Discussion paper July 2020

Lessons from the last hospital building programme, and recommendations for the next

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In October 2019, the British government announced the Health Infrastructure Plan (HIP) – a major new 5-year scheme to upgrade and redevelop NHS hospitals.[1] HIP wave 1 gave the green light to six hospitals that had existing plans that were ready to move forward. In addition, 21 schemes were cleared to proceed to the next stage, bringing a total of over 40 different schemes forming part of a 'rolling programme of investment in health infrastructure'. A number of these schemes involve major redevelopment of hospitals rather than just upgrading.

The NHS has been through this process before. Between 1997 and 2010, there were over 50 major schemes to redevelop acute hospitals at a total cost of over £10 billion, mostly financed through PFI. There were parallel investments in mental health, community and primary care buildings.

This previous experience could provide some important lessons for the present programme. Unfortunately, though, with the exception of the debate on the pros and cons of PFI, there has been very little formal evaluation of the actual schemes. In the absence of such research, this paper gathers

1 https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/835657/health-infrastructure-plan.pdf

together the views of a number of experts who were involved in the previous phase of hospital development. Contributors included NHS project directors, architects, health planners, researchers and consultants. We asked them to identify some of the most important learning, and the practical and policy implications that can be taken from this experience.

Some key issues identified by the experts that have immediate relevance include:

- the need to improve planning and the assumptions that underpin it
- identifying ways to improve the quality of design, procurement, project management and construction
- concerns regarding the approvals process.

In particular, experience demonstrates the importance of planning for the whole system, rather than just hospitals in isolation, and to form a plan for many services – thinking beyond health care delivery alone.

Furthermore, some responses to the Covid-19 pandemic have also served to reinforce the importance of a number of the ideas set out here, including the importance of reconfigurable space and the need to pay attention to constraints, such as bottlenecks in access to shared resources.

The paper reveals several consistent themes regarding the availability of skills and expertise; the need to greatly improve the sharing of information; and the need for a central team to support this, all of which point to a need for action. This should encompass much more than just project management and delivery – it needs to include, for example, the marshalling of intelligence, investment in knowledge exchange, and the development of resources to support projects. Support should include up-to-date technical guidance, modelling, and standardisation of rooms and approaches to important parts of the process, like developing the design brief and conducting procurement.

The paper also highlights some other important implications for policy relating to the allocation of capital, the approvals process and procurement. It will also be important to move to planning development at a system level supported by a masterplan that takes into account other health and public services rather than planning for individual organisations.

It is also clear that getting the best from the construction industry at low cost and higher quality remains a challenge – particularly doing so in a way that removes risk to the construction industry's fragile finances (in spite of their high costs compared to other countries). Practical lessons can also be learned from the past about oversight of constructors and the certification of quality: failure to do these things well in the past has cost lives and money.

All of this adds up to a major call to action to different parts of the system that delivers health infrastructure. These are summarised in the final section.

Planning

Assumptions

In the last round of hospital building and infrastructure work, the approaches to planning used in the 1980s and early 1990s were largely dispensed with, replaced by operational approaches like business planning based on annual planning rounds and working with commissioners on short-term processes to change pathways or improve care.

Experts observed that there were problems with the inputs used for the planning process that affected the design, size and functionality of the finished scheme. Planning for the new buildings often did not fully consider the emergence of new diseases or possible changes in disease management drugs, technology or the labour market. The most significant concern was planners' tendency to make overly optimistic assumptions about future demand and performance. This was often driven by a need to reduce bed numbers and other types of capacity in order to suit the financial envelope on offer. This meant that there was no real strategy for replacing assets. The cost implications of replacing a fully depreciated asset, such as a workhouse hospital, with a modern highly engineered building were not recognised by the financial regime, creating a pressure to reduce costs.

Some of the issues identified include the following:

- Assumptions about reducing length of stay or changes in outpatient attendances were based on crude benchmarking – often without case-mix adjustment or allowing for the fact that different localised practices or facilities could be distorting those assumptions

- Planning was at times based on managing demand or reducing length of stay without any real support or investment in community and other services – sometimes in ways that did not reflect the available evidence

- Hospital activity, rather than demand or need, was often used as the basis for forecasting

- Static forecasts were used instead of modelling flow dynamics within the hospital or the wider health and social care system – in particular experts noted a neglect of the impact of constraints imposed by imaging, discharge or other processes, and neglect of the potential for supply-induced demand (such as in the case of walk-in centres)

- Planning for routine elective care was carried out with an inadequate knowledge of the level of demand

- Limited thought was put into plans to fill the gaps in community-focused buildings that could integrate primary and community care and form a community hub. In many cases projects failed to join up with local authority services such as children's services.

