Channel 3® CONSULTING

Digital Technology and Partnering Strategy

August 2020

The Princess Alexandra Hospital NHS Trust

Contents

Executive summary

The Princess Alexandra Hospital of the future

"When we open we want to be the most technological and digitally enabled hospital in the UK, allowing us to transform the care we deliver and the experience of our people"

(Lance McCarthy, CEO)

Our hospital of the future will deliver world class care, in a paperless environment supported and transformed through a digital culture that is integral to our core.

We will champion and develop a patient-centric and data driven learning health system that continually improves outcomes.

A digital control centre will be at the heart of clinical and operational delivery, using insight to improve interventions, patient flow, and operational efficiency across the system.

Patient experience will be powered by a modern, open electronic health record, co-created by patient and clinicians. Patients will be supported by digital solutions to improve their visit.

Our data-centric digital hospital will exploit cognitive computing and analytics to provide actionable insights across clinical and operational activity. Open integration standards and platforms will ensure safe and efficient data sharing across partners.

Smart devices, robotics, and connected systems throughout the hospital will allow automatic technology-enabled care and real-time clinical and operational performance awareness.

Flexible, scalable, and secure technology will enable the use of on-demand cloud computing, allowing rapid adoption of new and emerging technologies.

Multi-channel contact will enable patients, staff, and hospital to interact when and where best as suited to them. New tools and ways of collaborative working will be implemented across the workforce, partners, and the wider Integrated Care System.

Buildings, operational, and clinical systems will be integrated to **improve patient outcomes**.

The new build hospital provides us with an opportunity to maximise the benefits of a purpose-built digital environment

The main purpose of this digital strategy is to set the vision of how a digitally enabled new hospital can transform the delivery of the new models of care for patients and our workforce.

This strategy supports the move to delivering more integrated services in keeping with our current digital roadmap and that of the integrated care system (ICS).

The recent models of care workshops provided us with the opportunity to identify the technology drivers that will transform the delivery of care in a purpose build digital environment.

In addition we will need to prepare the organisation to transform and mature into a digital first culture.

The following page illustrates the impact technology can have in the lifetime of a patient. Further examples can be found in the appendices.

The models of care covered the following areas

- Elective care, including outpatients and surgery
- Urgent care
- Family and Women's Services (FAWS), including women's services,
  - paediatrics,
  - Maternity
  - neonatal care
- Diagnostics and Cancer
- Discharge

The impact of digital on the life of a patient

Babyhood

Joanna and Harry are expecting a child. After discussing the potential compilations with the consultant and midwife of a homebirth, she opts to have the baby in the hospital.

The birth is straightforward, and they name the baby Oliver! Oliver's parents take him home the day after he is born.

Two days after Oliver's birth, Joanna receives a link to download his Red Book as a smartphone app.

However, Oliver is often unwell and by the time of his second PCV jab, when he is 12 weeks old, she mentions to the practice nurse that her baby is frequently wheezy.

Oliver is under his anticipated weight and his skin is salty.

The GP orders a blood test which is returned quickly. She schedules a video consultation with Joanna and Harry to explain the bad news, Oliver has Cystic Fibrosis.

Childhood

When Oliver is 9 years old he is contacted by the NHS and invited to enter a clinical trial to evaluate a new drug to alleviate the worst symptoms of his condition. He is given a tablet to record when he takes his pills and his daily diet. He is given a smart watch which will record his daily exercise and heart rate.

He has regular video consultations with a nurse specialist who has access to his clinical trial data. On one occasion the nurse, who has received an alert, asks him
to visit the hospital for an examination. One Oliver reaches the hospital, the hospital staff can see clearly that he has cystic fibrosis and requires special attention in respect of diet etc.

Oliver finds a website called "CF Together", a support group run and used by young
CF sufferers. The is created for confidential dialogue between young adults to get advice and support. The site can also be used to gain access to specialist professionals. These requests and follow up actions are, with his consent, recorded in Oliver's medical record.

Adulthood

Oliver's parents die in his 50's. He is unmarried and has no children. His condition has become more difficult. He feels lonely and sad. He seeks support for depression. He is introduced to a counsellor who calls him for an hour-long video call once a month following introductory consultations.

Later in life, Oliver starts to find his condition difficult to cope with. His GP introduces him to a special service which provides him with direct access to a CF nurse. He is provided with online tools which recommend exercise and self-management methods. His condition is monitored remotely, prescriptions and anything else he needs are reviewed by the specialist and delivered directly to his home.

Once Oliver's condition worsens a few years later he enters a care home.

Oliver's condition is stable, but his quality of life is poor and he feels he has battled for long enough. He states that other than to alleviate his pain and suffering, he does not wish to go on. He continues to receive oxygen to alleviate discomfort and he is monitored by a computer which will alert the specialist to a deterioration, and his priorities are recorded on the system.

End of life

Telehealth and connected health paperless online system, work anywhere access, screening and triage, remote monitoring e-consultation, telepresence.

Smart environment scheduling and wayfinding, automatic data capture and transcription, automatic observations, asset and equipment choreography, etc.

Decision Support Data analytics, recommendation systems, AI, dashboarding, reporting and alerting.

One-stop diagnostics & test support US/DXR/CT, pathology, etc, when clinically initiated.

