The King's Fund

Ideas that change health care

Clicks and mortar

Technology and the NHS estate

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Key messages

- Developments in technology are affecting the NHS estate in different ways. While some changes are already having a clear impact, for many others it will take years and significant scaling before the impact on physical space becomes clear. Together, these changes have the potential to deliver an estate that is better for patients and staff, smarter, and more integrated.
- Technology develops quickly, and changes are difficult to predict, while buildings can be around for many years. This means that providing flexibility within the estate, enabling it to adapt as technology develops, will be increasingly important.
- Changes in technology are likely to result in a different NHS estate, rather than a smaller one, with space being used for different purposes or configured in different ways. Technology may also provide opportunities for getting more value from the existing estate – for example, by supporting multi-purpose spaces.
- There are a number of challenges to getting the most out of technology and the estate. These include the availability of strategic and technical skills within the NHS in each of these areas, and being able to access the investment necessary, given pressure on capital budgets.
- Technology and the estate have too often operated in silos. To maximise their impact, the estate and technology should be brought together as part of wider plans for change – both within organisations and across local systems. This means developing an overarching vision and being clear about the role technology and the estate can play in delivering it.
- Sustainability and transformation partnerships (STPs) and integrated care systems (ICSs) can play an important role in planning technology and the estate across organisations. This includes collaborating with organisations beyond the NHS, such as local government and voluntary sector organisations, and taking advantage of the opportunities that come from working at scale.

- In addition to local leadership, there is a clear role for the national NHS bodies in supporting this work. In particular, the centre should support common data and technology standards (so that different systems can talk to each other) and facilitate the sharing of learning across the NHS.
- Engaging patients in the development of technology and the estate is critical to ensure that any changes meet their needs. It is important that engagement is as wide as possible to understand how different groups are affected. For example, engagement should consider whether the expansion of digital access to care will disproportionately impact some groups, and how to mitigate this risk.
- Successfully embedding changes in technology and the estate will also require the full engagement of staff. This means engaging staff in the design process to ensure that changes in systems and their working environment meet their needs.

1 Introduction

Growing demand for services, linked to an ageing population and increasing numbers of people with long-term conditions, is placing significant pressure on the NHS and social care systems. Both areas are also facing financial pressures. Continuing with existing models of care is unlikely to address these challenges; instead, health and social care services will need to work differently, breaking down barriers between organisations to join up services and improve population health.

Technology and the physical estate are both critical to delivering the changes required in health and care. The opportunities offered by technology range from more efficient administrative processes to a transformation in the way patients interact with services, and in the care they receive. While its ability to deliver transformative change may appear more limited, the NHS estate will also play a significant role in supporting developments in health and care and, crucially, in the experience of patients accessing the system.

The role of technology and the estate as important enablers for change has been recognised in a number of recent policy documents and reviews. The NHS long-term plan placed great emphasis on technology in particular, highlighting its role in delivering some of the most ambitious commitments, such as enabling patients to access primary care in different ways (**NHS England 2019d**). This builds on the direction of travel set out previously by the Wachter review (**National Advisory Group on Health Information Technology in England 2016**), which made recommendations on the digitisation of secondary care, and *The future of healthcare* strategy (**Department of Health and Social Care 2018a**), which set out the government's vision on technology, digital and data in health care.

Policy and other work on the NHS estate has often focused on its role in delivering efficiency savings, as well as its ability to generate capital through the sale of unused assets. These ambitions are reflected in the work of the Naylor review (2017) and, more recently, in the NHS long-term plan. However, these also recognise the NHS estate as a key enabler for clinical change, highlighting the important role of STP estates plans in supporting this change (**NHS England 2019d**; **Naylor 2017**).

In the past, however, both estates and technology have suffered from the absence of clear national strategy. At a local level, technology and the estate have historically remained near the bottom of organisations' priority lists, managed as discrete areas rather than as integral to plans for wider change (Maguire *et al* 2018; Wenzel *et al* 2017). Learning from other sectors suggests that this is a missed opportunity.

In addition, little attention has been paid to the interaction between the estate and technology, and to how developments in one area will affect the other. The Naylor review highlighted the 'major influence' that technology has had, and is likely to continue having, on the NHS estate, and recommended further work to understand the potential impacts (Naylor 2017). Learning from other sectors – for example, retail banking – suggests that technology has the potential to limit the need for land and buildings over time, but to date there is little evidence that this will be the case for the health and care sector.

It is also important to understand the different ways in which technology can affect the NHS estate – both directly and indirectly, by supporting changes in services which have consequences for the estate. In practice, the relationship between technology and the estate is complex, and there are multiple interdependencies between the two areas. For example, while the estate is expected to respond to developments in technology, technology can also provide new opportunities for the estate, particularly in the way it is run. This can be complicated by the contrast between the long life of the estate, which is planned over long timescales, and the rapidly developing technology agenda, which can be difficult to keep pace with. Indeed, it is also important to recognise that while technology, like the estate, is primarily seen as an enabler, it can also be a disrupter, acting as the catalyst for clinical and other changes. Finally, the estate can both help and hinder technological change; where it does not have critical infrastructure such as Wi-Fi, the estate can be an obstacle to realising developments in technology.

Our research

Aims

Within this context, The King's Fund, supported by NHS Property Services, undertook research into the impact of technology on the NHS estate. The purpose was to explore how current developments in technology in the NHS are affecting the estate, and to identify the opportunities technology may create for the estate in future. We also aimed to draw learning from previous projects carried out in this area. Specifically, we were interested in the following questions.

- What are the consequences of technological changes for the NHS estate, or what may the consequences of these changes be over the longer term? This recognises that changes to the estate are often by-products of technological change, which is driven by other factors.
- How can technology affect the way that the estate is planned and managed?
- What are the opportunities for planning technology and the estate together in future?

Scope and approach

Our work considered the estate in the primary, community and acute sectors, with a focus on buildings. We explored the impact of digital technology and medical equipment – including 'medtech' such as magnetic resonance imaging (MRI) scanners – on services and patient care. Our research also touched on technology supporting the management of the estate, but this was not our primary focus.

Our research included a review of the relevant literature on technology and the NHS estate. We considered literature on both the UK and international experience, and in health care and other sectors.

We also carried out 13 interviews with a range of people, including those with technology or estates expertise, and those with practical experience of having delivered technology and/or estates projects in the NHS. Given the number of interviews, quotations used in this report have not been attributed to protect interviewees' anonymity.

Our methodology is set out in more detail in the Appendix.

This report

This report sets out the findings from our research. It is intended to be an exploratory piece that highlights activity taking place today and, building on this, provides a view of what this may mean for the estate in future. It does not provide a detailed evaluation of technology projects already under way in the NHS, and our research does not support detailed recommendations on what needs to happen next. Instead, we provide our view of the main areas requiring further attention in future.

The remainder of this section provides a high-level overview of the estate and technology in the NHS. It also sets out the approach to funding in these areas. The next section sets out the broad changes in technology taking place within the NHS today, as well as their impact on the estate. Section 3 sets out what we might expect the NHS estate of the future to look like, while section 4 draws on learning from previous projects to identify some of the challenges and enablers in realising that vision. The final section sets out the main conclusions from our work.

Background

The NHS estate

The estate used to deliver NHS care ranges from large hospital buildings to small GP surgeries and pharmacies. Alongside this is the estate occupied by commissioners, commissioning support organisations and other non-clinical functions. In total, the NHS estate is worth tens of billions of pounds, and covers the area of a small city (Department of Health and Social Care 2018b).

NHS trusts and NHS foundation trusts own most of the buildings they occupy, although they also lease some land and buildings (Naylor 2017). Other providers of NHS care, such as GPs, independent providers and charities, have their own arrangements for accessing the estate they need. In some cases, they lease premises from an NHS body, NHS Property Services or Community Health Partnerships, but in most cases these services are delivered from facilities that are not owned by the government/NHS (Naylor 2017).

Planning for the estate takes place primarily at a local level. Traditionally, this has been carried out by individual organisations; however, there is an increasing emphasis on organisations working together to plan the estate across local systems (including working with other parts of the public sector and the voluntary, community and social enterprise sector). In 2014, the *NHS five year forward view* highlighted the role of the estate in delivering new care models as well as improving efficiency, setting the expectation that commissioners and providers would work in partnership to develop local estates strategies (**NHS England *et al* 2014**).

In 2016, Sir Robert Naylor was commissioned by the then Secretary of State for Health to carry out an independent review of the NHS estate. Its recommendations included proposals for addressing poor buildings and backlog maintenance, delivering land for new homes (in line with the Department of Health's target) and improving support for new models of delivering health care. The review also recommended the establishment of a new NHS Property Board to provide strategic leadership on the estate and to support STPs in delivering local plans (**Naylor 2017**). In 2018, the government published its response to the Naylor review, expressing support in principle for most of its recommendations (**Department of Health and Social Care 2018b**). This included a promise to provide additional investment for the estate (*see* below) and to improve strategic estates planning, although the proposed approach to delivering a national property board was different from the one envisaged by the review.

In August 2018, NHS England and others launched a review of the General Practice Premises Policy to address a number of issues around the general practice estate, such as sub-optimal utilisation and challenges in achieving mixed-use buildings (**NHS England 2018**). The review is due to provide some recommendations on ownership and operating models for the general practice estate later in 2019.

The NHS estate also features in the NHS long-term plan, which promised to improve the productivity of the estate as part of its approach to putting the NHS back on a sustainable financial footing. The plan re-emphasises the NHS's commitment to disposing of unused land and supporting the government's targets for new homes. It also sets out the ambition to reduce the non-clinical estate by 5 per cent, freeing up this space for clinical or other activity (**NHS England 2019d**).

Technology

Digital technology has received significant policy attention in recent years. In 2012, the Department of Health published *The power of information*, which set out a strategy for making better use of data (**Department of Health 2012**). Soon after, *Personalised health and care 2020* set out the importance of developing the NHS's technological maturity and the case for change (**Kelsey *et al* 2014**). It was only once £4.2 billion was announced for information technology (IT) that many current digitisation initiatives came into being.

The current direction of travel has its roots in the 2016 Wachter review, which recommended that the government set up a digitisation programme where certain providers would receive funding to be Global Digital Exemplars (**National Advisory Group on Health Information Technology in England 2016**). The intention was for these organisations to provide the blueprint for further digitisation efforts.

This approach had a clear local focus, providing funding and incentives for local NHS organisations to pursue digitisation on their own terms. This had been a conscious decision, to support local NHS organisations in managing change within their own workforces, recognising that previous IT initiatives (such as the National Programme for IT) had struggled to engage staff.

However, the result of a locally led approach was that organisations adopted their own approaches and systems, and consequently these did not necessarily adhere to recognised standards. Local NHS organisations could invest in their own technology without it being interoperable with other organisations' systems (**Maguire *et al* 2018**).

To address these issues, the Department of Health and Social Care designed a strategy, *The future of healthcare* (**2018a**), which aims to maintain local autonomy while improving national leadership on technology. To provide this leadership, the strategy sets out different principles relating to the way that technology and products are procured. This includes principles to prevent organisations from being locked in to a single product or supplier for a range of solutions. Fears around 'supplier capture' in the NHS – where suppliers hold long and large contracts which the NHS finds it difficult to get out of – were a key driver for this document.