Some of these issues arose because almost all schemes were plans for hospital redevelopments rather than being part of a wider exercise in local health system master planning. Commissioner and strategic health authority sign-off was required, but the extent to which this provided a corrective to the inherent problems is doubtful. Given the pressure to deliver, it seems that this may not have been adequate in many cases.

Follow-through

The whole process of planning the large new investments in the previous hospital building phase took between five and eight years, through design, construction and commissioning, in spite of the sped-up PFI process. Even where planning was done well, processes for ensuring that plans were followed through, or organisational memory to ensure they were enacted, were not always in place. Some individual examples are provided in Box 1.

Box 1: Examples of poor follow-through

- One hospital only discovered late in the day that an early assumption had been made that outpatient services could be decentralised. This came to light when the clinical schedule was found to be around one-third too large for the actual space available. The planners behind this decision had moved on, and somehow this key assumption about decentralisation was not passed on to their successors or incorporated into operational policies, consultant job plans or the acquisition of facilities in community settings.

- In a number of cases, an investment in home care that was promised never materialised and length of stay targets were not met. This ultimately required additional beds to be built.

- In one case, the organisation of departments across the site was carefully planned, but by the time the hospital opened, it turned out that these ideas could not be fully implemented. This resulted in inefficient patient and staff flows and suboptimal workarounds.

Cases where the follow-through could be deemed a success often involved approaches that developed and (if possible) implemented new clinical models, flows and ways of working prior to the building actually being occupied. Often this entailed years of experimentation and clinical engagement in redesign.

Connection to wider public sector planning

Looking back on most hospital development schemes during this earlier period, it is striking how limited the level of integration with local place-based local authority planning was. Local authority involvement often did not go much beyond granting planning permission. More recently, some schemes have made more explicit connection with opportunities to develop the wider local economy and to involve local authorities and the wider public in their plans. There are important advantages to doing this – not just in terms of ensuring integration with local transport arrangements, but also in capitalising on access to other development funds and making the most of the contribution to local economic development that a major construction project can bring. There is still much more to do in this area.

Skills and expertise

The dearth of new health care buildings for about 15 years during the Thatcher and Major governments meant that many people who were involved in hospital redevelopment in the early 2000s had little previous experience of large-scale service planning or capital development.

It used to be the case that there was high-quality expertise in health care building design, both within the Department of Health and in the regional health authorities. But by the mid 1990s, much of this had been lost through outsourcing or because national and regional estates functions had been stripped back.

With the adoption of PFI, which usually included bespoke design, standardised building approaches such as 'nucleus' and 'harness' designs were shelved, and the learning and skills lost. Some of the new designs were innovative and successful, while others were not. But the expertise and knowledge required to design them became proprietary, as did the finished products, and so learning was not shared well.

Since 1980, there has been a shortage of property development expertise in the NHS, despite it being a huge landowner. As a result, opportunities to make the most of the NHS estate have not been fully exploited. As the Naylor report noted:

> 'skills and capacity in estates strategy and management in the NHS largely reflects traditional skills, including technical knowledge and project management. This will not be sufficient in developing a comprehensive estates strategy'.

This meant opportunities to make the most of innovations such as campus developments incorporating other health and life sciences functions or partnership working with local authorities, SMEs and the creation of income streams from assets were missed.

There was also a shortage of experienced project directors and skilled supporting staff. Any directors that came from other sectors did, of course, bring relevant skills, but the complexity of health care proved to be a challenge. Evidence from experts consulted indicates that those directors who

'really understood' health care and shared a vision for what the building was supposed to deliver were significantly better in the role in terms of delivering highly functional buildings. Those focusing on project management and delivery may have been effective in this role, but they were not well placed to exploit wider opportunities to shape the schemes to get the best from them.

Knowledge sharing

In spite of efforts from some quarters to spread learning and ideas between the development schemes, there was a lack of knowledge about what clinical models were available and the best design options to apply to these models – even though many models were available and well developed and their strengths and weaknesses were understood. There was little curation of knowledge nationally (apart from that relating to PFI and transactions) and so there were a lot of examples of 'reinventing the wheel'. In some cases, this led to the development of suboptimal design solutions.

The Future Healthcare Network was established as a member-led group to spread expertise and to facilitate horizontal dialogue between schemes and with advisors, constructors and other experts. While valuable and well supported at the time, in retrospect this was not enough on its own to meet the need in this area.

The lack of knowledge curation and limited post-project evaluation also meant that lessons from projects early in the programme were not shared very effectively with those in later phases.