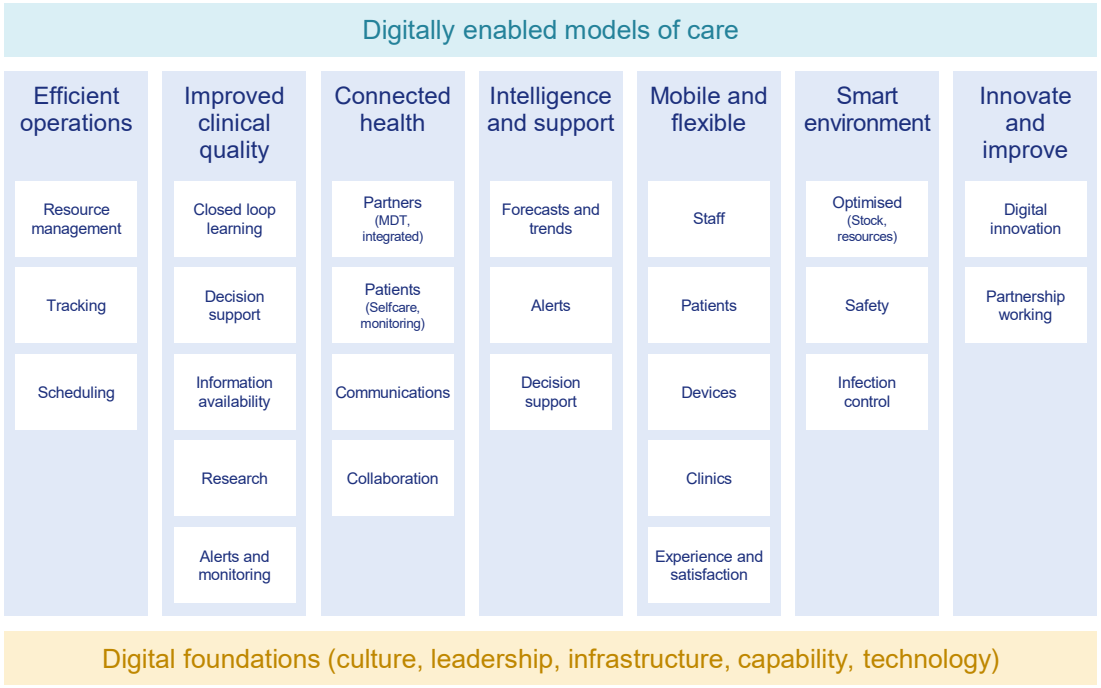
Data Data sharing across Integrated Care System, Electronic Patient Record, Human Resrouce's data, advanced analytics and visualisation.

We have considered the impact of seven core pillars in developing our vision for a digitally enabled hospital

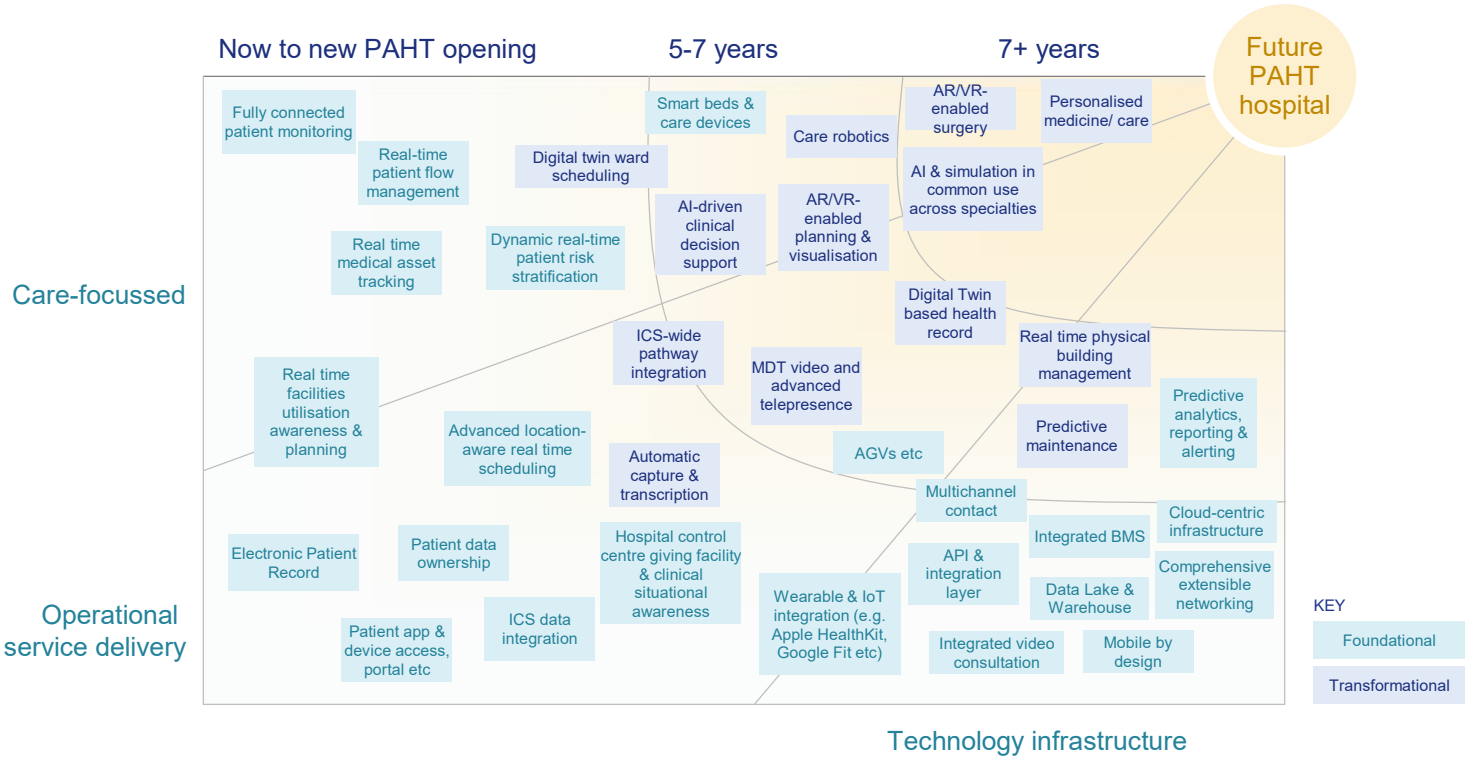
In applying the seven pillars we determine the technology and capability requirements that are needed to support our digitally enabled models of care.

Establishing and embedding strong digital foundations is critical to our transition to a digitally enabled hospital. Digital foundations go wider than physical technology and it is important that the organisation embraces a digital first culture from the top down.

Identifying the technology capabilities has enabled us to develop an ambitious roadmap for implementation and adoption of digitally enabling technology for the new build hospital.



We have an ambitious digital roadmap to support the new build hospital



To achieve our digital ambitions we need to get ready

We can only realise all of the benefits of technology if we start to build strong foundations now.

We need to invest in transforming the organisation in preparation for the transition to the new hospital, ensuring the enabling foundations of culture, capacity and capabilities are in place.