The NHS long-term plan continued this direction of travel and mainstreamed it by placing technology at the centre of a number of its commitments. The plan describes an NHS where an increasing amount of activity is moved from the physical space into the digital space. It commits to every patient having the option to access digital-first primary care (such as online and video consultations) by 2023/4. There is also a commitment to significantly redesign outpatient services, reducing outpatient visits by up to a third over the next five years. By 2020/21, the long-term plan wants people to be able to access their care plan and communications through the NHS app.

There are numerous commitments to build on digital infrastructure in the NHS too. The long-term plan supports further linking of patient data across organisations, announcing funding for three more areas to develop new longitudinal health care records, in addition to the five that are currently building these records. By 2024, secondary care providers should be fully digitised, extending a deadline that was initially to become 'paperless by 2020' (in fact, similar commitments have been made by previous ministers, going back to the 1990s) (**Jee 2017**).

In terms of skills and people, the long-term plan recognises the importance of board-level engagement in technology, recommending that a chief information officer (CIO) or chief clinical information officer (CCIO) should be on every board. The recent Topol review provides much more detail on how to develop digital skills in an evolving clinical workforce (**Health Education England 2019**).

Funding for technology and the estate

Development of the NHS estate primarily requires capital investment. Traditionally, new technology has also come with capital costs. However, increasingly there are also ongoing costs associated with technology, such as licence fees.

Capital investment in the NHS estate can come from different sources. For example, NHS trusts and foundation trusts can fund new buildings, equipment and repairs using internal resources (such as reserves or the proceeds from asset sales) or external resources (such as loans from the Department of Health and Social Care or the commercial sector). Sometimes funding is available for specific priorities (for example, the transformation funding provided to STPs). In the

past, these organisations have been able to access funding through partnerships with the private sector, such as private finance initiatives (PFIs), although in the autumn 2018 budget the Chancellor announced an end to these types of contract (HM Treasury 2018). The spring statement launched a consultation on addressing the challenges to infrastructure funding across the public sector (House of Commons Library 2019), confirming that the government would not be looking for a 'like-for-like replacement' for the PFI model (HM Treasury and Infrastructure and Projects Authority 2019).

Capital and revenue funding for technology also comes from a variety of internal and external sources. As with funding for the NHS estate, organisations may also access funding linked to particular policies or through specific programmes. For example, since 2015/16, GP providers seeking investment in technology or the estate have been able to apply to NHS England's Estates and Technology Transformation Fund (for both capital and revenue). This was established as part of the commitment in the *General practice forward view* (NHS England 2016) to modernise buildings and make better use of technology (the Department of Health and Social Care is responsible for most capital investment in the estate, although NHS England has a role in respect of the primary care estate). In 2016, the government announced the Global Digital Exemplar programme, which provided matched funding (capital and revenue) of up to £10 million to 12 acute trusts selected to be part of the programme. In 2018, a further four trusts were invited to join the programme.

In recent years, capital funding for the NHS has been under pressure. Since 2010/11, capital spending by the Department of Health and Social Care has fallen from £5.8 billion to £5.3 billion in real terms, primarily due to transfers of funds by the Department from capital to revenue budgets (which is due to continue in 2019/20) (Kraindler *et al* 2018). In 2017, the Naylor review placed a figure of £10 billion on the investment requirement for NHS estates: £5 billion to address backlog maintenance and a further £5 billion to support STPs in delivering the priorities set out in the Forward View (Naylor 2017). The cost of backlog maintenance across the NHS is now estimated to be £6 billion, of which £3 billion is 'high' and 'significant' risk (Kraindler *et al* 2018). It has also been argued that, while investment in IT has increased, the current capital budget is not sufficient to deliver the vision for technology set out by the Department in *The future of healthcare* (Kraindler *et al* 2018).

Although the government has made various commitments to invest in both the estate and technology, in practice this funding has not been provided in a consistent or transparent way. In 2014, the Comprehensive Spending Review promised £1 billion of investment in new technology over a five-year period. In 2016, the Secretary of State appeared to increase this, promising £1.8 billion to create a paper-free NHS (**Illman 2016**). However, in practice, it was not clear how much of this was 'new' money or what criteria would be used for investing it (**Honeyman *et al* 2016**). Doubts were also raised about whether all of this funding was allocated, particularly the capital element (**Heather 2018**).

In 2017, the spring and autumn budgets provided £3.9 billion of capital investment for transformation and improvement of the NHS estate (**Department of Health and Social Care 2018b**). However, the expectation was that the remainder of the £10 billion funding requirement identified by the Naylor review would be met through a combination of land and asset sales, and private finance (**The King's Fund 2017**).

Although in 2018 the government announced a 3.4 per cent annual increase in real-terms funding between 2019/20 and 2023/4, this did not include a commitment on capital spending. The NHS long-term plan states that a long-term capital settlement for the NHS will be provided in the 2019 spending review, including funding for the estate and to invest in new equipment such as computed tomography (CT) and MRI scanners (**NHS England 2019d**). It will also provide clarity on whether there is any additional digital funding available, particularly capital (**Heather 2019**).

Many have criticised the fragmented nature of capital funding. In the case of technology, funding is routed through a range of programmes, including the Health System Led Investment programme and Local Health and Care Record Exemplar, as well as the Estates and Technology Transformation Fund and the Global Digital Exemplar programme. This has resulted in a highly complex environment for providers. It has been argued that the system for allocating capital is not clear, and that this can be a barrier to investment. The capital regime has also been criticised for a lack of transparency and for the slow speed with which funding is provided (**Healthcare Financial Management Association 2018**). In recent months there has also been criticism of the way in which capital funding has been distributed, as some of the funding identified in 2017 remains unallocated (**Carding 2019**) and

cannot be carried forward. Recognising many of these challenges, the long-term plan has promised that capital investment will be accompanied by a set of reforms aimed at addressing fragmentation and 'short termism' in capital decision-making (NHS England 2019d).

Few steps have been taken to manage funding for the estate and technology in an integrated way. The Estates and Technology Transformation Fund provides funding in both areas to support practices in increasing their capacity. However, the prioritisation process for investments in technology and the estate is different (McDermott *et al* 2018). In practice, many projects supported by the Estates and Technology Transformation Fund have focused on one area or the other.

This is consistent with the broader context, which demonstrates that plans for the NHS estate, policies on technology and investment in each of these areas have typically been developed in a separate rather than connected way. As the funding profile for technology projects changes, with an increasing emphasis on revenue rather than capital costs – for example, to support new licences (McKenna 2018) – taking an integrated approach to planning and funding the two areas may become increasingly difficult.

2 How is technology currently having an impact on the estate?

Digital technology is transforming many different parts of the health and care sector. It provides new ways for people to access services and generates more data to inform the way services are managed. These changes are affecting the estate in different ways. Some will have an impact on the NHS estate by shifting physical activities online or creating the need for more space to house new technologies; others will require a more flexible estate or one that is prepared for new technologies.

Some of these developments can already be seen in the NHS today. This section describes the existing digital developments that are changing the NHS estate, while the next section describes how the relationship between the estate and technology is likely to evolve, and what this may mean for the estate of the future.

Through our research, we identified five categories of technological development which are impacting the estate:

- access to services
- care closer to home
- sharing expertise
- digital patient information
- data and analytics.

This section describes each in turn and the impact that this is having on the NHS estate.

Access to services

Technology is facilitating new ways for patients and service users to access services. This is likely to have some consequences for the estate, as increasingly there are alternatives to the face-to-face interactions between patients and clinicians which require them to be in the same physical space.

For example, telehealth has been used by different NHS services for some years to provide patients with remote consultations with a GP or consultant (Castle-Clarke 2018). Digital access is now being brought into the 21st century, using online consultation and video consultation. In January 2019, the long-term plan announced new priorities for digitising people's interaction with services (NHS England 2019d). The first commitment was to give everyone the right to a digital-first primary care offer – for example, video consultations – by 2023/4. The second was a commitment to reduce 30 per cent of visits to outpatients, through a redesigned offer drawing on technology.

General practice has been quicker than other parts of the health sector to embrace forms of digital consultation. Different types of digital-first primary care offer different transformative impacts. For example, online consultations are being used by some GPs to triage their patients remotely, allowing some to receive the care or advice they need without a physical appointment or with just a phone call. Other models of digital-first primary care, such as GP at Hand, allow online access to GP services over a video consultation (Baird *et al* 2018). Physical centres are provided at five hubs across London but these are not the primary way of accessing care, and attendance will always be preceded by a video consultation.

Outpatient services currently account for the largest amount of NHS contact with patients in a hospital setting. Through digital services, there is scope to deal with many of these contacts remotely (Isherwood *et al* 2018). The NHS long-term plan has recently highlighted the potential to redesign outpatient services to reduce visits, partly using digital solutions such as virtual clinics that allow follow-up for outpatients in primary care. There are examples of this happening within the NHS already: virtual clinics, such as the Tower Hamlets chronic kidney disease e-clinic, allow GPs to consult directly with consultants. The e-clinic utilises information-sharing and digital communications to support a single pathway from primary to secondary care. There is evidence that virtual clinics can be effective

and they receive high levels of satisfaction from patients (Healy *et al* 2019). In future, services like this may be able to reduce waiting times and hospital appointments (**NHS England 2019d**).

As the Royal College of Physicians argues, outpatient visits have an impact on estates requirements and therefore these changes may reduce the amount of space needed over time. There are also positive environmental impacts associated with a reduction in outpatient appointments due to fewer car journeys (**Isherwood *et al* 2018**). Both of these effects could equally apply to a reduction in face-to-face GP appointments.

Technology is also changing the way that patients access traditional physical services. Some organisations are using kiosks at the front door of the hospital to sign in, thereby reducing the need for a large reception area. Kiosks can also collect and manage data about visitors who have checked in. In the newly completed Chase Farm Hospital (*see* box on page 25), for example, kiosks are able to allocate patients to appropriate waiting areas, depending on how busy each waiting area is. If a patient comes in for two tests in one visit, the system can send them to the department with the shortest queue first.

> *The check-in system checks them in and directs them to the most appropriate waiting area for the clinic that they're booking into. Then they're called through on their screen into [the] zone that they need to go to for their appointment so it's all quiet… So we can manage the queues as they're happening.*

These changes are affecting the estate in different ways. Some might reduce the size of the estate needed by changing the nature of these interactions, while others are changing the type of estate needed. As in the online consultation example, this might mean less consulting space and more office space, as traditional appointments are increasingly dealt with digitally. The impact of these changes varies by sector. The changes to Chase Farm Hospital, for example, have a more direct impact on what the buildings look like than digital-first primary care. In practice, however, not many hospitals have had the opportunity to start from scratch in the way that Chase Farm has. Digital-first primary care is being adopted quite rapidly, albeit in different formats, by those operating from existing premises.

Care closer to home

Technology is also supporting the shift away from care in hospitals, in line with the ambition set out in the Forward View (NHS England *et al* 2014). Increased use of remote care and telehealth is able to facilitate more care being provided in the community and primary care, as is improved communication between health professionals. The technologies involved in this shift range from providing patients with self-care support, through apps and advice, to monitoring patients on an ongoing basis with equipment such as sensors.

Mercy Virtual Care Center in the United States has been dubbed the world's first 'virtual hospital'. As well as digital access to services, it also has a virtual intensive care unit (ICU), which oversees care for 17 hospitals. Staff at this centre are also able to monitor patients with chronic diseases at home, using a mix of video and monitoring of vital signs to provide support and advice remotely. This aims to reduce the amount of time patients need to spend in a hospital (Allen 2017).

