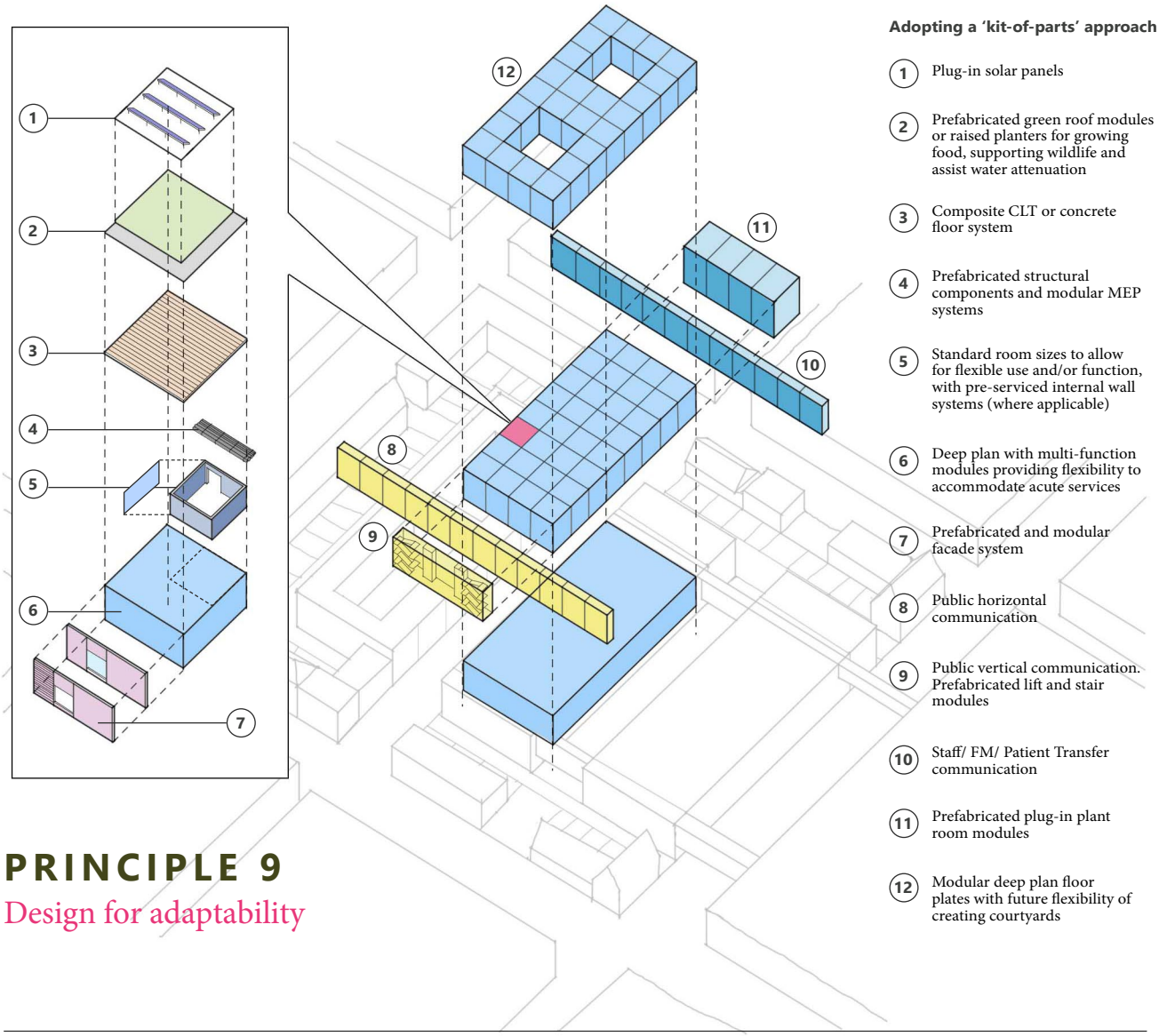
Realising opportunities through time

Alternative futures with change of use over time. The Hospital site must be resilient and adapt.