The NHS as an intelligent client

The consequence of a lack of the right people, poor knowledge sharing and a sometimes adversarial approach to contract management meant that the NHS often failed to act as an intelligent client. Adversarial and low-trust approaches could elicit a response in kind from contractors, and the project would generally suffer as a consequence of the loss of good will. A lack of client-side skills can have serious consequences. This seems to have been one of the reasons behind the three-year delay in commissioning the new children's hospital in Edinburgh, for example.[2]

2 www.constructionnews.co.uk/contractors/multiplex/tender-error-caused-three-year-delay-edinburgh-childrens-hospital-13-09-2019

A view within the construction industry, supported by those we have interviewed, is that procurement teams in the NHS need to be strengthened and processes need to be streamlined. The emphasis placed on getting the lowest price may have resulted in some of the problems seen with the collapse of Carillion.[3]

Hence, a key lesson is that there is often a trade-off between speed and quality. One researcher in this area comments that "more often than not, when large hospital projects are announced by the government, it is said that they will be delivered to specific timescales and within a particular budget,"[4]. But this is a potential problem: these kinds of schemes are generally very complex and getting consensus between different stakeholders should not be rushed.

Design

Experts interviewed recalled that some building schemes had a very clear idea about how a new building would facilitate a new clinical model – and in these cases, close engagement in elements of the design was helpful. One benefit of PFI was the development of user groups and more frontline involvement in design, although experience with them was mixed. Some users gave detailed suggestions based on existing service models, or their understanding of them. Some idiosyncratic designs emerged as a result that proved to be inappropriate for the delivery models that subsequently emerged, and also unhelpfully inflexible. Experts involved found that some clinicians had a clear view about the process requirements for their own specialty, but limited understanding of the complex flows outside their immediate area.

A number of people felt, on reflection, that although wider user involvement could be valuable, much of it had taken up a lot of time without being particularly helpful. Experts felt it was more important to have a small core team responsible for decision making, reconciling competing demands and driving standardisation – and for this team to have very good dialogue with users. It would have been helpful to specify standard approaches to design and to have provided more up-to-date and usable information on how particular room types and layouts could support a variety of clinical models.

3 www.constructionnews.co.uk/civils/contracts-civils/medical-issues-problem-hospital-builds-22-10-2019

4 www.constructionnews.co.uk/civils/contracts-civils/medical-issues-problem-hospital-builds-22-10-2019

This may have led to the development of a library of replicable room styles that could have acted as a corrective to idiosyncratic design and reduced the likelihood of 'reinventing the wheel'. It would also have helped to address the problem of delays from design teams having to seek derogation from out-of-date design guidance.

Furthermore, project teams could have made more use of modelling and simulation to 'dry test' designs and understand the flows through hospitals and out to the wider system. Experts recalled that there was often a lack of clarity over some of the capacity constraints. At the time, there was no clear consensus on some key aspects of hospital functioning – for example, what the optimal method was for organising the emergency department, the reception, diagnosis and onward movement of emergency cases (especially in medical specialties). There were similar debates over the best models for outpatient care and elective care.

The rapid changes and innovations in models of secondary care, tertiary care and, to a lesser extent, primary care presented a major challenge. For example, many new hospital schemes were premised around an underestimate of the future demand for emergency department attendance, and naturally did not include NHS England's current ambition to reduce face-to-face outpatient attendances by 30%.

This raises a question about how far designs should seek to embody specific clinical models in detail as opposed to designing a highly flexible space. Approaches that understood the nature of the clinical pathways, processes and workflows or approaches that designed buildings using a small number of standard rooms seem to have worked well. Choosing room sizes that had a 'loose fit' i.e. slightly larger than the minimum specified, and including 'soft space' were good future-proofing solutions, although they added to the overall cost of the scheme (see Box 2). This could be offset against the fact that schemes that made changes in design further down the line, during procurement or particularly during construction, generally incurred a large cost penalty.

Box 2: Designing flexibility

The high level of uncertainty in making forecasts has led to more emphasis on building in flexibility at both a micro and macro level. Micro-level strategies include:

- *'Loose fit'* – generous room size specifications
- *Adaptable space* – rooms and spaces designed to change function or accommodate multiple functions
- *Transformable space* – designs that allow internal walls and services to be moved, meaning that buildings can be reconfigured as needs evolve with minimum building necessary
- *Convertible space* – accommodating changing functions through some construction, but reducing cost and time by anticipating future needs. For example, acuity-adaptable rooms can be designed to facilitate change from regular inpatient rooms to critical care rooms if they are designed with the appropriate clearances for medical equipment and the ability to access additional medical gases and additional power.

For situations involving more fundamental uncertainty over the size of the whole facility, a number of macro-level approaches to flexibility can be used:

- *'Soft space'* such as storage and administrative offices can be built around high-tech departments to enable them to expand if necessary, with minimal upheaval and cost
- *Interstitial floors* are important components that allow services to be expanded, rerouted and changed with lower costs for electrical and engineering services.
- *Building shell space* is a similar strategy, particularly for services that may need to expand but which need to be co-located. Shell space allows future expansion or can be fitted out for alternative use if this is not required. Building additional engineering, or the capability to add it in, is important for the potential of such space to be realised.
- *Building for planned expansion* – vertical expansion can be expensive if shell space, spare elevator capacity, engineering and structural components are not provided as part of the initial build and where there is roof-mounted engineering. Horizontal expansion can be facilitated by initial masterplanning and by providing circulation models that allow easy future expansion. In densely developed areas, vertical expansion may be the better option.