Sensors are also beginning to reduce the need for hospital care among users of social care. Calderdale Clinical Commissioning Group, for example, is completing a five-year project to equip care homes with sensor equipment to monitor residents and alert staff if clinical assistance is needed. Sensors include wearable pendants that detect falls. This model has reduced avoidable hospitalisations and visits from the GP (Hughes 2018b), and over time may curb the increasing amount of space needed in secondary care.

Similarly, we heard examples of technology being used to keep vulnerable people out of hospital. In Surrey, for example, sensor technologies were installed for older people with dementia being cared for informally in their own homes (Digital Health 2016). Clinicians were alerted when the sensors detected behaviour that might be out of the ordinary. While in its early stages, these kinds of technologies present opportunities for supporting vulnerable people to live more independently.

Moving care out of hospitals is a clinical transformation, supported by technology. However, this shift may have significant knock-on impacts on the estate by allowing patients to be effectively monitored and supported in out-of-hospital settings, thereby reducing the amount of inpatient space required to deliver care. On the

other hand, however, the equipment and computers required to facilitate this care model could potentially take up more space or require buildings to be configured in a certain way.

Sharing expertise

Not only can technology bring clinicians closer to patients in their homes, it can also bring clinicians themselves closer together, enabling them to access expertise remotely. For example, virtual clinics are allowing GPs to hold outpatient follow-up appointments by messaging hospital specialists. This means that patients can go to their GP for follow-up, rather than travelling to hospital.

Organisations are also exploring ways of using augmented reality (AR) and virtual reality (VR) technologies[1] to bring expertise to where it is most needed. For example, the HoloLens headset is being trialled at Alder Hey Children's Hospital (**Hughes 2018a**). The headset combines AR and VR to present holograms to surgeons, giving them additional visualisations of a patient's anatomy as they operate. This technology is also being used at the Royal Free Hospital, enabling a remote consultant to augment what a surgeon sees during an operation (**Royal Free London NHS Foundation Trust 2017**). This means that patients can benefit from expertise at the Royal Free, without necessarily needing to be in a Royal Free operating theatre.

Currently, these technologies are not commonly used within the NHS. However, if scaled up and developed, AR and VR could reduce the need for specialists to be on-site in certain parts of the country as they are able to advise more effectively off-site. There is also evidence that these technologies change what is required from the estate. AR and VR often require dedicated spaces to be used effectively, especially if used for other functions, such as a patient's physical rehabilitation (**Hood 2018**).

[1] Both AR and VR use video technology that changes the wearer's field of vision but differ subtly in how they provide the wearer with information. AR overlays additional information on top of what they are seeing in the real world – this could be additional information about someone's vital signs, for example. VR allows the wearer to be completely immersed in what is happening somewhere else, allowing a surgeon to see everything another surgeon is seeing, for example.

> *Because one of the ideas that's being floated is that you might go for a consultation and they would be able to bring in, by prior arrangement obviously, an expert consultant into the conversation, but remotely. And what is the best way to do that? Currently you've just got standard webcam-type stuff, but I can't help feeling that there may be better, more comforting, ways to achieve that.*

As such, these changes are likely to have implications for the estate, primarily in terms of the nature of space – for example, less consultation space and more space needed to house equipment – rather than its overall size. Our interviewees referred to this category of technology less often than others, and therefore we heard less about the impacts this kind of technology might have on estate footprint. Despite this, it could be an area that allows some of the geographical constraints of the physical estate to be overcome – for example, by supporting clinicians in different organisations and locations to share expertise. This also reduces the need for patients to travel in order to receive specialist input into their care.

Digital patient information

Digitisation of patient information has been a policy focus for many years. The NHS long-term plan reiterated that, by 2024, all secondary care providers should be fully digitised and patient data should be shareable. This current trajectory of digitisation and sharing of records facilitates flexibility in how and where patient information is accessed. The plan articulates the importance of having easily shared patient information for people with long-term conditions and those with an ongoing relationship with the NHS.

In primary care, information on patients has been captured in an electronic medical record for some years. However, the recent GP contract requires GPs to digitise historical paper records by 2022, which will have a corresponding impact on the need for storage space (**NHS England 2019c**).

Digitising and sharing patient information has opened up the potential for making more effective use of the estate. One example of this is the opportunity to remove pathology departments from hospitals and consolidate them to improve efficiency, as recommended by Lord Carter (**Digital Health 2018**). Technology is a necessary prerequisite for this; interoperable, digitised services are needed to ensure that information can travel freely from hospital to lab. This can reduce the necessary

footprint of the estate, or at least provide more flexibility in where these services are provided, enabling them to be moved to less expensive estate. There is also an opportunity around medtech, which interviewees said sometimes is not being used optimally across a locality – for example, in scenarios where there are multiple MRI scanners in a local area, all of which are underutilised. Again, addressing this requires adequate digital infrastructure to share patient information.

Digitising and sharing patient information also facilitates greater remote working for clinicians. Safe and secure portals to access patient information can allow more flexible working for consultants on call. This is unlikely to have a direct impact on the estate but increased flexible working could have long-term impacts on the need for individual consulting rooms and offices.

Something raised frequently in our interviews was the direct impact that digitisation of patient information is having on the estate footprint by freeing up space previously used for storing paper records. This is happening in general practice and in the acute sector, including Chase Farm Hospital, which was built with no space for paper records. As more hospitals deploy electronic records, they are considering how to use the space that previously had to be dedicated to paper records:

> *We took the leap of faith that we weren't going to have [paper] medical records… There's nowhere to store them and there's no nurses' station, there's no big desks anywhere.*

Digitising patient information is having new impacts on the estate, allowing information to be accessed without the need to be geographically close to the information. This is supporting flexible working and greater sharing of expertise, meaning that patients should not need to tell their story multiple times. As this information is digitised, it is also reducing the need for physical space to hold paper records. This could have a significant impact on the footprint needed for storage.

Data and analytics

The technologies described earlier are creating more and more data about staff, about patients and about the estate itself. This data can be used to improve services and make them work more efficiently. Analytics is increasingly being applied to this data to design precise and predictive algorithms for managing people and buildings.

Some places are trying to make use of data explicitly related to equipment and the estate. Building sensors into the estate allows data to be captured in real time about the utilisation of the estate and equipment. This could lead to more efficient use of space and a better understanding of the utilisation of medtech (**Rosebraugh 2018**). NHS Property Services provides a service called NHS Open Space, which allows users to access clinical and non-clinical space through an online booking system. As well as maximising the efficiency of the estate, and making the most of underutilised space, NHS Open Space generates valuable data on the way the estate is being used (**NHS Property Services 2019**).

The Countess of Chester Hospital NHS Foundation Trust has deployed infrared sensors to track the location of patients, staff, beds and equipment in its hospitals – known as 'TeleTracking' (**Stevens 2016**). This data is collected and displayed to operational teams who can use it to allocate beds or analyse bed utilisation. Other information can be collected using this kind of tagging, including when different assets need maintenance (**Idox Health 2018**). This technology is not being used commonly across the NHS but more trusts are exploring it as an option.

Improvements in cloud storage (where data is stored remotely instead of on-site) mean that NHS organisations are increasingly moving patient data into the cloud. Over time, cloud storage has become more reliable, faster, less expensive and more secure. There has also been support for this shift at national level, with national guidance for organisations on the benefits of cloud storage and how to implement it safely (**NHS Digital *et al* 2018**). For organisations making use of cloud storage, it can reduce the need for physical server space, as well as reducing the overall costs of data storage.

> *Technology is allowing us to free up space so medical records, we can put [those] onto the cloud and, therefore, we can get rid of huge areas of estates as a result.*

Data and analytics are being used in different ways that may impact the estate. Partly, this is about improving intelligence about the estate and how it is running, and then supporting actionable insights to optimise the use of the estate. Where this data is stored also has implications for the estate, particularly with the move to more cloud-based models, provided by external suppliers, which is reducing the need for physical space.

The picture so far

Our research shows that technology is increasingly being used across the NHS. While these changes are driven primarily by clinical factors and an ambition to improve patients' experiences, there are some clear implications for the estate.

It also shows that these impacts vary. Technological developments have the potential to change the amount of space required within buildings. The opportunities for freeing up non-clinical estate, such as the space used to store paper medical records, are relatively easy to identify; however, the opportunities for reducing clinical space are more difficult to predict. Whether the traditional assumption holds – that technology can reduce the overall footprint of the estate – is not clear. Developments in technology may also affect the nature of the space required – for example, the balance between clinical and non-clinical space, or the layout of buildings. All of these changes in turn are likely to have an impact on the experience of patients and staff alike.

Our research also shows that technology is beginning to make the estate smarter in how it is planned and managed, in particular through the use of data and analytics. Ensuring that digital infrastructure (such as Wi-Fi and sensors) is built into the estate will be critical.

Of course, not all technologies described in this section are substantially impacting the size or nature of the estate, particularly in the short term. However, it is clear that much of the technological change we are seeing today has the potential to bring about a different kind of estate in the future. This is discussed in the next section.

3 What might the estate look like in the future?

The impact technology is having on the estate is only likely to grow. Building on what we know about technology and the estate today, and the key themes from our research, in this section we describe what the estate of the future might look like.

A patient-friendly estate

Many of the technologies described in the previous section face patients directly, and even those that do not may have an impact on the patient experience. As such, these changes have the potential to make a big difference to the way in which patients experience health services.

As mentioned in the previous section, digital-first primary care is one example where patients are already experiencing care very differently as a result of technology. While this technology is in use in the NHS today, some argue that the health sector is only just catching up with the expectations instilled by digital transformation in other sectors (Franklin 2017).

Many interviewees felt that the estate of the future should aim to meet these expectations. Technology is already improving how patients interact with the health service, making it easier for some patients to use and navigate the service. Interviewees were confident that these benefits were just the start and that, as things advance, an increasing amount of patient contact would move online:

> *Look, all I know is that I think it's magic at the moment, that I can press a button, I can get a GP appointment in 5 minutes, and I can be speaking to someone in 10, and the Well app will then send me another notification saying they've got my prescription 10 minutes after that, and then the next day it's through my letterbox. To me that's… even within the current constraints of regulation and NHS tech, it's a pretty good experience, and I can only imagine that getting better.*

Access is not the only aspect of a patient's experience that can be improved by technological adaptations to the estate. Research has shown that unwanted sounds in a hospital, such as alerts, can have a significant impact on the sleep of patients in ICUs (Xie *et al* 2009). This issue was highlighted by our interviewees, who discussed the possibility of using technologies that were able to alert health care professionals without loud noises (*see* box below on Chase Farm Hospital). Recognising that the environment patients inhabit in a hospital has an impact on their experience, interviewees also spoke about different ways that the environment could be redesigned around patients' needs:

> *[Talking about a digital nurse call system, which works like a smartphone.] Patients like it. It's quiet, we don't have alarms going off all the time, which is one of the, you know, from an estates point of view, when you go into a hospital, generally it's a very noisy place.*

Chase Farm Hospital – a digital environment for patients

The recently completed Chase Farm Hospital is described as one of the most 'digitally advanced' hospitals in the NHS (**Royal Free London NHS Foundation Trust 2018**). Patients check in to their outpatient appointments through electronic kiosks; a smaller concierge desk is available for people who cannot use the kiosks or need directions.