What do we need to prepare for our digital journey?

- A roadmap that prepares us for the new build
- Technical principles to base our future decisions on
- Technology architecture considerations
- The building blocks for a digital foundation
- Understand how ready we are
- Keep an eye to the future
- Note our affordability considerations
- Note our physical space requirement

To achieve our digital ambitions we need to develop partnerships to take advantage of cutting-edge health innovation

Achieving an ambitious technical eco-system will require the participation of numerous supplier organisations.

Engaging each directly will be time consuming and complex. Measuring individual accountability will be challenging.

There are different types of relationships, linked to the maturity and degree of integration between buyer and supplier; transactional, collaborative and strategic. Non-commoditised IT services typically require a higher degree of collaboration in order to derive maximum benefit.

What are our partnering objectives?

Our strategic partnerships will ensure that maximum value is received of our investment in suppliers.

Our objective will be to ensure that all contracts with suppliers support our digital needs including that of our existing partners and the ICS.

Our strategic partners will need to play a part in setting the technical direction for us, and it will be important that we engage properly and effectively.

How will we identify who to partner with?

We will need to establish a framework that allows a measurable performance along the path of further supplier and partner integration.

Once this is in place it can be used to assess existing suppliers and partners and conduct market scans in order to complete our required capability and/or supplier portfolio.

To achieve our ambitions we need to start now

We have a significant opportunity to transform patient care for the people of Harlow and beyond. In order to achieve our ambition we must focus on planning and prioritisation.

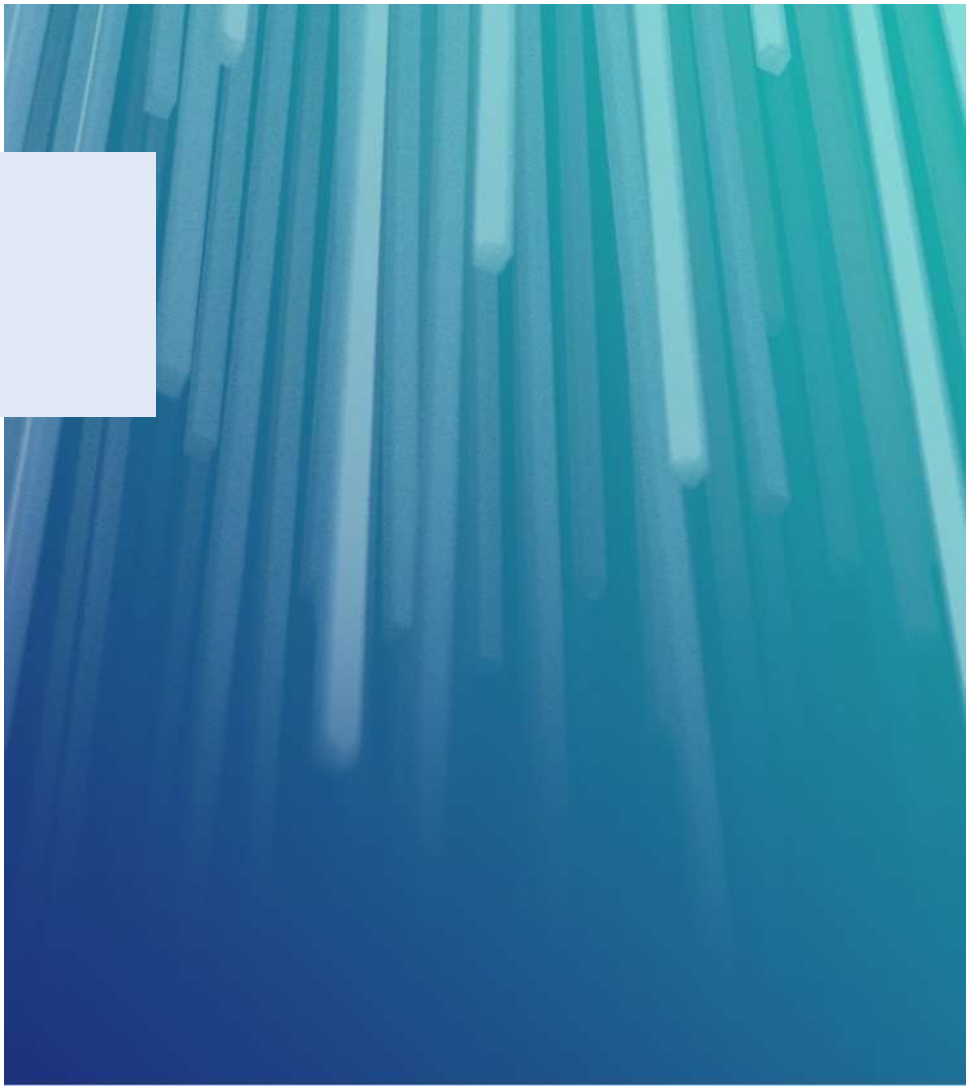
We need to ensure that our plans include, securing appropriate investment, powerful sponsorship and considered consultation with clinicians, managers and patients. Our digital ambition puts us at the centre of an ICS which secures the highest possible standards of care and patient participation, feeds intelligent systems which predict events and is the bedrock of medical research in the east of England.

Combined with our state-of-the-art building, we can be one of the best places to work in the NHS, with technology providing staff with innovative ways of communicating with patients, with each other and with collaborators anywhere in the world. The possibilities for a better work-life balance and agile working will be possible for all.

There are six things we need to start now

1. **Instil a digital culture**
   - Share our emerging digital vision
   - Commit to a paperless environment
2. **Establish and invest in a digital transformation programme**
   - Lead our digital journey
   - Engage widely with our staff patients and partners
3. **Evaluate our readiness for the journey**
   - Identify our risks to successfully deliver our digital vision
   - Develop plans to address them
4. **Reorganise our functions and project structures**
   - Reflect what is needed to deliver our ambition
5. **Plan and build the digital foundations**
   - Including critical technology enablers such as the procurement and implementation of an EPR
6. **Plan our partnership model and approach**
   - Engage potential suppliers
   - Get their ideas, test their enthusiasm and commitment to be a part of the journey to achieve our vision

Introduction



Digitally enabling healthcare

Future digital healthcare is founded on an ever-changing blend of innovative solutions, technologies and partners.