Although the proposed HIP is not intended to be funded using PFI, there are some lessons that can be drawn from that experience that will still be applicable (even more so if the results of the current crisis mean that the government needs to find alternative funding sources).They are as follows.

- Where designs were driven by narrow financial considerations, the results were often poor. Economic and design compromises were made that reduced the functionality of the end product. This is not unique to PFI.

- Pressure to scale down costs often led to reductions in circulation space, 'soft space' (to allow easy expansion of departments), and room sizes, all of which have significant implications for flow and flexibility. This process also led to the removal of design features that improved aesthetics. On some occasions, the cost-cutting extended to attempts to remove elements that would promote environmental sustainability and other important aspects of the finished scheme. This was rather misleadingly named 'value engineering'. Better, more strategic solutions to dealing with schemes that are over-budget are required.

- As the costs of design and constructing for flexibility were borne by the PFI consortium while the costs of adapting buildings currently in use fell on the NHS, there was a misalignment of incentives to build in flexibility.

- It is unlikely that having up to three bidders submitting fully designed solutions was economically efficient. It probably drove innovation to some degree, but bid costs needed to be recovered somewhere in the process.

- The 'bundling' of design and construction in the same contract sometimes meant that the best design team or concept was not part of the winning bid. However, this was less of a problem in cases where there was early engagement in the design process and partnership with the contractor – or, less commonly, where the design team was contracted directly by the client and novated to the construction consortium at financial close.

- PFI was successful in making schemes consider the whole life cost of developments, although these were narrowly defined and usually did not include the cost implications of design beyond immediate maintenance and operating costs. For example, costs would generally not factor in additional nursing costs associated with particular layout or size of hospital

wards. At the same time, the whole-lifecycle costs often had the effect of making even minor changes extremely expensive – hence the many stories of exorbitant bills for minor works such as putting up a shelf. Lifecycle costs for the wider system were not considered at all.

Many of the design solutions for PFI hospitals did bring new ideas that were more up to date than the 'nucleus' style and tended to have better connectivity and consideration of space and functional relationships. In some cases, however, this was at the expense of an extensive use of deep-plan buildings, which required more engineering, left some areas without natural light and could be inflexible.

Building quality

Many experts have the strongly held view that the quality of construction in a number of schemes was not what it should have been. But Grenfell Tower and experiences with quality in the construction of schools in Scotland shows that this is not unique to NHS schemes. Builders operate on very tight margins and consequently may not have been able to take on the risks required of them. These issues led to problems that were exacerbated by a lack of control over quality and insufficient articulation of the quality standard the scheme was expected to achieve by the client.

Many builders put a lot of effort into making small savings through changing what was built and, in some cases, by cutting corners in ways that compromised quality and functionality. Some mistakes were repeated across different schemes, and there were particular problems with works being difficult to access and therefore to inspect – see Box 3.

Box 3: Examples of construction quality problems

In schools and health buildings in Scotland, it was found that brickwork had not been properly tied, leading to a catastrophic collapse of a large wall into a school playground. The work had been certified by a leading engineering firm. Many schools and a number of health facilities in Edinburgh were closed to make urgent repairs and correct the construction problems.

Drainage and water schemes seem to have been a very common source of problems, sometimes based around issues such as narrow bore waste pipes that blocked easily and thin walled water pipes springing pinhole leaks. Dead ends in plumbing systems also remained a problem. One approach to capping of drains, rather than sealing the ends properly, saved the contractors £40,000 – but unfortunately these were dislodged when the drains were cleaned and the subsequent leak of sewage led to a successful claim for £4 million for loss of use.

There have also been frequent problems with fire stops between compartment walls, especially where pipes or power have been fitted after the main work has been done. For example, the PFI hospital in Peterborough had to carry out extensive works to deal with this problem.

These may appear to be issues of detail, but the combined effect was to disrupt services, create large financial risks and, in a few cases, to be life threatening to both staff and patients.

The approach taken by several builders that operated models where much of their work was subcontracted was to rely on their quality assurance arrangements and inspection. This did not work well. It reduced the incentive to exert firm control or for builders to challenge their sub-contractors. Some of the providers of certification were rather passive, reliant on sampling and often had an overly close relationship with the builders, which made challenge more difficult. Inspectors and certification staff were not always sufficiently expert to deal with the wide variety of issues in complex hospital buildings. These problems could be exacerbated where building regulations were administered by the builders, and self-certification of these issues was found to be very unreliable as a source of assurance. The disappearance of the 'clerk of works' role and the nature of the relationship between contractors and design teams in contractor-led design models has meant that oversight has

been weakened as contractors sometimes limit the access of the design team to the construction site.