Chase Farm has made further changes to reduce noise throughout the hospital. Patients have call buttons that alert staff through their smartphones, instead of using buzzers. Staff can either respond to the call or let it buzz through to the next health professional free to deal with the alert. Patients can then speak directly to the clinician, allowing them to triage the query depending on its urgency.

Other technologies have reduced the space needed at Chase Farm, such as being paperless, but the focus has been on cultivating an attractive environment for their patients.

Some technology may have the potential to improve the environment for patients at the same time as changing the amount of space needed. For example, it would be possible to attach sensor technology to patients to monitor their vital signs as they moved around, thereby allowing them more freedom during an inpatient stay:

> *I can see a future where a lot more telemetry is attached to the patient and encourages them to walk around and not be sitting in a bed. You can see that that sort of technology is going to make quite a difference to the amount of space in a bedroom perhaps.*

Interviewees suggested that this technology could also be adapted to support care at home. While these changes might offer an opportunity to reduce the estate footprint, our interviewees did not necessarily think they should be used in this way. Instead, it may be desirable to use freed-up space differently and provide patients with the additional space. This is the reality in some newer hospitals where each patient has their own room, such as the Queen Elizabeth Hospital Birmingham (**Mathieson 2011**). Providing patients with private rooms can improve noise levels and privacy.

Space in other settings can also be reconsidered with the patient in mind. Interviewees told us about developments outside of hospitals where the environment has been redesigned to enhance people's moods or cater for children. Primary care was one setting where these ideas held particular relevance, as interviewees saw this space as becoming more of a community space where people might spend more time. In this case, spaces that have traditionally been functional health care spaces might be redesigned to be more welcoming:

> *So all interiors, regardless of where they are – it could be a workplace, it could be a hotel, it could be a cruise liner, it could be a GP surgery – all could take up opportunities for, if you like, ambient technology to be incorporated into the fabric of the space. So whether that's to enhance mood, whether it's to have a playful function to entertain kids, whether it's got an educational role or whether it's for communicating information to people, it's how you integrate technology into the surfaces of the space itself.*

However, interviewees noted that enabling more digital access to services is not without its risks. Some models of digital-first primary care, mentioned in the previous section, risk further eroding continuity of care in primary care in future (**Baird *et al* 2018**). However, technology can also be used to ensure that there is continuity of information on patients, while the estate should be used to ensure that there is mixed space for health professionals. Between them, integrated systems and multi-purpose space can be used to provide continuity for patients:

> *The slightly worrying trend is the thing that, you know… is how do we preserve the continuity bit of it… how do you use digital to enable continuity and not create a 'go the whole Amazon' and have a completely warehouse-based system of general practice, that would be a real shame.*

To deliver a future estate which is truly patient-friendly, patients will need to be better engaged in technological transformation. One reason for this is to ensure that they have the capability to make use of new technologies, which will be particularly important if those technologies (such as video consultations) rely on the computing power in someone's pocket:

> *Empowering patients more through putting all this sort of stuff in their own hands, so yeah, the thing around how can we make better use of patients' own devices…*

Another reason to engage patients is to understand their views and preferences when it comes to designing the estate and technologies. This is relevant because there are many issues that are important to people but are not necessarily reflected in the drivers for clinical transformation. For example, not all plans recognise the key role that buildings play in local communities – community pharmacies were given as one example:

> *If we see a significant shift towards online, does that pharmacy network look different in 5, 10 years' time? But then you've got the opposite problem, which is the access, so people who can't or won't go online, people in rural communities, you know, will the government intervene to prop up those unprofitable but socially useful pharmacies?*

There is also a risk that differing access and use of technology means that new developments entrench existing inequalities. Designing services without understanding who loses out risks providing better services to those who need them least (*see* box on page 28 on Alder Hey Children's NHS Foundation Trust). Involving patients and understanding how they access and use technology is one way of mitigating this risk, which is especially important if digital space is to replace physical space.

Alder Hey Children's NHS Foundation Trust – involving the public in digital and estates transformation

Alder Hey Children's NHS Foundation Trust is a trailblazer for engagement in both estate and technology. Children and young people were involved in designing the new hospital, which maximises light in the building and green space outside it (Alder Hey Children's NHS Foundation Trust 2017).

On technology, Alder Hey has designed a chatbot – 'Ask Oli' – for children to ask questions about the hospital and their care (AHSN Network 2018). This was in response to a survey which found that questions go unasked and could be used as an opportunity to provide reassurance to patients and families. The survey was also used to generate ideas for questions that the chatbot should be able to answer.

Other examples include engaging broadly with the community about technology and the estate together, especially where buildings and their contents are not yet built. Ebbsfleet Garden City, as part of its Healthy New Town work, asked its local community what kind of building and care model they wanted from their new health space (Dartford, Gravesham and Swanley Clinical Commissioning Group 2019). This generated ideas such as creating a 'hub' for GP services and community services, and participants also discussed including non-medical facilities too, such as a gym. This kind of engagement helped to determine how the new care model would need to be digitally enabled to facilitate this co-location of different services.

A modern estate designed by the public may look different to what we expect or predict. The public are very attached to bricks and mortar but that does not mean that buildings cannot evolve to play a role that is more consistent with a digital world. If buildings become less clinically relevant as care models change, the NHS should still consider what role those buildings can continue to play in the community.

The King's Fund is conducting ongoing work on how health and social care systems can better listen to their populations (Wellings and Evans 2018). This work highlights the importance of making listening to patients 'business as usual', and especially where services are being redesigned. An estate of the future needs to understand the views and experiences of patients if it is truly to design digital services that people will want and be able to use. The only way to do this will be to ask people.

A staff-friendly estate

The way technology currently affects the estate is having an impact on how staff work, and this impact is likely to increase in the future. These changes have the potential to bring benefits for staff, particularly if staff are engaged in designing and implementing them; however, there are also some challenges to be considered.

One benefit technological advances offer is the opportunity to break down physical barriers between colleagues – as in the case of shared medical records – although training and change management are required to make best use of this technology. Other research by The King's Fund demonstrates that technology will not be used to its full effect without proper processes for change and staff development (**Maguire *et al* 2018**).

Technology can also support greater flexibility for staff. Our interviewees highlighted how workers in other sectors had benefited from the flexibility that technology brings. This includes moving away from traditional private offices to more flexible working spaces. Improvements in the working environment can have a significant impact on staff:

> *A big key thing in the NHS which is workforce and retention and recruitment. If you're working in a nicer environment or a more work-friendly environment, it makes it easier to retain or recruit staff.*

Increased flexibility will also mean that more NHS staff can work from different locations. Interviewees told us that having access to records from home is already making it easier for senior clinicians to maintain a healthier work–life balance. This can allow consultants to be on call and potentially check a patient's details from home, rather than requiring them to come into the hospital to see a computer. Interviewees pointed out that this type of flexibility would become more and more common as a newer generation of clinicians come into practice. These clinicians may value the flexibility that technology affords them:

> *You have to offer people something that makes it appealing to have that, but actually you find that the generation of clinicians that are coming through now are much happier working in an open plan environment and find it more welcoming. And it's obviously important to give them good social working and collaboration spaces that*

they can use for that, but actually the generation that's coming through is much more up for that and much less into putting obstacles in the way of that development.

In primary care, this change was perceived to be particularly relevant. Interviewees discussed GP workforce challenges, noting that issues such as retention, flexible working patterns and burnout could be partly addressed with technology. In particular, it was perceived that digital-first primary care affords options for more flexibility, including working in office space or working from home (*see* box below on eConsult).

You've got a workforce, and some of the digital-first providers have done this ahead of the NHS, so the likes of Babylon and Push Doctor, their GPs already work from different locations. I don't think we'll ever move – and we shouldn't, we shouldn't move away from the list-based model of general practice, because I think actually a lot of the continuity is really important as well, but newer, different ways of working you could see would definitely support the estate.

eConsult – encouraging more flexible working

eConsult is one example of a digital-first primary care solution, typically called an online consultation, that allows patients to submit questions to GPs. GPs can then respond to these in their own time – asynchronously – allowing them to either provide a face-to-face appointment, telephone appointment or signposting to other services (**Baird *et al* 2018**).

This technology could allow GPs to clear some patients in a flexible working day or even from home. In some areas, eConsult is being provided across a network of practices. Scaling up the provision of online consultations could provide opportunities for further flexible working, where GPs spend one day a week working from home.

Interviewees mentioned that online consultations were already giving GPs more opportunities for flexible and remote working. They could see this having positive implications for morale and retention, as well as estate implications, whether in terms of reduced estate (through more home-working) or different estate (like office space).

However, designing a more staff-friendly estate is not without its challenges. Interviewees spoke about the risks of providing space that is flexible but an unpleasant environment; spaces need to be designed so that they encourage a positive culture of working, including reducing the potential for burnout or

loneliness, which in other sectors have been linked to remote working (Moss 2018). This includes maintaining a 'human touch' in the estate. With changes to the physical space clinicians work in, our interviewees spoke of the need to reassure the workforce about change. Hot-desking was a key example where there needs to be effective management of changes to working practice. Another example was the personalising touches that clinicians add to their spaces, which may have benefits for themselves and patients:

> *Should the individual doctor be able to influence the environment of the consultation room to reflect their personality in any way? So currently you have a situation where they might have their own books on the bookshelf and they might have their kid's school certificate on the wall or whatever. And there is, I believe, some evidence that having those elements is comforting to patients, and also you want the doctors to be able to have some expression of personality, theoretically.*

Our research suggests that flexible working, supported by technology, will be key to delivering a staff-friendly estate in future. However, this must be balanced against the need to create spaces which take the preferences of staff into consideration. As with a patient-friendly estate, this is most likely to be achieved by engaging staff in the design process.

A smarter estate

Data and intelligence are increasingly being used in the NHS estate, as described in the previous section. However, the estate of the future is likely to be an even smarter estate, generating and using this information to improve its effectiveness.

Leveraging data can be separated into two elements. The first involves the direct provision of data to people who can use it for operational purposes. This might be facilities managers who can track what is happening on the estate and take actions based on this – for example, identifying where maintenance work needs to be undertaken. The second element is using data on the estate to influence planning. A common example of this today is using data to understand energy consumption and how this can be reduced, and factoring this intelligence into future plans.

As well as understanding buildings and equipment, there are examples of technology being used to track staff and patients across the estate. Tracking data is then fed back to a control centre where available resources, such as beds, can

be seen in real time. As discussed in the previous section, this is already happening in some places within the NHS. However, the future potential of these changes can be seen in the United States, where command centres are sometimes integrated across different sites. This supports better allocation of resources to different parts of the estate, both in terms of hands-on directing of patients and staff, but also in generating data that can be used for more effective planning (**Castle-Clarke 2017**).

We heard from interviewees that there are opportunities to supplement tracking technologies with additional data, such as clinical information, and get a better understanding of where patients are in the pathway:

> *Essentially like a command control centre who basically study in real time to get data on patients referred into the hospital, what current treatment they're having in hospital, and what is holding them up in the acute care pathway.*

Some interviewees said that using actionable data could also begin to transform the delivery of care and the patient experience. Some GP practices and hospitals allow patients to check in for appointments and in some places the data is being used to direct patient flow through a hospital to reduce waiting times. Coupled with alerting buzzers – similar to those used in restaurants to alert customers that their food is ready – this could allow patients to move around the hospital while they are waiting, instead of requiring them to stay in a specific waiting area.