Through the lifetime of the new build, there will be iterations of innovative technologies, most of which are yet to be invented. Therefore we need a vibrant digital eco-system that supports collaborative digital working with suppliers, communities, social networks, commercial, research and academic partners.

Using technology will give our clinicians and nursing staff more time to care for patients – removing and simplifying the administrative burdens placed on staff, making better use of our scarce and highly skilled resources. Patients will only need to come into hospital when truly necessary, with many interactions with clinicians and care staff being conducted virtually.

Our staff will be supported by a modern, digitally enabled environment, that provides multi-channel technology, combined with mobile technology to enable agile working.

Data is a critical building block for maximising the impact of technology

Data and seamless integration is the key to the effective use of technology in delivering care.

Adoption of highly innovative technologies such as AI and machine learning can streamline processes, such as prioritising reporting of diagnostic scans so that radiologists are freed to focus on the most urgent and time critical cases, and through a virtual clinical expert network, access to a wider virtual eco-system of resources can provide an elastic resource in times of high demand and directed to where specialised expertise is needed.

Underpinning all of this is a modern and high-quality electronic patient record, comprehensive data analytics, and a highly flexible hospital management system, delivered through a secure and flexible digital infrastructure.

We recognise our current EPR is not fit for purpose and we are embarking on a procurement exercise to secure a suitable solution.

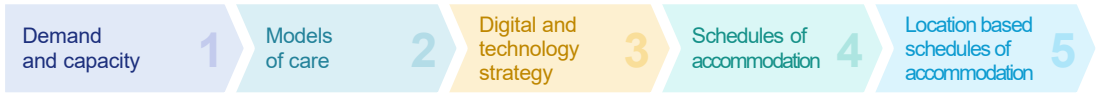
How this strategy has been developed

In June 2020, the Trust commissioned Grant Thornton UK LLP, Academic Health Solutions, Channel 3 Consulting, Archus and Mott MacDonald to help challenge and stimulate the Trust to **push boundaries of how healthcare is planned and delivered**. This work will inform the Trust as it develops its Outline Business Case (OBC) for its proposed new hospital for the residents of Harlow and the wider conurbation.

The work was delivered over five phases each providing the input required for the basis for the following phase.

This document responds to the requirement for a digital and technology strategy and is informed by the recently published Models of Care.

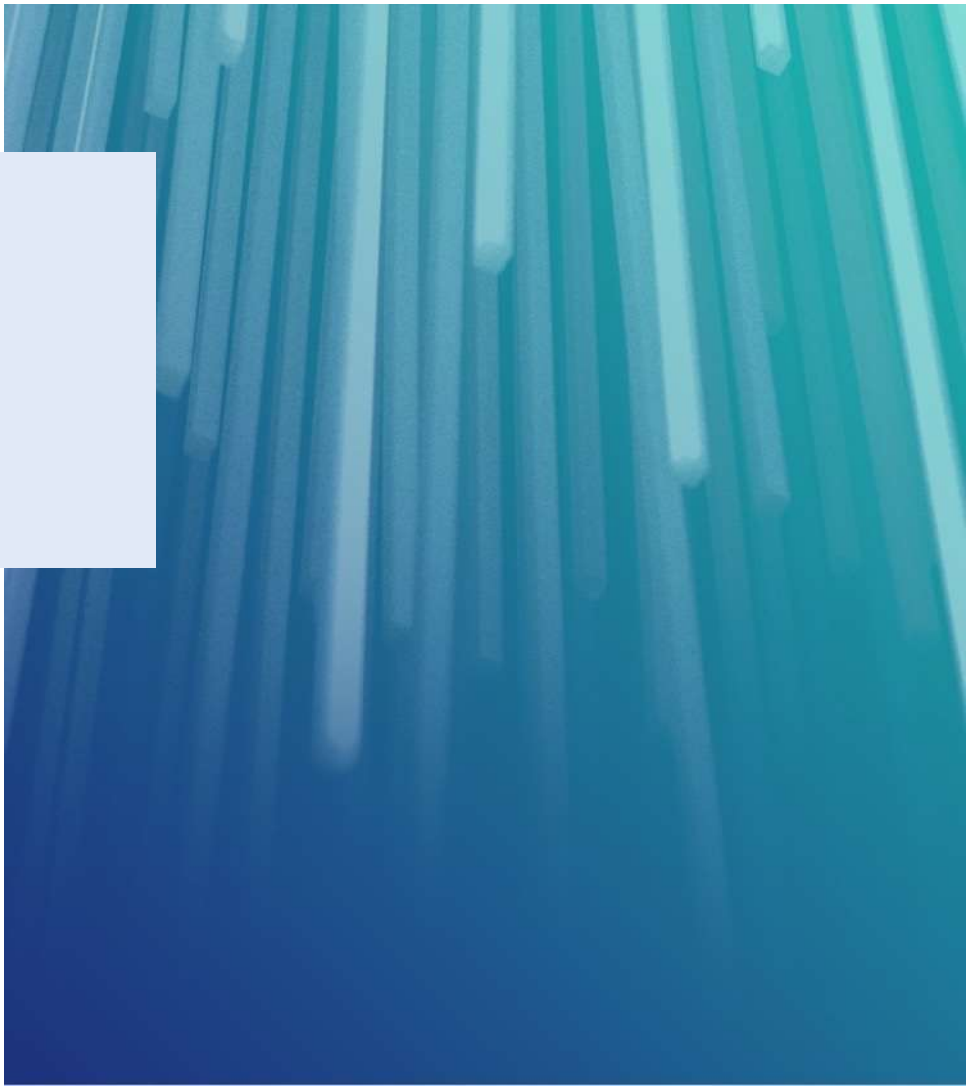
To establish a technology baseline we have undertaken a desktop review of the PAHT provided documentation and the ICS roadmap. We have consulted with available key stakeholders concerning the technical capability and vision of the future hospital.



Throughout the models of care phase we participated in the workshops to garner a clear understanding of the digital clinical requirements. This also provided us with the opportunity to apply our approach of addressing the 'seven pillars' (further detail can found in the following section) to determine the technology and capability requirements that are needed to support digitally enabled models of care.