Other problems emerged as a result of cost-cutting, including making savings on detailing and finishes that spoiled the look of the building or created problems for cleaning – plastic fittings that allowed bacterial or mould growth being a particular culprit. In one project it was necessary to set out a 'book of parts' to ensure that standards of fittings and finish were clear and adhered to.

Under-exploited opportunities

Technology

The technological progress made since the last round of hospital building has been enormous. Schemes have not always taken full advantage of the opportunities this offers at the right time – robotic pharmacy management systems being one example. The potential for designs to incorporate smart building technology and for the incorporation of teletracking and other wireless systems is considerable, as is the better-understood saving to be made from not using film or paper records.

Workforce

The future workforce was often forgotten or assumed to be completely flexible. With hindsight this is regrettable as it may take longer to develop and validate specialist expertise than it does to build a new hospital.

Sustainability

While schemes did pay some attention to sustainability, it was not as central to the thinking as now seems appropriate. Some cost-reduction measures removed or attempted to remove features that would reduce the environmental impact of the building. An important lesson is that good, well liked buildings get retained and converted, and bad unloved buildings get demolished. Two of the schemes from the hospital building programme are based on the demolition and replacement of buildings that are only 35 years old. This is not a sustainable approach.

Therapeutic environment

The pressure to contain costs and the use of deep-plan building designs sometimes had the effect of limiting access to daylight and, in particular, access to natural views. There is good evidence for the benefits of gardens and having a view.[5,6] More could have been done to incorporate well-evidenced lessons about how design can minimise noise, reduce stress, improve the staff working environment and improve outcomes and experience for patients.[7,8]

Leaders of building projects were often nervous about investing in art, although there is good evidence to support its importance[9]. It had potential to be controversial, particularly in the case of large 'statement' pieces, such as a sculpture bought with charitable money for UCLH.[10]

Single rooms

Given the evidence relating to the adverse effects of noise and the need for improved infection prevention and control, it is surprising in retrospect that more emphasis was not put on the provision of single rooms – although there is a debate about whether their use should be universal as they can leave patients lonely and isolated.[11] North Bristol had 75% of beds in single rooms and Pembury hospital had 100% single room accommodation, but these were exceptions. There are operational and design challenges in getting the best out of single room-based models, but they do not seem to be associated with significantly higher nursing costs.[12]

5 Ulrich, R. Health Benefits of Gardens in Hospitals. Conference Paper. www.researchgate.net/publication/252307449_Health_Benefits_of_Gardens_in_Hospitals

6 www.ncbi.nlm.nih.gov/pubmed/6143402

7 www.researchgate.net/profile/Roger_Ulrich4/publication/273354344_Effects_of_Healthcare_Environmental_Design_on_Medical_Outcomes/links/557ed93408aec87640ddee0b.pdf

8 www.researchgate.net/publication/236000806_Healing_environment_A_review_of_the_impact_of_physical_environmental_factors_on_users

9 www.ncbi.nlm.nih.gov/pmc/articles/PMC2996524

10 www.theguardian.com/artanddesign/2005/oct/27/art.health

11 www.bmj.com/content/347/bmj.f5695

12 www.ncbi.nlm.nih.gov/books/NBK274434

Approvals and capital allocation

The approvals process

The capital approvals process appears to have developed over the last 20 years as a method of capital rationing and delay rather than as a rational approach to capital allocation. The emphasis on a high level of detailed scrutiny at different stages of the approvals process has created a great deal of delay. This may have been in response to some of the problems with the quality of the planning identified above, but if so, it neither solved these nor provided much of a corrective.

Such a slow and bureaucratic process is not consistent with the government's ambition to fast-track capital spending, and unless there are changes to the approvals process there will continue to be slow progress for many schemes.

There is general agreement from experts involved about the extent to which the business planning process has become too complicated and bureaucratic in the following ways.

- The number of stages and review points – elements of the Gateway process used to review schemes are certainly seen as helpful, but overall the process is bureaucratic, slow, contains a lot of duplication and is much less helpful than it was designed to be.

- The volume of material that needed to be produced for plans and the large number of different plans resulted in over-specificity in content. It generated huge amounts of work, much of which was of questionable value.

- There seemed to be a disproportionate amount of oversight. The previous 'approval in principle' approach required much less detail about the content of the scheme and was focused on the case of need and the broad economics.

- Frequent delays in approval and multiple requests for information can mean that there needs to be a reworking of the financial model, cost estimates and other elements – consuming a lot of managerial and advisory time and adding to costs for little or no benefit. In one scheme, 23 different business case iterations were required between 2009 and 2014,

partly due to queries and issues being raised multiple times due to the frequent churn of staff and consequent loss of organisational memory.