As in other sectors, emerging technologies offer opportunities for more proactive operational interventions. Cameras are already being used to monitor vital signs for some patients (**Hughes 2018b**) but our interviewees spoke about the potential for this to be used more proactively to improve flow through the front door:

> *There's technology now that can monitor patients while they're sitting in a waiting room, get their vital signs before they're even seen by the clinician. So you could start to do some of that monitoring, either within physical buildings when they come in or from home, that starts to feed that data into the clinicians in a meaningful way. So, for example, in an A&E [accident and emergency] environment it might be picking up the sickest people as they walk through the door, because you've got cameras focused on them that are picking up their vital signs, and then you could prioritise those people in the queue, ask them the right questions and get them to the top of the queue.*

Similar technology is being used in commercial airports to track and detect threats. This highlights the need to ensure that privacy and good governance are maintained – something our interviewees noted as a significant challenge as technology becomes more proactive.

As well as using data for operational purposes, this data can also be used to improve planning. The NHS is already using some elements of property technology in ways that generate real-time data on what is happening within the estate, both in terms of patient activity and key aspects of the way that a building is run. This can be used to inform procurement of suppliers, as in the case of energy suppliers, or to optimise use of the estate:

> *You can link it all together then we can put sensors on particular areas that provide us with the data that we need and the hospital needs to really understand how it's ticking in terms of quality and cost on a daily basis. That's where we want to get to. We want to see real-time data that we can use, in a procurement basis (so also utility bills and things like that) but also in an operational basis, so we start seeing that when we have an influx of patients in one particular area of the hospital, it has a massive impact in terms of the operational cost that's associated with that.*

A key development here is sensors, which are increasingly being used to understand how the estate is operating. Sensors allow assets, such as medical technologies, to be tracked in the estate. The footprint of an MRI scanner, and associated space, is large. Interviewees said there was potential in the future to use information about these assets to use them more intensively. In the future, having this data could also support more effective use of assets across different organisations, by providing information on usage patterns:

> *And I think if you actually look, you will find that your average MRI scanner is only used… If you think that theoretically it's available 24/7, it's probably used for less than 30 per cent of that time. It's not used at night, it's not used at the weekend and it won't be used, you know, during lunch times, dinner times. So, actually, before you need to start worrying about losing estate to more MRI scanners, you need to more intensively use the kit you've got.*

However, interviewees acknowledged that knowing that assets can be used more effectively is not the same as using them more effectively. This depends on a range of other factors, such as having enough staff to make use of this equipment outside of core hours. Nonetheless, technology and increased access to data will be valuable in helping organisations to identify opportunities for greater efficiency, even if they are not able to put them into effect fully or immediately.

Both operational and planning uses of data currently require significant human input to action the data but developments in technology may mean that there can be significant automation of the actions taken as a result of the data. This would begin to break down the barriers between using data for operations and for planning. We heard that, in other sectors, 'intelligent buildings' are fast becoming a reality:

> *You want these buildings to be really intelligent, but really intelligent in a way that they are autonomously talking to each other and telling each other, okay, on the campus we have 20 buildings where there are maybe 100 meeting rooms, they should be able to talk to each other and offer the right meeting room with the right carbon footprint and with the right optimisation when it comes to heating, ventilation and cooling.*

However, seeing this kind of future for the estate is heavily dependent on buildings creating the kind of useable data that is actionable (as well as the expertise to interpret it – *see* the skills section on p54). Truly intelligent buildings require intelligence on estate, staff and patients.

Finally, the estate of the future also needs to consider how to minimise negative environmental impacts. As well as the positive environmental impact of reduced car journeys to outpatient appointments (as described in the previous section), the NHS long-term plan proposes improving productivity and reducing waste, with a commitment to making better use of land, buildings and equipment. This includes a commitment to improving energy efficiency within the estate and reducing the NHS's carbon footprint (**NHS England 2019d**). There will be more opportunities available for technology to improve the sustainability of the estate. Previous work by The King's Fund has highlighted the benefits that technology such as telehealth can have in minimising travel and reducing emissions (**Naylor and Appleby 2012**).

An integrated estate

Integration is often a motivation for the technology described in the previous section. This supports the NHS's ambition to join up services for patients through increased collaboration between local organisations. In this section, we refer to integration at the operational level and at the strategic level.

Operational integration

Technology enables the joining up of information and systems. This supports services and staff to work in a more integrated way, including across different sites.

Interoperable sharing of health records enables expertise and resources to be accessible across organisational and geographical boundaries. This means professionals can consult one another more easily, laying the ground for more integrated services. In the previous section, we highlighted the importance of sharing information between organisations, services or staff in different places. However, information-sharing can also make it easier for different services to be co-located – for example, by supporting continuity of information for patients accessing different services within a single 'hub'. If GP and community services are being provided in a single building to simplify referral processes, then it is important that this physical integration is supported by shared information, with information on patients being readily shareable and accessible between practitioners (**Williams 2016**).

Our interviewees said that digitising individual elements of a pathway can be a missed opportunity. Instead, a whole-pathway approach should be taken towards digitisation, so that it is possible to determine how changes in care models might impact services and estate demands at all points along the pathway:

> *Part of the problem at the moment is that people come into the urgent care system because general practice isn't coping. So you don't want to digitise the urgent care system in isolation because if you push more stuff into general practice, it can't cope. So the idea is you've got to make the whole system more efficient.*

Collaborating in this way would also allow digital systems to operate at scale, providing the technology once to multiple health care professionals and organisations.

One example of this is the ability for GPs to access specialist advice from consultants. The new Referral Assessment Services, intended to support complex care pathways, enables providers to access clinical information from the GP (or other referrer) and make decisions about the appropriate onward clinical pathway (NHS Digital 2018). Care models built on electronic referral and information-sharing, such as the Tower Hamlets virtual clinic described in the previous section, show how technology can support the movement of activity from secondary care space to primary care space.

Other kinds of technical integration support different ways of working for staff. Examples include enabling staff to book work spaces digitally across the estate. Currently, these examples are mainly found in single organisations; however, in future, they could be expanded to a wider estate footprint. Similarly, technologies that provide estate intelligence within one organisation could be applied across a local area to support more flexible use of space.

Strategic integration

Going beyond operational integration, IT and estates are often discussed as key enablers for strategic integration. Most STPs have set out their plans for developing IT and estates as part of a wider system (Ham *et al* 2017). In the future, systems might consider how technology and data can help to manage activity and demand, in the way that best utilises the estate – for example, having live intelligence about where beds are available across a local area. Data provided by sessional space booking systems – for example, the NHS Open Space service provided by NHS Property Services – could provide one example of sharing estate utilisation information across a local area to make better decisions (NHS Property Services 2019).

Efforts to join up services go beyond the NHS to include social care and other local services. The ambition of STPs and ICSs is to bring NHS and other organisations together to improve prevention and population health by acting on the wider determinants of health. As such, integration of the estate, supported by technology, need not stop at the NHS.

NHS England's Healthy New Towns programme provides funding for local areas to rethink how health and care is supported in new communities. The programme provides important learning on how health and local government can be more

integrated in their approach to ensuring that housing developments are designed with health in mind. The One Public Estate initiative (*see* box below) supports projects aimed at making best use of public land and property, with partnerships spanning different public sectors. However, previous work by The King's Fund suggests that the NHS has not always been as engaged as it could be in place-based approaches to the estate (**Wenzel *et al* 2017**).

One Public Estate – integrating the estate

One Public Estate is a programme run by the Local Government Association, the Ministry of Housing, Communities and Local Government, and the Office of Government Property (**Local Government Association *et al* 2018**). Its objective is to support joint estates planning across the public sector. It works across 90 per cent of councils and with many health organisations too.

The programme fosters partnerships and secures funding for estates projects, including across health and local government. These projects include building affordable homes for NHS staff in London and combining fire and ambulance stations in Lincolnshire.

In the Liverpool city region, One Public Estate has provided some funding towards a new Knowledge Quarter, which will feature the Royal College of Physicians' northern office and space for a new proton beam therapy centre. The Knowledge Quarter is providing space for technology, science and health in close proximity to the new Royal Liverpool University Hospital.

Interviewees mentioned the importance of the One Public Estate rationale when considering health care estate, recognising the role of the estate in supporting more integrated care. This linked to understanding where the estate could become space for the community, rather than being seen simply as land and buildings. We heard of examples of this kind of approach being used to provide beneficial services, such as yoga classes, and potentially combat issues around social isolation. Technology supports these approaches by enabling patients to access traditional health services

in different ways, thereby allowing physical space in communities to be used differently or more flexibly. The data generated by this technology can also be used to plan the estate better:

> *We're going to be less talking about a trust and its buildings, and much more talking about the anchor institution for this in communities, the importance they play in bringing communities together, and providing ways of interacting. And I think less about the NHS having a set of hospitals or GP surgeries or equivalent, I think much more being an integrated public sector community estate, which is providing much more than just service delivery.*

> *We're already seeing a better use of the public sector estate… The fire station down in Weymouth also doubles up now, pretty much as a community centre. There's a small café in there, you can book the rooms in there for various yoga classes or whatever really. So it's no longer just a fire station.*

There are clear parallels between the risk of losing continuity and community, and what can be seen in the decline of vibrant high streets in small towns. Integrating the estate at a strategic level should seek to mitigate this risk through creating mixed-use health and community space. Technology could be used to augment the physical presence of anchor institutions in local communities, by creating a more flexible and modern estate.

A smaller estate?

In many sectors, reducing estate footprint is a key reason for technological transformation. Especially where buildings are expensive to run or numerous, as in the banking sector, moving customers online has been a major driver of technological change. In the case of the NHS estate, our research found that it is not clear whether or not developments in technology will result in a smaller estate, or whether or not a reduction is desirable.

Many of the examples in the previous section suggest that technology may have the potential to reduce the estate footprint. Sometimes this was as simple as moving physical space into digital space – for example, where electronic health records are

removing the need for paper storage. In other cases, this has been a digitally enabled model of care that has knock-on impacts for the estate, such as remote monitoring of patients:

> *[The next opportunity] is what I've probably mentioned already, is the digitisation of records and releasing the footprint. Because that will then enable more estate to become available within the system.*

Technology can also support the consolidation of space, particularly within non-clinical estate. For example, NHS Property Services recently undertook a project with a group of London clinical commissioning groups (CCGs) aimed at optimising their use of an office building. This involved using data on space usage to improve the layout of the building and reduce the overall amount of space being leased. It also involved using technology to support agile working, for example enabling staff to work from home when appropriate, to make best use of the remaining space.

In most examples, however, it is clear that reducing footprint is not the aim of the technological transformation. There are strong clinical reasons for moving care closer to home but, if embraced, those changes could reduce the estate needed:

> *But again that's a real opportunity, as the technology gets better and better and you can monitor patients remotely, that will save the patients coming in to physical buildings to have things like blood pressures done, certain long-term conditions won't need to be done physically in the building, you could do those continuously while patients are at home or at work.*

The changes with the most potential for reducing the size of the NHS estate are likely to be whole-system transformations. Individual technologies may not drive a smaller estate but rather this may come from combining many different innovations and new ways of working. However, even in these cases, it is not clear that the result will be a smaller estate, rather than an estate which is used or configured in a different way. The use of video and online consultations in primary care was frequently mentioned as an example of technological developments that are part of a wider change:

> *I think we'll see more and more of a shift towards networks, and possibly even national chains of GP practices, and I think Babylon, GP at Hand is the model there, where you've got a mixture of digital consultations and sort of things that can be done digitally, and then clinics where you can pop in to those things that can't be. If that model scales out, then that's going to have a major impact on the GP estate, I think.*

Interviewees hypothesised that primary care estate will be quite radically changed by technology. Some saw this transformation as a trailblazer for other health services – pharmacy being an important example. Pharmacy is undergoing its own transformation as there are challenges with sustaining its physical presence. Technology is already being used to streamline and centralise the supply chain in pharmacy. As the pressures on physical space become greater, some interviewees discussed new challenger companies that were providing pharmacy services online, bypassing traditional pharmacy buildings. One interviewee broadened this trend to primary care as a whole, predicting that in 10 years' time, there will be an 'extreme consolidation [of provider organisations] in primary care, across both GP and pharmacy'.