This strategy sets the vison for the new hospital and contains concepts, principles and capabilities that the Trust can flex in accordance to its needs. It provides a roadmap and supporting information to deliver the technical vision.

What technology capabilities do we need?



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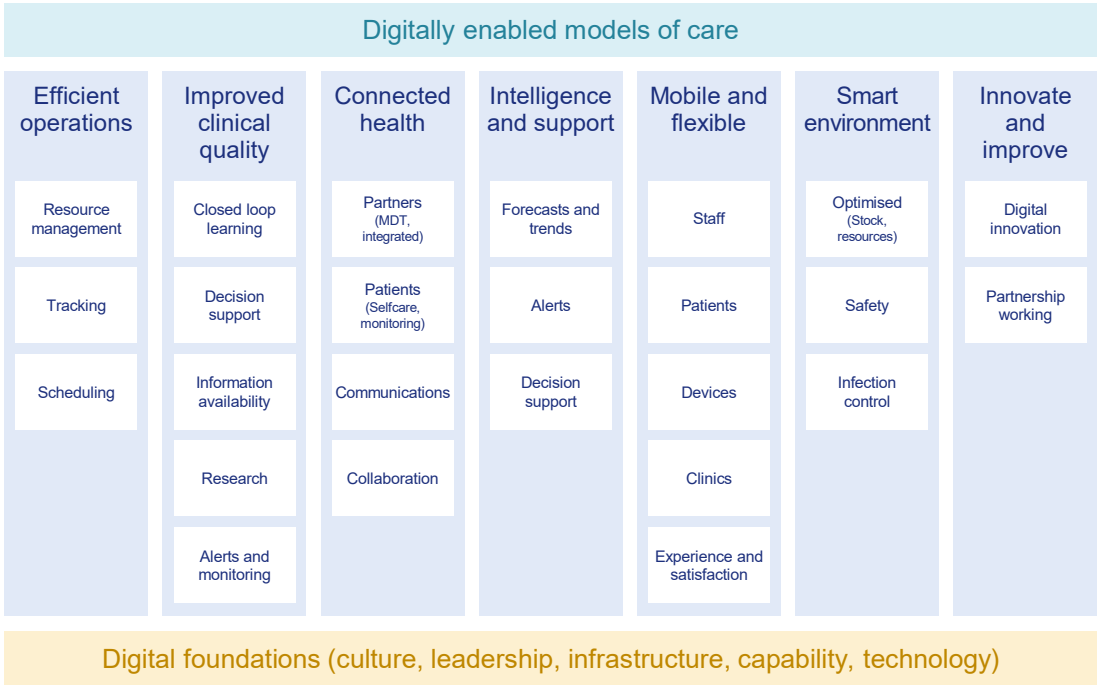


Efficient operations – overview

Building a new hospital offers us a once in a generation opportunity to rethink the way we provide healthcare to the people of Harlow and our wider catchment. We will use the latest technologies to achieve efficiencies across our clinical specialties and services in these ways:

Efficient operations	What does good look like?	Technical capabilities	Example solutions
Resource management	Managing resource to allow more time for clinicians to involve patients and plan their care holistically	• Clinical productivity technology that automates routine tasks that are traditionally done by people	• AI screening of radiology
Tracking	Knowing where patients, staff and resources are at any one time. Being able to understand fully how staff and patients interact and use the data to make services run more efficiently	• Facial recognition • Radio frequency identity tags	• Check-in consoles that recognise patients
Scheduling	Ensuring patients, staff and resources such as medicines and equipment are in the right place at the right time	• AI-supported staff rostering	• Central hospital 'control room' such as those at Salford Royal NHSFT and Johns Hopkins, Baltimore

Efficient operations – a dynamic scheduling example

The anxiety of delay

Mike is an active sportsman who plays tennis and rugby regularly. Recently he has had a niggling pain in his calf which has prevented him from playing sports.

He has been waiting for a long time for an MRI scan at the hospital and, finally the day has arrived. He sets off in good time to the hospital, but a lorry has collided with a car and the accident has blocked the motorway.

The traffic is crawling at a snail's pace. Google Maps tells him he will be over an hour late for his appointment. It's likely he will need to rebook and wait for another few weeks.

Detection and automated rescheduling

Mike's appointment is linked to a PAHT scheduling application which has provided him with the fastest driving route from his home to the hospital.

Detecting in real time that Mike has been delayed, it adjusts the MRI clinic schedule to bring forward patients who have arrived early and find him a slot later in the same day.

It sends him a message to his hospital app to update him of the time for his new appointment.

Resource management

Tracking

Scheduling

Efficient operations – a dynamic scheduling example

Staff and patient movement in the hospital

Mary manages two surgical wards and simply cannot understand why they are so different. Ward A is a headache, absence rates are high, morale is low, patients stay longer than they do on Ward B (even though the mix is identical), patient satisfaction rates are consistently low. Ward B is the opposite. Staff attendance is good, lengths of stay are as expected, patients are happy. Mary has tried a few initiatives but cannot change the situation.

Furthermore, a Ward B patient's children complained to Mary yesterday that their elderly mother was left unattended all day. The nurse responsible is adamant she looked in on the patients twice in the morning and twice in the afternoon. Unfortunately, there is no record of these events.

She would love to spend more time observing how work is done on the ward but does not have the time. And anyway, people behave differently when they are being watched.

Tools for tracking people and supporting accountability

A system that tracks patients and staff has given Mary an unparalleled amount of insight. She can see the daily movement of staff around the wards and can create heat maps of where staff spend their time. She can see instantly, where staff are interacting with patients and can start to analysis staff time with staff and patient satisfaction data. How far do staff walk? Do they get enough time to rest during the day? Where are staff most satisfied: in the busy ward or the less busy ward?

She now has clear evidence of whether her patient was seen by a nurse during the day. Where the hospital acted correctly, the relatives can be shown the information and provide them with reassurance, where patients are missed, as an oversight, resourcing, planning and management can play a role in avoiding future issues.

Resource management

Tracking

Scheduling

Improved clinical quality

Combining the Learning Health System with high fidelity data and a range of analytical and operational technologies will create a system that embeds continuous clinical improvement.