- Approvals were sometimes undertaken by individuals who had limited technical or local knowledge to allow them to make informed decisions. This led to an industry of checklists, information requests and questions developing that was widely seen as unhelpful and obstructive.

- It is not clear that the business case has any useful purpose after the approval has been made – which explains some of the issues about follow-through identified above.

In addition to these issues, constraints imposed by the capital regime and the setting of affordability envelopes may mean that solutions are developed to fit the budget rather than for what is best at the organisational or the system level. The Department of Health's infrastructure plan also identifies problems associated with uncertainty about the availability of capital in future years as an obstacle to making long term commitments.

Capital allocation and planning

An atomistic approach to capital planning in the past has meant that schemes have tended to be looked at in the order in which they are available, rather than according to their strategic importance or priority. The development of a unified regional tier in the NHS may help to improve the prioritisation process.

The current financial regime for capital does not seem to operate effectively. Making capital a part of the tariff has not allowed the accumulation of sufficient reserves, especially as there have been very demanding cost improvement targets over a prolonged period. International experience suggests that there may be other, more effective ways of allocating capital while still retaining the discipline that can be absent where capital is treated as a free good. In Germany, the Länder award capital grants to providers in accordance with an overall capacity plan. Denmark has used a system-wide master-planning approach to determine the location and size of major investments.

NHS England/Improvement are working on this area, but are experiencing difficulties in developing a workable system. Previous attempts to do this have stalled.

Implications for the Hospital Improvement Programme

Where there was a combination of high quality planning, a good relationship between the NHS and the designers, appropriate clinical engagement, clear leadership, use of innovative best practice, and a service-led rather than a finance-led approach, the Hospital Improvement Programme led to some excellent and sometimes innovative buildings. For example:

- Endeavor Unit, James Cook Hospital, South Tees
- Southmead Hospital, North Bristol
- Central Middlesex Hospital
- Northumbria Hospitals
- Leeds Cancer Centre/St James's Institute of Oncology
- University College Hospital London
- Sheffield Children's Hospital

Many of the problems experienced during the PFI process described here were a direct consequence of the difficulties the NHS has had in developing its skills and capacity as an informed client. Some of the causes of this are the NHS's own rules and culture. Others are wider problems that go well beyond the NHS.

Unfortunately, there is no reason to think that there will be less damage done from these issues in the next round of development than there was in the last. The greater the emphasis placed on the speed with which projects are delivered, the greater the risk of error and of leaving a legacy of poorly constructed, badly designed and inflexible assets. There are a number of implications for policy and practice that we can draw from previous experience, and these are set out below.

Furthermore, in several areas there is a strong case for central guidance and support to prevent the need for individual schemes to develop their own approach. More structured sharing of information and learning is also necessary. Perhaps the most powerful piece of learning from the last major programme is that all the effort on central guidance was about procurement, transactions and financing. This was generally very high quality, but there was no equivalent information about planning service delivery models or the actual content of schemes.

System planning

Capital redevelopment should be understood in the context of the plan for the wider system, rather being seen simply as a hospital redevelopment plan. In this context it would make more sense to base the spending limit on the needs of the whole system. This should be defined to include social care as well as wider economic development – rather than criteria related to individual organisations, such as current rules on the ratio of revenue to capital expenditure.

This system-level planning should also link with key strategies outside the health sector and the role of hospitals as anchor institutions in their local economies. Ensuring that there is expertise in this area may also open opportunities, sources of funding and help to develop important external relationships by feeding into local economic development.

There needs to be better use of the evidence when forecasting activity. Modelling the capacity and resilience of the future system was never really undertaken in the PFI planning process. It would be useful for understanding and testing future proposals in the HIP projects.

There is a need to professionalise planning at all levels. Strategy, capital, workforce, operational and space planning all have a shortage of individuals with the required level of knowledge and experience. There is also a need to develop some property management expertise to ensure the NHS understands the potential value of its estate.

At a system level, resources need to be developed to help health care planners explore future innovations in clinical capability, technology and diseases, and the implications that these have on health and care provision. These resources should include geographical information systems, which can be useful tools in planning and needs assessment (eg SHAPE) as well as modelling complex systems to understand the interaction of different parts of the system.

Planners need to consider the future system workforce requirements at an early stage and understand how their existing workforce will be transformed to meet their future needs. This should include an estimation of how much routine work can be undertaken digitally. This will be particularly relevant in outpatients and diagnostics.

Design

Thought needs to be given to how best to ensure that some of the downsides of 'contractor-led' design build detailed above can be avoided. This might be achieved by ensuring a close relationship between the design team and the client and by adopting a more value-based approach to procurement. Given the importance of design and the fact that it represents a tiny fraction of the lifetime cost of the building, making a higher level of investment in this area will pay a high dividend.