Well Pharmacy – prescribing technology

Well Pharmacy set up its own in-house tech start-up – Well Digital – as a means of transforming its delivery model. The first stage has been to deploy a hub-and-spoke dispensing model for central fulfilment of prescriptions. This model has warehouses holding prescription stock, with an automated system for selecting and distributing prescriptions to physical pharmacies.

This has laid the groundwork for bypassing physical estate altogether. Well has launched its own app, allowing patients to request their prescription directly and have it delivered to their door. There are challenges with implementing this, including how existing incentives in pharmacy are set up to respond to a more centralised model of prescription fulfilment. However, in the future, this provides a clear opportunity for the NHS to learn from business models in other sectors, such as that of Amazon, to reduce estate and provide a more convenient service.

In practice, however, it is not clear that technology will lead to a smaller NHS estate in future. We heard different views on the extent to which marginal space gains from technology would result in a smaller estate overall.

Some felt that developments in technology – and the potential gains in space that could result – should be viewed in the context of growing demand for services: technology might influence whether or how much the estate needed to expand in future but would not necessarily mean a smaller estate overall. In the inpatient setting, for example, technology may affect the need for beds, with some patients spending less time (or no time) in hospital. However, this is unlikely to fully offset the growth in demand, which means that any space which is 'freed up' will still be needed. Similarly, the Naylor review made the assumption that, due to rising demand, the level of hospital capacity required will remain unchanged even once the new models of care set out in the Forward View have been embedded (Naylor 2017).

> *There's going to be a reduction in inpatient capacity. And we've just got… we just had a new paediatric unit and I can't imagine that [they are] going to allow us to have any extra beds. And with a reduction in hospital beds around us I think our demand is going to increase. So we may not use [fewer] beds, but actually we'll be able to absorb some of the impacts of changing bed numbers in the area.*

Others felt that, if technology did free up space, it should be put to different uses. One interviewee said that we should be thinking about the wider trends in the population; if we free up space today, then we should be considering the space we might need tomorrow. Given increased demand on social care from a population that is both older and sicker, we should be thinking about how physical space can be reoriented to face the challenges of the future. This will require integration and planning across the public sector:

> *Let's take an extreme example. If the minimum invasive surgery technique means that we can half the number of theatres and half the number of inpatient beds in surgical sites, we shouldn't dispose of those sites. We should be very quickly converting them to social care facilities.*

We also heard that, rather than focusing on creating a smaller estate, in future technology could allow the NHS to get more value out of its estate. This happens through a more efficient use of current footprint – for example, by ensuring that spaces are not left unused for long periods of time within a day. This may be the kind of saving hoped for in the NHS long-term plan, which commits to freeing up 5 per cent of non-clinical space for clinical activity (**NHS England 2019d**). Technology can also support better use of the estate by freeing up staff time:

> *What technology should be doing is making it easier for them to do their job or it creates capacity within time. So that means that you might not increase the estate's footprint but you can get more out of the estate's footprint because they've got more time on their hands. Or it creates time which then takes away pressure, which then has a knock-on effect.*

Technology has the potential to change the face of the estate and free up estate for more innovative uses. If the right opportunities are taken, the estate of the future could be more integrated, smarter, and a better environment for staff and patients – but it is not clear that it will be any smaller.

4 How can we maximise the opportunities offered by technology and the estate?

The many technology projects under way in the NHS today suggest that it is already on the path to delivering our estate of the future. In practice, however, progress is patchy, and some areas are likely to arrive there more quickly than others. We also know from the experience of previous projects that the ability of the estate to respond to technology, and to maximise the opportunities it may offer, depends on a number of factors. While these are broadly consistent with lessons on change in the NHS more widely, their importance is underlined by the fact that both technology and the estate have traditionally been low on organisations' list of priorities.

This section sets out the key enablers and challenges identified by our research.

Developing a vision

The experience of all types of change across the NHS suggests that new models or different ways of working are most likely to be successful when underpinned by a clear vision. In the context of technology and the NHS estate, this is partly about organisations taking a longer-term view of the change they want to see and choosing to prioritise these areas despite facing many competing pressures. We heard that a key driver for the hospital development for Chase Farm, for example, was 'a decision made by the board… The group was going to be advancing its digital position in the NHS… Chase Farm became an opportunity to try new things.' However, we also heard that finding the 'headspace' necessary to plan for the future in this way could be challenging:

> *Estate facilities directors are quite often just fighting fires, dealing with winter pressures and so on. It's quite hard for people in that role to make the time to*

> *really step back and think strategically… You know, they've just got a lot of really practical stuff on their agenda… So I think actually giving them the time to do this is really important.*

To maximise the opportunities offered by the estate and technology, organisations should bring these areas together as part of a wider vision, supported by integrated plans (*see* below). Part of the task is to think differently about what health and care could look like, and the role that technology and the estate can play in this, rather than seeking small improvements in the existing system. Interviewees highlighted the importance of taking risks: 'some stabs in the dark'. This vision needs to be accompanied by clear leadership, which supports risk-taking and innovation. Leaders must also prioritise engaging staff across the organisation in the vision for change (**Maguire *et al* 2018**).

A clear, strategic direction set by the national NHS bodies is important for organisations developing a vision for technology and the estate (an issue highlighted in previous work on the NHS estate by The King's Fund) (**Wenzel *et al* 2017**). However, as the NHS increasingly focuses on collaboration – a direction of travel recently reinforced by the long-term plan – responsibility for developing a vision for both technology and the estate will increasingly fall to local systems.

> *I think we need to all come together and be led by our local STPs to say you need to put your heads together and see what technology, changing workforce and estates are going to look like in the next 10, 20, 30 years.*

Integrating plans

In order to maximise the opportunities offered by technology and the estate, these areas should be planned in an integrated way, part of a holistic approach to delivering service change.

> *Once you've taken the records out of a building, you might potentially create two to three consulting rooms. But you need then the investment to be able to then transform that estate into the… So it's about, yeah, thinking about everything that can potentially come from the technology, and then it's about wrapping it all around, so you're doing a whole programme.*

Despite this, we heard that there is considerable variation in the extent to which either IT or estates professionals are engaged in planning service change. This supports the findings of previous research by The King's Fund and others, which found that estates requirements are often not included fully or early enough in the process (**Buckingham *et al* 2018**; **Wenzel *et al* 2017**). This lack of engagement fails to recognise the key role that the estate plays in bringing about changing models of care, whether these are supported by technology or otherwise.

Our research also found that the estate and technology tend to be planned separately and are rarely brought together in a strategic way. Although we heard about efforts to develop the estate in such a way that it could accommodate future technology, there were few examples of technology projects which had proactively considered the consequences for the estate. This separation is also reflected to some extent in the experience of the Estates and Technology Transformation Fund. Although the fund offers investment in both technology and the estate, giving organisations the opportunity to consider the two areas together, in practice many of the projects it has supported have focused on either technology or the estate (for examples, *see* **NHS England 2019a**). It is likely that this is, at least in part, a result of having separate prioritisation processes for estates and technology, despite investment coming from the same fund, which has led to some confusion within CCGs about which projects to prioritise (**McDermott *et al* 2018**).

There appear to be different factors driving this siloed approach. One issue identified was differences in the planning horizons for technology and the estate, which can make it challenging to link up plans. As discussed in the context of flexibility (*see* p47), developments in the estate or new builds tend to be planned over long timescales, which can make it difficult for these to keep pace with rapid developments in technology. However, we also heard that, in the case of updating old estate or addressing backlog maintenance, the 'reactive' approach taken could contrast with the 'proactive' approach taken to planning for technology.

We also heard that, because each area requires specific technical expertise, there is a disciplinary separation between estates and IT (and between each of these and others within an organisation), and a failure to compensate for this by bringing the two areas together at a strategic level:

> *I don't think they are thought about together if I'm honest… Both areas require deep specialism if you're advising or if you're active in it. So, if you're the director of the estate you're often not the director of digital or IT or patient records or anything like that. And therefore I think the disciplinary silos are an obstacle rather than an advantage in this space.*

Again, in the context of a shift towards greater collaboration within the NHS, the driving force behind a more integrated approach is likely to come from local areas and systems.

Planning as a system

ICSs and STPs will provide a mechanism not only for planning technology and the estate in a more integrated way, but also for planning across organisations – making better use of shared (and often limited) resources in order to develop more integrated care for patients. The Naylor review highlighted the value of planning property disposals, addressing backlog maintenance and delivering service change across a system (**Naylor 2017**).

In practice, however, encouraging organisations to work together in this way can be challenging (**Buckingham *et al* 2018**). The Naylor review proposed incentivising this behaviour by making access to public capital for estates development contingent on organisations embedding their plans within STP plans. The review noted the challenge in getting organisations to focus on system interests rather than organisational ones but saw the shift towards 'accountable care' (although the terminology has since changed) as a helpful development in encouraging this. In its response to the review, the government called for collaborative planning across STPs and indicated that NHS organisations would be entitled to retain the receipts from land sales, where these were reinvested in delivering local priorities and STP plans (**Department of Health and Social Care 2018b**). Our interviewees also noted the importance of incentivising a system approach rather than an organisational approach:

> *I mean, money always helps but where would you apply the money? I think projects at an STP level or at an AHSN [Academic Health Science Network] level are the way to go. I would not be looking to fund individual trusts because you'll just encourage and promote the parochial attitude, which of course we don't want.*

We heard that developing plans across STPs would help to ensure that plans were responsive to local circumstances. For some, this should happen at a more local level, where there is a detailed understanding of population needs and faster progress may be easier (**Buckingham *et al* 2018**):

> *But if you start designing that system from the top down it would spend 10 years in approvals and funding arguments and then half the system wouldn't adopt it. So, the first thing is, I think we need to turn it on its head, and we need to be developing it from the bottom up.*

As we have argued elsewhere (**Charles *et al* 2018**), the real prize offered by ICSs is the ability for NHS organisations to work in partnerships with others, acting on the wider determinants of health in order to reduce inequalities and improve population health. Again, this will require systems to take a long-term view, recognising the important role that the estate and technology have to play in bringing about changes in health and care.

Other parts of the public sector provide learning for how the NHS might consider integrating estates plans. The government is currently looking at how it can provide flexible space for civil servants in any department to work in 'hubs' outside of traditional urban centres like London (**Parsons 2018**). This is underpinned by smarter working, using technology to support more flexible approaches to where civil servants can work. The NHS can learn from this approach about how strategy from national agencies can enable better estates and technology planning across organisations. It also highlights the role of national NHS bodies in sharing learning across the system, as discussed on page 49.