Improved clinical quality	What does good look like?	Technical capabilities	Example solutions
Closed loop learning	The organisation supports frequent and rapid cycles of improvement, where learning is applied immediately and successful clinical innovations are scaled up at a fast pace	• Innovation management system integrated • Ability to collect and analyse data from improvement cycles	• Simply Do, an app-based solution that facilitates innovation 'challenges' across organisations
Decision support	All data is analysed to provide information that adds value to the clinical decision-making process; machine learning techniques are used to predict the 'next best action' for clincians to take	• Data sharing access across ICS • Advanced data analytics • Recommendation systems • AI	• Patient discharge is expedited by AI-supported planning of the required follow-up activity, whether this be in hospital or the community

Improved clinical quality

Improved clinical quality	What does good look like?	Technical capabilities	Example solutions
Information availability	There are no information 'not spots' across the organisation: patient information is accessible wherever it is needed, underpinned by a flexible EPR	• 'Work anywhere' access • 5G • Flawless wireless connectivity	• Simply Do, an app-based solution that facilitates innovation 'challenges' across organisations
Research	The organisation leverages its technological maturity in the wider healthcare community with a strong research programme and partnerships with industry and academia	• Data sharing access across ICS • Advanced data analytics	• Patient discharge is expedited by AI-supported planning of the required follow-up activity, whether this be in hospital or the community
Alerts and monitoring	Machine learning is used to baseline physiological data for each patient whose health is being monitored and to set appropriate thresholds for intervention. These are presented to clinical teams in a simple and intuitive way	• Integrated patient monitoring using a wide range of connected sensors, from wearables to motion-detecting • AI • Dashboarding	• Aparito, uses wearable devices and apps to monitor patients. Including medication adherence, spontaneous adverse events, and Patient Reported Outcomes

Improved clinical quality – a decision support example

Improved clinical quality

Waiting for a crisis




John is 53 years old. He smoked thirty cigarettes a day until two years ago when managed to give up. He has COPD and sees his GP every two week. He was hospitalised three times last year when his breathing became so laboured he thought he was going to die. He has another anxious bout of breathing problems and calls the ambulance.

After being stabilised in hospital, he feels better after a day. He is less anxious because he knows the professionals are there.

But on his last admission, on a Friday afternoon, he was not discharged for 5 days because the hospital consultant had no GP information and needed to speak to the GP directly. This took a few days to organise.

He hates being in hospital again because he has heard of patients dying from infections.

Ambulance and acute hospital

John gets home after being discharged. His breathing is better but his anxiety remains. He does not feel he has any control over his situation. He has some good days when he can walk for short distances, on other days he feels the need to sit in his armchair all day, fearing that minimal exertion will cause him to hyperventilate.

Remote monitoring and self management




John visits his GP every week or two rather than when he feels unwell. When his situation is acute, he calls an ambulance.

John is computer savvy and is happy to measure and record his own spirometry results once or twice a day, indeed, he feels this would give him some control over his condition.

He is given some tools by his GP: a spirometer and a blood pressure monitor.

He starts to enter results from these devices over the internet, algorithms – the parameters set in advance by his clinician - will detect a deterioration in his condition and a hospital clinician will call him on the phone, or on a video call application or can alert his GP.

Realising that his condition is being monitored, John relaxes and this alleviates his COPD symptoms.

Decision support

Information availability

Alerts and monitoring

Connected health

The tools for managing complex processes and high volumes of data are already in the hands of most people. The COVID19 pandemic has demonstrated the value of connected working. The changes achieved in a few short weeks in the NHS are likely to endure beyond the most critical stages of the crisis.

Connected health	What does good look like?	Technical capabilities	Example solutions
Partners	The organisation is part of a network spanning the ICS, with links further afield to academic and industry partners. Information is shared to improve delivery of healthcare and facilitate innovation and research, subject to stringent consent processes	• Data sharing across ICS • Patient-centred information sharing consent	
Patients	'Smart' homes enable patients to share their physiological and subjective health data with their clinical team rather than visit hospital; patients' interaction with the Trust is via their preferred communication medium	• Wearables and other remote patient monitoring sensors • Dashboarding • Omnichannel capability	

Connected health

Connected health	What does good look like?	Technical capabilities	Example solutions
Communication	The organisation maintains super-fast connectivity across the estate; staff have the tools they need to work effectively at any location	• Super-fast/5G connectivity • Remote working and consulting technologies	
Collaboration	With the organisation at the centre of a connected ICS, collaboration with partners in health and social care becomes part of normal working life. MDTs and care planning meetings work more effectively because attendees can join remotely, and they have access to a greatly enhanced set of physiological and other information streamed from the patient's home Patients are able to play a more active part in their care by providing feedback through their preferred communication channel	• Data sharing across ICS • Patient-centred information sharing consent • Super-fast/5G connectivity • Remote working and consulting technologies	

Connected health, multidisciplinary team working, example

Connected health

Old ways of working

Eric Pearce, a medical oncologist, reflected on the total cost of a tumour board, a meeting involving some of the most expensive professionals in medicine, in addition to his own: pathologists, radiation oncologists, surgeons, geneticists, specialist nurses and social workers. This group would gather regularly to review lists of cancer patients and take a view on what the best plan was for each individual. In the past, these could be tedious get-together with a radiology meeting followed by a pathology meeting (often somewhere else in the hospital). Not everyone had the images so time would be wasted explaining things to colleagues. The boards could easily take a whole morning.

The modern tumour board

He is relieved as he walks into the spacious meeting room with high resolution and high resilience video communications. The hospital had recently decided to work in collaboration with oncologists at a teaching hospital in New Delhi and he feels like he now knows Vikram and Sampat very well even though he has never met them face to face. Such is the quality of the video link.

Now, rather than move between separate radiology and pathology meetings, the high-resolution imaging and digital pathology images can be presented on a screen at the same time and pathologists and radiologists could participate in the same meeting.

The work is done in half the time and Eric feels and he thinks it now makes better decisions.

Time for patients

By mid-morning, Eric is already doing what he'd typically be doing in the afternoon. He is arranging for patients to be contacted and arranging their next stages of treatment.