THE BUILDING SCALE

This adaptability is reinforced through design at smaller scales. Historically the NHS has developed, with varying degrees of application and success, a standardised approach to the healthcare estate based largely on template designs. In more recent times, particularly with the Private Finance Initiative programme, hospitals have been designed as non-standard bespoke buildings, which have subsequently proved difficult and costly to change[1].

Recent developments in building and engineering systems, manufactured off-site in controlled factory settings, now offers the possibility of developing a more flexible and adaptable approach to the design of hospitals and other related facilities[2]. Modern methods of construction (MMC) offer the possibility of developing a hospital standard 'kit of parts', manufactured to the specific quality standards required by the NHS. Dimensionally, the kit of parts will be based on the planning grid for a 'standard room', sized to accommodate a range of common functions, ranging from inpatient room through consulting and examination room, treatment room, utility room, staff base and so on. This average room size[3] has the potential for creating standardised settings for common procedures, with consequent training advantages. The average size will be multiplied to provide for the variety of larger sizes hospitals often require; and it will also inform the structural grid and associated sizes of all structural components. This generates our ninth principle:



Adopting a 'kit-of-parts' approach

1. Plug-in solar panels
2. Prefabricated green roof modules or raised planters for growing food, supporting wildlife and assist water attenuation
3. Composite CLT or concrete floor system
4. Prefabricated structural components and modular MEP systems
5. Standard room sizes to allow for flexible use and/or function, with pre-serviced internal wall systems (where applicable)
6. Deep plan with multi-function modules providing flexibility to accommodate acute services
7. Prefabricated and modular facade system
8. Public horizontal communication
9. Public vertical communication. Prefabricated lift and stair modules
10. Staff/ FM/ Patient Transfer communication
11. Prefabricated plug-in plant room modules
12. Modular deep plan floor plates with future flexibility of creating courtyards

PRINCIPLE 9
Design for adaptability

1. Burke, Angela, 'Towards a New Hospital Architecture', University of East London, pp. 39-40 (2014) https://repository.uel.974d10d07d3aa187dbd7b426c64fdba76af39fcf78a049c/22109043/140314_Complete_PhD_FINAL%255B1%255D.pdf> [accessed 15 June 2021]
2. https://www.rootsanalysis.com/reports/view_document/modular-facilities-in-pharmaceutical-and-biotechnology-market-2021-2030/178.html.
3. Olsson, N. and Hansen, G., 2010. Identification of Critical Factors Affecting Flexibility in Hospital Construction Projects. HERD: Health Environments Research & Design Journal, 3(2), pp.30-47.

CONCLUSION

Ultimately, a hospital's performance is built on the underlying health of the population it serves. We therefore need planning and design principles, across a range of spatial scales, which enable hospitals to treat illness in ways that also support the building of underlying wellness.

At the regional scale, our ideas build on the NHS drive towards geographically-based Integrated Care Systems. Learning from international precedents, we propose distributing the facilities of each integrated system throughout its region, in relation to its population's spatial demographics, through a range of health hubs and campuses.

At the scale of the particular hub or campus, our principles reimagine hospitals as the seeds of neighbourhoods that foster wellness by supporting active lifestyles. Creating links between the hospital and the neighbourhood's wider activities, these ideas also have implications enhancing the value of the NHS real estate; potentially increasing the funding available for the hospital facilities themselves.

Finally, at the smallest scale, we have developed design ideas for the spatial structure and physical construction of the hospital elements themselves. Here we have focused on improving patient experiences, clinical outcomes, staff wellbeing and integration with wider health and social care at the most personal level.

Taken together, the principles we have developed should not be seen as a rigid recipe. Focused on creating positive relationships between the potentials of particular regions, neighbourhood contexts and healthcare demands, their outcomes will depend on the nature of these potentials in each particular location. If used creatively, therefore, the same underlying principles will always generate unique, situation-specific outcomes. There is, however, a common factor: these principles help the designer break free from the conception of the hospital as an isolated element. The whole, in healthcare terms, becomes more than the sum of its parts.

THE HOSPITAL OF THE FUTURE: A NEW TYPOLOGY