Providing flexibility

Unfortunately, alongside the many benefits of taking a long-term approach to planning technology is the challenge of being able to keep up with the pace of change. This also poses a problem for the estate and its ability to respond. The speed with which technology develops means that even the steps taken to 'future-proof' a building can quickly become obsolete – we heard the example of a building having been designed to include multiple sockets and additional copper

cabling, only for the advent of Wi-Fi to make these changes redundant. We heard that this could act as a barrier to building technology into long-term plans:

> *Things change so quickly within the digital world that if you start to plan something, by the time you've actually put it into place it's already out of date, and that definitely is something that would put people off using digital solutions if they were doing long-term planning, you know, a 10-year programme or something.*

The primary response to this challenge is to build in as much flexibility as possible. This is partly about organisations taking a long-term view of technology and the estate, as already discussed (it also requires a long-term view from commissioners) (**Buckingham *et al* 2018**).

We heard about adaptable buildings, and spaces designed in such a way that they could be reconfigured over time as needs – and technology – changed. We also heard that technology itself could help to provide flexibility, enabling the function of a space to change without requiring any alterations to the fabric of the building.

However, there was also some challenge from our interviewees on the idea of building in flexibility. We heard that, in practice, building in flexibility usually comes at a cost:

> *I also think that people need to be careful when they think about flexibility… Because actually to make somewhere truly, truly flexible, you potentially have to put in more infrastructure than you'd need… So flexibility is often offered up as the great panacea in terms of architectural design, but quite often you don't actually want to overprovide on flexibility.*

Providing flexibility and agility within plans also relies on many of the factors discussed elsewhere in this section: a long-term approach to the estate and technology, a sufficient appetite for risk and the ability to engage a wide group of people in the necessary changes.

Sharing learning

A number of interviewees highlighted the value of being able to learn from previous projects about the range of technology available and how it might impact on the estate.

There is some evidence of efforts at a national level to share best practice. The Global Digital Exemplar programme includes a blueprinting workstream that collates information on what works for a range of health improvements, including digital initiatives. These have been created by trusts recognised for using digital technology to support transformation, for the benefit of other trusts (NHS England 2019b). Recent research found that these blueprints could support the spread of learning beyond implementing specific technical solutions (Castle-Clarke and Hutchings forthcoming). The Estates and Technology Transformation Fund is also a mechanism for sharing learning. Its role includes evaluating the projects it funds in the primary care sector and building up a database of experience that is shared across the system to support others. This learning is also used to inform the Fund's subsequent decisions on where to invest. Given the wide variation in the nature of the primary care estate, being able to share learning is important.

In practice, however, our interviewees felt that they did not have as much access to best practice as they would have liked. There was a sense that national NHS bodies could do more to share learning across the system, helping to ensure that progress was more evenly spread:

> *I do wonder if there could just be more done to think about sharing best practice. You know, there is just a risk that you end up with, you get some really pioneering organisations but you end up with a bit of wheel reinvention.*

Spreading best practice also means rolling out models which have been shown to work – a task which is not always straightforward, and one which the NHS has often struggled with (Collins 2018). Part of this is about making sure that successful projects are supported to develop and that their experience is made visible so that others can learn from them.

> *Getting it rolled out at scale, getting it implemented across the country is an extremely difficult thing to do. It's very expensive, it's very time consuming and a lot of people run out of steam long before they're able to realise the benefit of*

individual developments or innovations they've come up with. So, we need to find a way of bringing these things out into the open faster and then pushing their implementation quicker.

Some emphasised the role of national NHS bodies in supporting this spread but, as with other elements of planning for technology and the estate, it is likely that STPs and ICSs will have a growing role:

What we've seen is where one CCG has gone with something that has worked particularly well. We've then seen that replicated over the other CCGs within an STP footprint. So we've seen an expansion of the scheme. So one scheme might have been for interoperability for a CCG, but then because it's worked so well and so cost effective, it's then been spread across all the CCGs within that STP footprint.

Learning from other sectors

The NHS can also learn from other sectors about the potential of technology and its impacts on the estate. Some sectors provide inspirational stories, such as how smart infrastructure in cities is being used to monitor and redirect traffic flow (**Wright 2018**). Other sectors provide cautionary tales on the risks of digitising previously physical space, such as how high streets of small towns have suffered, demonstrating the importance of active planning for change (**Portas 2011**).

Our interviewees looked to how digital has transformed other sectors. Sometimes they used other sectors to articulate the art of the possible with regard to technology and the estate. However, they could also be a practical source of understanding on the range of products and services technically available, and how they could be tailored to the needs of NHS organisations:

We thought, well, look, if you can check in at an airport you must be able to check in to an outpatient appointment and, you know, and really that's how we went into it, is saying, 'look, if it works in other sectors, it must work in health care'.

Sometimes the most relevant learning for the NHS was about the approach to planning and how the NHS could be more flexible when it came to the estate. Interviewees used examples in other sectors where flexibility is factored into a building to future-proof it from technological change:

> *The intention is a bit like when you sort of see WeWork or the office people, those guys going in to rip out sort of 1960s office blocks and flood it with Wi-Fi and sort of let the millennials get on with it pretty much. The plan is to sort of do an equivalent thing, so rather than be too prescriptive about where the walls are, to design the buildings as such that they can adapt to different iterations of technology and the way in which we want to reconfigure the spaces according to how clinical practice and research demand responds over the sort of next 20/30 years.*

Attempts at digital transformation in different sectors also highlight some of the risks involved. Online banking is one example where there was some resistance to moving away from physical buildings, with some sections of the public initially concerned about the accessibility of technology and the security of information. For online banking, these concerns proved surmountable (although online banking comes with its own risks to service continuity). The experience of the banking sector highlights potential challenges for the NHS estate, where buildings often act as important institutions in communities. This also demonstrates that reducing estate footprint can present challenges for some demographic groups who are more likely to be digitally excluded.

> *So, you know, online banking went from something that scared people, and they thought they were going to get hacked, and their money was going to get stolen, to today, where, it's unusual if you don't do online banking. I think the stat is something like 65, 70 per cent of banking transactions are done online now. So, that's grown so rapidly, and obviously had a major impact on the banks, in terms of the high street networks.*

Engaging widely

To maximise the benefits of new technology for the estate, and more widely, these changes need to be embraced by a wide range of people within NHS organisations and across the wider system.

Many interviewees acknowledged that, due to past experiences, IT often has a 'credibility problem' within the NHS, with many people inherently sceptical of new technology and its scope for delivering benefits. Some people highlighted concerns around privacy and confidentiality as specific challenges to overcome.

Several high-profile breaches of data security, as well as the experience of the care.data programme (which was closed following criticisms that insufficient care had been taken over patients' consent), have tested people's confidence in data-sharing (Evans 2018). The recent introduction of the General Data Protection Regulation (GDPR) is likely to have heightened concerns in this area.

In our interviews, we heard that a culture of 'obsessive confidentiality' could be a barrier to some changes, such as the use of sensors to collect more granular data on activity. Previous work by The King's Fund found that fears around patient confidentiality could be an obstacle to data-sharing in particular, and that robust information governance structures and a culture of trust between organisations were important in combating this (Maguire *et al* 2018).

Engagement is particularly important among those who will be required to work differently as a result of changes in technology or the estate. Staff engagement is key in ensuring that facilities are used in the way envisaged (Buckingham *et al* 2018) and a major factor in whether or not new technology is embedded properly or used to its full potential (skills are also important here, as discussed on page 54). In some cases, this will involve staff working across multiple sites or organisations:

> *You can have all the technology in the world, but actually unless you've got groups of clinicians who are willing to use it and embrace it, it's going to take ages to realise any benefit.*

Engagement of staff is partly about being clear on the case for change, particularly in terms of clinical and patient benefits, and the role of technology and the estate in supporting this. It is also about assuring staff on issues such as confidentiality, as already noted. Our research highlighted the importance (and potential challenge) of engaging all staff, both those likely to benefit directly from changes – such as the nurses developing new skills by working in a virtual ward – and those for whom changes could make '[life] less easy' – for example, by requiring them to collect additional data on the estate. As we know from previous research by The King's Fund, involving clinicians as drivers of change is more likely to secure buy-in for technological changes across an organisation (Maguire *et al* 2018).

As described earlier, engaging the public is also a vital element of achieving a well-designed, appropriate configuration of digital and physical space. The risk of not involving the public in a conversation about the overall direction of travel for services is that the NHS moves faster than its population. In the case of the estate, this recognises that the public can be deeply attached to buildings and very resistant to change. Taking active and early steps to engage people in changes to the estate, and being clear about the case for change and what can be expected, is key (**Buckingham *et al* 2018**). There are many examples in the media of what happens when insufficient attention is paid to the needs of patients. One recent story provided an example of this in the case of technological change: a patient in California received news from his doctor that he had only days left to live via a videolink, attached to a robot (**Associated Press 2019**).

Putting patients at the centre of planning the estate and technology is a simple way of ensuring that they are at the centre of any transformation plans.

Access to funding

As discussed in the first section of this report, both estates and technology projects require capital investment, although increasingly technology projects also require revenue investment.

In recent years, there has been pressure on capital budgets at a national level. At a local level, these issues are putting pressure on providers, with many organisations either scaling back or delaying capital plans in response to the challenges around funding (**Williams *et al* 2019**). These issues were reflected in our interviews. For some, the answer lay in dedicated funding or 'an innovation fund' to support innovation across technology and the estate:

> *For example, our command centre which we were talking about before, we are funding that ourselves from last year's bonus for hitting our control total. And I think that's fine. But that is not a sustainable way in order to fund innovative projects for technology which require capital in a system. There should be a clear national framework for trying to make it efficient and allocate the funding appropriately.*

In the case of technology projects, we also heard about the importance of investing revenue in 'organisational development' to help with embedding projects and supporting the spread of successful changes, such as virtual wards, across an organisation. Interviewees suggested that competing pressures on NHS organisations meant this type of investment could also be difficult:

> *The problem with the GP Forward View funding is it supports the technology – that is, it'll just about buy the technology, but it doesn't really buy any of the thinking that you need to implement the technology, which is often why the technology takes a long time to implement, because no one really funds the change management bit. And actually some really proactive CCGs or STPs used that ETTF [Estates and Technology Transformation Fund] to do that, the support, the project costs and… introducing this technology, so that's really good and really important.*

However, as set out earlier, we also heard that this pressure on an organisation's resources could contribute to a case for investment in technology. Some interviewees highlighted the opportunity technology offers for reducing an organisation's running costs, in particular through using data more effectively to understand (for example) a building's energy usage. Automating administrative and other processes was also seen as an opportunity for cost savings:

> *In a lot of trusts, it will be the revenue cost pressure, which is actually driving people to say, 'we need to think about what we can automate'. So there's quite often a good business case about the investment and the savings, certainly on that side of things.*

Having the right skills

The availability of the skills required to make best use of technology, and maximise the opportunities this can present for the estate, was also highlighted by our research. This is about having both the strategic skills needed to ensure that estates and technology are sufficiently well-integrated into clinical plans, and the technical skills necessary to implement and embed changes.

Finding the strategic skills required in either of these areas can be challenging (*see*, for example, **Buckingham *et al* 2018**). The Naylor review noted that the skills and capacity available for estates planning and management within the NHS tend to be

primarily technical, rather than commercial or strategic (Naylor 2017). There has also been an emphasis on the importance of having technology and data expertise at board level within organisations (NHS England 2019d).

In the case of technology, our interviewees suggested that there is also a shortage of some of the relevant technical expertise required. For example, we heard that, while the NHS was generally good at collecting data, the skills required to analyse it effectively were more limited and varied across organisations.