Eric now calls the patients on a video call. He found that he could dedicate a little bit more time to this sort of communication. Patients really like speaking to a doctor so that they can ask questions. Where appropriate, Eric can use some of the data from the meetings to help the patient better understand their condition and why the proposed plan was deemed appropriate.

The patients' arrangements are confirmed by email or a message in the PAHT patient app and scheduled into the patient's personal care diary.

Partners

Patients

Communication

Collaboration

Intelligence and support

Intelligence and support capabilities provide the basis for turning data into information, and through analysis, actionable insights that improve outcomes.

Intelligence and support	What does good look like?	Technical capabilities	Example solutions
Forecasts and trends	No data is redundant: the organisation uses advanced analytic techniques to generate information to inform both clinical decision-making and the operational management of the hospital. Service demand, staff capacity and disease prevalence are forecast effectively, based on historical trends fused with wider healthcare data from the ICS, along with other datasets such as demographics, public health and environmental data.	• Big data and analytics • Control centre • AI • Machine learning	

Intelligence and support

Intelligence and support	What does good look like?	Technical capabilities	Example solutions
Alerts	Machine learning is used to baseline physiological data for each patient whose health is being monitored and set appropriate thresholds for intervention. These are presented to clinical teams in a simple and intuitive way.	• Integrated patient monitoring using a wide range of connected sensors, from wearables to motion-detecting • AI • Machine learning • Dashboarding	
Other	The information rich organisation has a 'digital twin' modelled from data, permitting real time asset monitoring; location-based resource allocation and monitoring; performance analytics; effective space utilisation; energy efficiency; predictive maintenance and diagnostics.	• Big data and analytics • Control centre • AI • Machine learning	

Intelligence and support – example

Old ways of working

Procedures and surgery are centrally planned, and for much elective surgery, generally quite a way in the future. As a result, despite letters, and text notifications, and automated phone calls, a persistent number of patients do not attend on their appointed date.

Using AI to actively target DNAs

Using a variety of data, including patient attendance history across the ICS, pre-operative assessments, referral-to-appointment time, day, age, ethnicity, and weather forecast (as examples), PAHT produces a DNA risk profile for patients, who are contacted directly by telephone by the outbound contact team prior to their planned procedure.

Better resource utilisation, reduced wait times

Using a predictive model based on a trained machine learning algorithm and a wide variety of data points, PAHT is now able target patients who have a higher potential for DNA.

This specific intervention has resulted in a 35% reduction in DNAs, saving the Trust significant resources.

Combining this approach in the smart scheduling system gives considerably more certainty of workload and a much higher fidelity forward forecast of true capacity.

Forecasts and trends

Alerts

Mobile and flexible

The use of multi-channel technology, combined with mobile technology and devices allows patients and staff to interact with the hospital and each other, in ways and at times that are most convenient to them. While there will frequently be a need for interactive conversations between patients and clinicians, these interactions can be made more effective by technology.

Mobile and flexible	What does good look like?	Technical capabilities	Example solutions
Staff	A PAH smartphone app provides access to some of the crucial tools that staff need to do their job: the EPR, pathology and radiology results, their HR record. The app could also locate the member of staff and provide a 'bleep' service. Staff are able to work effectively regardless of physical location	• Cloud-based applications and storage • EPR	
Patients	A patient-facing version of the PAH smartphone app facilitates easy access to hospital services and records, and integrates consumer wearables for real time monitoring. Check-in and wayfinding functions in the app make patients' time in the hospital a smoother experience	• Cloud-based applications and storage • EPR • Aggregation of wearables and other sensors	

Mobile and flexible

Mobile and flexible	What does good look like?	Technical capabilities	Example solutions
Devices	Wireless, energy harvesting technology (i.e. powered by solar or kinetic energy generation, without connection to a power grid) allows devices provided to staff and patients to work in any location without loss of fidelity	• 5G or super-fast wireless connectivity	
Clinics	Clinical space is reconfigurable so that it can be used for different purposes		
Experience and satisfaction	Measures of patient and staff experience and satisfaction are built into workflows and clinical pathways		

Mobile and flexible – example

Starting out

Adrian is 35 and has recently returned to running. He is generally well and reasonably fit, but after a recent training run, he was in severe ankle pain. His GP suspects a torn Achilles tendon and has referred him to PAHT.

He regularly uses a fitness tracker. He has downloaded the PAHT app and has granted access to his Apple Health data.

Diagnosis and planning

Adrian has attended a virtual outpatient clinic appointment, and has visited the community MRI facility in central Harlow. His MRI shows a torn tendon as suspected. Given the nature of the injury, following discussion, he is offered surgery, which he agrees to.

On synchronising his tracker's activity data with his health record, and processing it using state of the art risk analytics, the system has identified an unusual trend in his recovery rate after exercise.

Treatment

Adrian is referred to a cardiac specialist, who explains the situation, and possible causes in a virtual appointment.

Following scans and tests, he is diagnosed with infective endocarditis, admitted and successfully treated with antibiotics.

His surgery is automatically rescheduled based on a algorithmic prediction of his likely recovery time.

Fully recovered from the infection, and at the predicted time, Adrian has his Achilles tendon surgery.

Once home and recovered from his surgery, he enters the rehabilitation process.

Rehabilitation

Adrian is assigned a therapist, and entered on to a course of functional rehabilitation provided through a virtual reality system that also employs haptic feedback to help Adrian get the exercises right. The system monitors and dynamically manages his progress, and he has periodic 1-to-1 online sessions with his therapist. His wearables continue to collect activity data, so the therapist is also able to confirm progress outside of formal sessions.

Four months later he is ready to start running again.

Smart environment

Technology will change not only the way that care is delivered, but also the way that the hospital is run and maintained, with increasing recourse to automation of repetitive processes. Much more data will be available for analysis, meaning that workflows can be optimised with minimal risk.