Much more could be done to develop standardised rooms and suites by evaluating the suitability of different service model types. There needs to be national advice and support to projects in this area. 'Loose fit', 'soft space', having a majority of standard room types, and a reduction in the practice of overspecifying certain rooms and the incorporation of design features that support a change in use will all improve flexibility and need to be incorporated. Beyond this, thought could be given to designing floorplates with depths that can accommodate several different clinical functions. This could be tested by measuring their ability to accommodate several different types of repeatable clusters of clinical space – suites of rooms that fuses architectural and clinical design streams. These floorplates need to create a healthy environment with regard to daylight. These should be connected with a circulation 'chassis' that enables them to be plugged in and out and change function, and would also allow segregated circulation that will undoubtedly become a focus for post-Covid-19 design. The HIP projects are the perfect testbed for this. The process of simplifying and rationalising the design process would also benefit from central guidance to develop a standard suite of documents. This does not mean that the standardised internal designs cannot have an external 'wrapper' that is consistent with local building materials and style.

Future construction needs to put much more emphasis on producing low-carbon and preferably carbon-neutral buildings – both in terms of the resources used in construction but also in the ongoing sustainability of the building. More guidance about how to achieve this is required and is another area in which central and national organisations could provide support.

Spatial modelling

As noted above, operational (as opposed to financial) modelling was underused in the previous round of construction. Building information modelling (BIM) systems are now available that provide the potential to create much more sophisticated approaches. This often includes the capability to provide a virtual reality walk-through for users.

Combining 3D modelling techniques with prototyping physical designs using pre-specified standard rooms/suites of rooms and layouts described above would provide the design process with a model that could be used to:

- Prove the early concepts
- Use as a reference model throughout the design
- Unify the clinical, business, and operational planning
- Plan the launch and set business and operational metrics
- Troubleshoot problems as they arise
- Achieve BIM level 2, where the design/construction model is handed over to the client and becomes the backbone of the facility's building management system.

The design cycle could use this model as a digital twin to which the designers and stakeholders could return – using it first to validate the concept, then as a prototype for testing the advancing design, then as a digital twin for planning the launch and troubleshooting.

This would also allow a much more holistic view of the whole-life costs of the building and the implications of design decisions for the costs of operating the building.

Knowledge sharing and curation

The general failure to conduct a proper post-occupation evaluation of most of the major schemes of the last two decades has left a gap in our collective knowledge. It would be worth commissioning a high-level review of the lessons about design, procurement and current use of more recent projects.

The development of an open source health planning and design knowledge resource would be helpful. This should cover issues relating to design and

planning mentioned above, as well as service planning, workforce, technology, and information about how to engage with wider economic development.

A model of 'learning while doing' and buddying schemes will also be helpful, at least to organisations later in the process and for future schemes. Commissioning some 'researchers in residence' or collaborations with the ARCs (Applied Research Collaborations) or other research groups to develop a continuing programme of learning and evaluation during the process would be valuable.

Finally, the interfaces and opportunities that exist between future healthcare delivery and technology, technology and workforce, and technology and building design need to be more fully recognised in the HIP programme. A knowledge sharing and development programme would support this.

Other skills and expertise

The shortage of experienced project directors with the knowledge and ability to draw together the client-side expertise of the NHS is a major concern. Steps need to be taken to train and develop the next cadre, and to pass on learning and approaches that work to a new generation. The same is true of the substantial teams that are needed to support these individuals.

As noted above, there is also a shortage of property development expertise. It is unlikely that most health systems will have sufficient work to make the direct employment of this worthwhile, and NHS England/Improvement could develop better routes to this advice for when health systems require it.

Improvements needed in the process

The user voice is important. Understanding what users value, the processes they use, their operational model and their aspirations for improvement are all vital inputs to the scheme. Detailed specifications and some of the advocacy of idiosyncratic designs are less helpful. Helping schemes find the right approach for their context and their future demand would instead be useful. More effective ways for incorporating the patient and user voice are still required.

Likewise, some standardisation of approaches to design, procurement and project management (including relationships between client and

constructors) would also be helpful – with the caveat that crude 'one size fits all' approaches are not beneficial.

The processes for approval and capital allocation need to be extensively revised and simplified. Improvements have been made to the procurement process but there is still further scope for learning and improvement.

Building quality

Finally, projects need to pay attention to the methods and processes they will use to ensure that the building is of the required standard. This will require investment in expertise on the client side and in procurement and ongoing project management. The wider policy question regarding the quality of UK construction requires broader government action.

Covid-19 postscript

Some of the initial responses to dealing with the pandemic have served to reinforce the importance of a number of the ideas set out here. These include:

- **The importance of reconfigurable space** – being able to move or re-equip clinical areas to much higher specifications without major building works without adding very high or unnecessary costs to the initial building. This may require some redundancy and spare capacity in engineering.