The issue of skills was raised in particular in the context of embedding changes. Assuming that introducing new technology or a new system will be sufficient to bring about change is a common pitfall:

> *People have gone down the sort of the silver bullet technology route in the real estate space and been disappointed with the solution in not driving out the benefits they wanted because they haven't trained the people to use the systems properly. They haven't thought how the systems are used in an effective way.*

We heard about the use of 'digital angels', employed with the specific purpose of ensuring that systems were being used to their full effect. In another example, an NHS organisation looked to an external organisation for support with their check-in system because 'we simply didn't have the skill to manage the interface between what was happening operationally and putting together the technical information for the system to work'.

The Topol review looked at the issue of digital skills within the clinical workforce, recommending wholesale changes to education, training and continuing professional development (Health Education England 2019). However, wider issues around the data and IT workforce have not yet been comprehensively addressed (Castle-Clarke and Hutchings forthcoming). For example, there are shortages of roles within provider organisations for data analysts who are required to make use of the huge volume of data being generated (Bardsley 2016).

Getting the infrastructure right

Technologies that impact the estate require robust infrastructure to ensure that they operate in a stable way and present a realistic alternative to physical space. High-speed Wi-Fi is crucial, reflected by the effort to progress delivery of this nationally. It is important that this is accessible across the entire estate; however, we heard that in some cases there are significant gaps or 'black spots' within organisations.

Beyond simple Wi-Fi, interviewees spoke about local connectivity – both in terms of broadband and mobile reception. Infrastructure in some places is not currently good enough to support stable and high-quality video, for example. Mobile reception in rural areas frequently does not support any kind of internet. These factors are important for technologically supported models of care that exist outside of the traditional estate. We heard that, where a technology-based system was in place (such as video consultations in primary care), it could be undermined by the limitations of the underpinning infrastructure.

> *There's an estates challenge around video consult, and that's the fact that actually the infrastructure isn't there… When you've only got 10 minutes to speak to a patient, you don't want to waste time at the beginning of that consultation trying to connect to them… most of these practice buildings… the old buildings… [have] pretty shoddy broadband connections, [which] means that it doesn't really support at-scale use of video.*

These issues also present significant challenges for commitments made in the NHS long-term plan around remote working for community workers and reducing the need for face-to-face outpatient appointments.

National standards and regulation

While there was a clear sense that estates and technology planning should take place at a local level, we heard about several actions that could take place at a national level to support this work. This included developing national standards and supporting interoperability in particular, recognising that the complexity and fragmentation of the system could be a barrier to progress. These messages are reflected in recent research on national technology policy (Castle-Clarke and Hutchings forthcoming). Interoperability and standards were mentioned as centrally important to sharing information between organisations. Common standards support better sharing across organisations but can also facilitate a better user experience, either for staff or for patients. It was recognised that many of the issues around standards had been introduced by the fragmentation between different organisations. Development of open standards for sharing of data could support better exchange of the data and make it more easily accessible:

> *So somehow or other, someone needs to do a bit of work to set some common standards and protocols which allow for interoperability, and allow potentially for us to be able to then define how the user experience can be reasonably consistent across a number of different sites. So fragmentation is a big issue, as I see it.*

Some interviewees welcomed recent national policy that described a more consistent approach to developing standards on technology, such as the approach in *The future of healthcare* (**Department of Health and Social Care 2018a**). Similarly, it has been suggested that NHS Improvement will develop some standardised building designs to support STPs in developing their estates plans (**Carding 2018**).

Linked to its role in sharing best practice, the centre can also support organisations by bringing data about operations together at a national level. This could begin to give more consistency to the intelligence that is being used to improve estates and roll out transformation across the NHS:

> *When you bring the data up to a national level, you can look across systems and you can plan effectively. That's what we're able to do now through the model hospital but we could do so much more.*

Interviewees also suggested that national regulations could better support introducing new technology or developing the estate in a way that supports technology. We heard that health building notes, which provide guidance on the planning of new health care buildings and adaptation of existing ones, have not been updated for many years, and therefore can fail to accommodate changes in technology (as well as other changes in ways of working):

> *I do think there is a piece of work that needs to happen… updating the health building notes, and giving people a new baseline from which to start that design work, taking into consideration different ways of working, as well as technology. Integrated working and… So all the good practice guidance, which we have to use when we write business cases, is out of date.*

Similarly, regulations can be a barrier to the new or different ways of working which are enabled by technology. For example, the premises-based regulations and systems could present a challenge to the digital pharmacy model. In the case of Well Pharmacy (*see* p40), we heard that the 'electronic prescription server' requires patients to specify which Well Pharmacy they would like their prescription sent to, rather than giving them the option of being able to access it across multiple Well Pharmacy sites.

5 Conclusion

Our research demonstrates that technology is being used widely across the NHS today, bringing important benefits for patients and NHS staff. For the older person supported by sensor technology to live at home, for example, these changes are significant. We identified many more opportunities offered by technology in future and a clear sense of optimism about their ability to improve care.

Drawing on experience within the NHS and more widely, our research also provides an insight into how changes in technology are likely to shape the NHS estate over the longer term. Our NHS 'estate of the future' demonstrates that, by influencing patients' interactions with the service, and the settings in which their care is delivered, technology has the potential to affect the estate in many different ways. The NHS estate of the future could be more integrated, smarter, and provide a better environment for patients and staff. It is not clear that technology will lead to a smaller estate over time; instead, it will be important to have an estate which maximises the space it has and is agile enough to adapt to changes in technology (and other needs).

Despite their great potential for change, technology and the estate are primarily enablers. While technology offers improvements in many areas, including in the management of the estate, clinical transformation and the needs of patients must always be at the forefront of change in the NHS. It is clear that, if organisations and systems are to take full advantage of this opportunity, a more strategic approach to estates and technology is needed.

So far, innovation has been patchy, with some organisations and systems moving forward more quickly than others. In many cases, technology and the estate are still seen as 'add-ons', rather than integral parts of a much wider vision for change. As a result, the changes we have seen to date are piecemeal and do not yet show the signs of supporting a bigger transformation in care. Our research suggests that technology has only had a transformational impact on the estate in other sectors where these two enablers are viewed together, in a strategic way.

In line with broader changes taking place across the NHS, it will increasingly fall to local systems to lead, embed and scale up this change. STPs and ICSs have the potential to address a number of the challenges identified by our research – for example, by taking a strategic view across the estate and technology and bringing these areas together as part of wider plans for change. STPs and ICSs also support cross-organisational working on these issues, taking advantage of opportunities for working at scale and, importantly, supporting the delivery of more integrated care for patients. In some cases, the true benefits offered by technology will only be fully realised at this scale – for example, the new ways of working offered by digital-first primary care. STPs and ICSs also provide an important opportunity for organisations to work with partners outside of the NHS.

However, local systems cannot provide all the solutions themselves. Many of these systems are still developing and have a long list of priorities to work through. There is an opportunity for those in national NHS bodies and central government to support more action using the levers at their disposal – for example, on the issue of funding.

In addition, there is a tension around the timescales that operate for clinical transformation, estates and technology. To realise the future vision we set out earlier in this report, local systems will need to take a long-term, strategic view of technology and the estate. National NHS bodies need to give them the permission and headspace to plan for the long term. Only if that happens will the NHS be able to maximise the value of the estate it has, while delivering care which is more joined up to better meet the needs of patients.

Actions in the following areas (some of which are already under way) will be particularly important in supporting progress.

- Developments in technology and the estate may have significant consequences for both NHS staff and patients. This means it is critical that staff and patients are involved in a meaningful way, and as early as possible, in plans for change. These should be developed to meet the needs identified by staff and patients, rather than only consulting them when plans are in their final stages.

- Organisations and local systems need to routinely consider the role of the estate and technology in wider plans for delivering clinical change, including exploring the opportunities that come from considering the two areas together.
- Developing the skills necessary for organisations to maximise the opportunities that come from planning the estate and technology together will be key. In particular, it is important that organisations have the analytical capability to make use of the data provided by technology, and the strategic skills required to embed this intelligence in planning. This means going beyond the Topol review's focus on developing digital skills among clinical staff.
- As they increasingly focus on collaboration and on opportunities for joining up services and engaging with communities, local systems should consider how technology can help them to share space more effectively – both within the NHS and with partners outside of it. This applies both at an STP/ICS level and more locally within places and neighbourhoods.
- Collaborative working on the estate and technology through STPs/ICSs should be supported by further action from national bodies. In particular, this means:
  - provision of the infrastructure and standards necessary to support integrated ways of working, in line with commitments made in *The future of healthcare*
  - arrangements which support the provision of capital investment where multiple organisations are likely to benefit
  - support for primary care, allowing them to scale technologies across multiple practices and leverage some of the benefits that come from this.
- Technology is sometimes seen as a challenge to bricks and mortar but it need not be. The estate will increasingly need to be considered as part of a local community, and local systems should think about how technology can support them to use existing space in different ways that promote health and wellbeing.
- Achieving the most from technology and the estate will require capital investment. This requires a long-term capital commitment at the national level, as well as delivery of promised changes to the capital regime to address issues such as fragmentation.

Appendix: Methodology

Aims and scope

The broad objectives of our research were to:

- explore the impact of technology on the NHS estate
- identify the key lessons from previous technology projects in the NHS (and in other sectors), where there were possible implications for the estate
- identify the opportunities and risks of taking forward projects in this area in future.

Our research explored technology and all parts of the NHS estate. We explored the impact of digital technology and medical equipment – including 'medtech' such as MRI scanners – on services and patient care. Our research also touched on technology supporting the management of the estate, but this was not our primary focus. We considered evidence from the NHS and other sectors, as well as international evidence.

Approach

Literature review

We carried out a review of the literature relating to the impact of technology changes on the NHS estate. We also reviewed international literature (English language only) on the impact of technology on health care estate, and any relevant literature from others sectors, such as banking and retail.

Interviews

During January and February 2019, we carried out 13 semi-structured interviews with a range of people. They included those with experience of technology projects within the NHS, people from the national NHS bodies, and a number of others with expertise in the technology and estates sectors.

Our interviews were audio-recorded and professionally transcribed. The data was subject to a thematic analysis and brought together with the themes from our literature review to develop this report.

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Before joining the Fund, Lillie worked in the health team within PricewaterhouseCoopers' advisory practice, where she supported NHS organisations on a range of assignments including public procurement projects, organisational and commercial change, and strategy development projects. While at PwC, Lillie spent 18 months on a secondment to the Department of Health's NHS Group where she worked on provider policy.

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The King's Fund Ideas that change health care

With the NHS and social care experiencing growing demand for services and financial pressures, there is a need for the system to work differently. Technology and the physical estate are essential for delivering change, with the potential to transform the way patients interact with services and support different ways of working for staff. Despite this, however, technology and the estate have historically remained near the bottom of NHS organisations' priority lists, and are rarely considered together.

Clicks and mortar: technology and the NHS estate reports on research carried out by The King's Fund, supported by NHS Property Services, on the impact of changing technology on the NHS estate and highlights the need for joined-up thinking as part of plans for wider clinical change.

The report provides an overview of where we are now – how technology is currently being used across the NHS and how the estate has adapted. It also considers what the estate might look like in the future and the opportunities and challenges the NHS faces in delivering this, including working as a system to develop a vision and plans for the future, learning from other sectors, securing the required funding, and ensuring the right skill mix.

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