- **Attention to constraints** – bottle necks in access to shared resources such as scanners, operating theatres

The experience of the pandemic has also changed the number and frequency of outpatient visits that will be conducted on a face-to-face basis. This has significant implications for design including:

- The size of outpatient departments (smaller and more orientated to procedures)

- The need for office space to do remote consultations. This could reuse space liberated by an increase in remote working by administrative staff

It has also put much more emphasis on infection prevention and control, including:

- Emergency departments layout (larger waiting areas, more cubicles, access to CT and the ability to segregate flows)
- Increased changing, locker and shower facilities for staff
- More spacious ward designs and a higher proportion of single rooms
- Critical care departments with negative pressure facilities and space that can be segregated
- Creating flow patterns that allow for segregation of different activities and the ability – for example, to create 'hot' / 'cold' or infectious/ non-infectious flows
- Elective-only sites with the capability to do post-operative critical care.

The crisis has also shown the potential for a lot of administrative work to be carried out remotely using technology. There are over 1.4 million square metres of office space in NHS acute hospitals[13], and there may be opportunities to reduce this in future.

Conclusion

Looking over the recent history of hospital building programmes, there are a number of actions suggested by this history that are directly relevant to NHS organisations today. Many of these recommendations are interdependent, so there is a need for action across a wide range of these ideas rather than merely selecting a few. Each part of the system has a key role in getting the best value out of these important investments. The centre can promote quality and lower costs through standardisation, the management of the procurement programme and providing frameworks for assurance. The individual schemes can use the standard designs and working with the procurement processes to develop solutions that work locally.

13 https://digital.nhs.uk/data-and-information/publications/statistical/estates-returns-information-collection/england-2018-19

The main areas for action include:

NHS trusts planning redevelopment should:

- Appoint a project director with experience beyond project management and link them to others in the field
- Identify a small group with the credibility to provide planning and clinical input and manage user engagement
- Be prepared to resist demands for idiosyncratic designs for departments or functions
- Make links to local authorities, housing and voluntary sector organisations as well as relevant industry sector partners to ensure that investment potential is maximised and the development contributes to wider and the local economy
- Make connections to a network of those involved in similar schemes
- Avoid letting long debates on clinical strategy delay the development of the scheme – it is likely that the details of this will have changed by the time the building is commissioned – focus on methods to allow flexibility of approach

ICSs/STPs and regions should:

- Test clinical models and pathways across organisational and sectoral boundaries against current and future practice
- Explore innovations nationally and internationally that might be relevant in the next 5–10 years
- Move quickly. Notwithstanding the need to plan and develop at a system level, experience suggests that delays cost money, may endanger the viability of schemes and the best can be the enemy of the good
- Ensure that the whole-system lifecycle cost is considered in a systematic way, including impacts on social, community and primary care as well as wider issues of sustainability

- Rigorously challenge planning assumptions to ensure they are evidence based, avoid optimism bias and are not reverse-engineered to fit the budget

- Test future system designs for high-level resilience, safety, affordability and flexibility, building in surge capacity.

NHS England should:

- Invest in a central resource/representative that can provide advice and steer the process for knowledge about: design, service models, carbon reduction and sustainability, the impact of digital, procurement and contract management, etc.[14] This should involve drawing together learning from projects undertaken in the last two decades. Leading experts should be involved, including a significant number of people drawn from outside the NHS.

- Integrate strategic workforce planning with health care building and technology investment processes

- Involve NHSX in thinking about the opportunities for strategic investment in technology as part of developments and in understanding the implications of this for schemes

- Support networking between schemes – including those at different stages of development

- Create an up-to-date library of standard rooms, process flows and other design elements

- Develop a modelling approach using these standard rooms to allow schemes to test their ideas

- Radically streamline and improve the approvals process, including considering a modernised outline 'approval in principle' element and an approach that recognises hospital developments as part of a system-wide approach rather than as individual schemes

14 www.tandfonline.com/doi/full/10.1080/09613218.2015.1033880

- Work with wider government and industry on building quality, but also on the very high cost of health care construction

- Consider holding the funding for risks associated with optimism bias and construction on a pooled basis rather than attached to each scheme

- Give particular support to schemes that can demonstrate wide social and economic impact and adjust the approval criteria and approach to economic evaluation to reflect this

Redevelopment of many hospitals and other health service buildings is vital work – particularly in order to fill the large gaps between provision in hospital and people's homes or care homes. Nuffield Trust's next work will be to investigate the establishment of a learning network to support hospital improvement sites. We will also be encouraging NHS England to provide some of the support and leadership approaches proposed here, and we will be working alongside other initiatives and researchers aiming to assist development in this important field.

Nuffield Trust is an independent health charity. We aim to improve the quality of health care in the UK by providing evidence-based research and policy analysis and informing and generating debate.

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Published by the Nuffield Trust.

ISBN: 978-1-910953-81-5

Design by Soapbox: soapbox.co.uk

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