Smart environment	What does good look like?	Technical capabilities	Example solutions
Optimised stock and resources	The organisation has an automated supply and logistics chain, reducing waste, improving tracking, storage and stock rotation. Stock exhaustion is minimised through automatic reordering and replenishment, There is reduced need for manual stock taking	• Big data and analytics • Control centre • AI • Machine learning	• Smart lighting
Infection control and safety	Modelling run using the 'data twin' allows the organisation to test different infection control regimes and choose the most effective one. Robotic cleaning and pneumatic waste disposal systems increase the efficiency of infection control	• Big data and analytics • Control centre • AI • Machine learning	

Smart environment

Smart environment	What does good look like?	Technical capabilities	Example solutions
Other	Bed washing is automated; pharmacy uses robotic dispensing; automated guided vehicles move supplies around the building; energy use is regulated centrally, and energy harvesting technology actively reduces carbon footprint	• Energy harvesting sensors	• Robotics • AGVs • Smart lighting • LiFi

Non-clinical assumptions based on our intended delivery of service and models of care

Digital technology is changing hospital maintenance and operational practices, providing ever-greater efficiency, optimising the use of space, re-defining the hospital building.

The smart hospital concept partnered with a digital representation of the facility (digital twin) enables:

- Asset monitoring
- Location based resource allocation and monitoring
- Performance analytics
- Space utilisation metrics
- Self reporting building
- Common data environment
- Standby Power – cleaner fuel/offset technology
- Energy harvesting
- Digital asset monitoring
- Energy and environmental monitoring
- Predictive maintenance and diagnostics
- Augmented reality
- Adaptable estate

Non-clinical assumptions based on our intended delivery of services and Models of Care

The introduction of Robotics into the hospital operations via technology can increase efficiencies, infection control, reducing manual handling and increases system resilience

- AGV's
- Robotic cleaning
- Automatic chutes
- Pharmacy dispensing
- Bed washing

An automated supply chain and logistics system can

- Reduce waste
- Improve tracking
- Improve storage
- Improved stock rotation
- Minimises stock exhaustion
- Automatic reorder and stock replenish
- Reduce need for manual stock taking
- Generate min and max stock levels

The Integration of digital systems and process flows

- Improves patient capacity
- Reduces clinical overload
- Increases productivity
- Reduces need for manual data entry
- Visibility of patient journey
- Integrates multiple FM services
- Provides greater visibility of associate FM service costs

Smart environment – example

At the GP

Mark Shaw is a nine year old boy who visited his GP with his mother, Susan a few days ago. Mark had headaches which could not be explained and the GP has referred him to have a MRI scan in the paediatric imaging department. The GP explained what an MRI scanner was to Mark, a narrow tube which you needed to lie in and keep still for around 30 minutes. The doctor told him that it was perfectly safe but it was a bit noisy and made a lot of clanging.

In spite of this reassurance, Mark is doubly worried. The experience sounded frightening enough, but what if he also had a brain tumour like the boy at his school. He was very ill and needed to go to hospital again and again.

Before and then arrival at the Hospital

Susan is sent an email about his appointment for an MRI scan along with a link to a 'Buddy' app. She lets Mark install the app on her phone and he can select and name a buddy (an electronic friend). The buddy starts to send messages to Mark: 'Hi Mark, don't forget you have a hospital appointment on Tuesday. You might be worried, but it's ok, I've known a lot of children have the procedure and it's really safe.' The evening before the procedure, the Buddy reminds him not to eat any breakfast the following morning.

When they reach the hospital, Mark uses the wayfinding in the application as the buddy leads him to the paediatric imaging department. Mark is given an electronic badge which creates his buddy's image on the interactive digital wall in the imaging department waiting room. The buddy reminds him not to be frightened.

In the MRI scanner

The buddy appears as an image on a screen the bore of the MRI machine. "Ok, Mark, you need to hold your breath for five seconds, I'll count for you, one, two, three…"

The distraction provided by the buddy has helped Mark keep still during the scan and take breaths at the right time. The clinicians experience has been that the buddies are so effective at distracting the children that very few now require sedation. Mark needed no sedation, so he is able leave with his mother as soon as the scan is complete.

The interactive image of the buddy appears on the interactive wall as he leaves. "Goodbye and take care, Mark', it says.

Smart environment – examples

Smart lighting

An EU funded development of Energy Management and Control Systems was tested at four hospitals in Europe, including Fundación Sanitària Mollet.

Smart lighting tests indicated a saving of 75% on energy costs for lighting, over 50% was saved on natural light detection.

Patient information and wayfinding

An interactive 'buddy' concept was developed for this paediatric hospital in the Middle East. The smart-phone based application informed children about their hospital appointment, prepared them for the visit and assisted in wayfinding through the building. The same buddy would then be present on interactive screens in the hospital, in the MRI machine and elsewhere.

People tracking

People tracking in hospitals offers a range of opportunities including improvements to staff and patient safety, accountability reporting, staff efficiency and infection control. Tracking people interactions will be a vital tool in contract tracing and the control of infections.

Asset utilisation tools

Large medical equipment companies typically offer more sophisticated tools for measuring and managing asset utilisation. Often these tools extend beyond the measurement of machine productivity and can also provide data for associated staff and clinical processes.

Smart environment – examples

Supply systems

Automated supply chain logistics systems:

- Reduce waste
- Improve tracking
- Improve storage
- Improved stock rotation
- Minimises stock exhaustion
- Automatic reorder and stock replenish
- Reduce need for manual stock taking
- Generate min and max stock levels

Smart hospitals

The smart hospitals concept allows for the consideration of numerous opportunities including: predictive maintenance, air quality, temperature control, security, asset and tracking and much else.

LiFi

LiFi technology is a potential replacement technology for WiFi, using data transmission through light. To date, LiFi remains substantially experimental in hospitals. However, there has been substantial research and development. By the time of the completion of the PAHT new build, LiFi may offer much greater potential.

Robotics

The introduction of Robotics into the hospital operations can increase efficiencies, infection control, reducing manual handling and increasing system resilience. Examples include.

- Automated Guided Vehicles
- Robotic cleaning
- Automatic chutes
- Pharmacy dispensing
- Bed washing

Innovate and improve

The new build hospital provides us with a platform to develop a learning health system and use technology to continually improve outcomes and patient experience.

Our state of the art building will attract resources and partners with whom we can collaborate and establish a culture that embraces innovation.

As the culture becomes embedded, we will work to grow an ecosystem of partners in academia, the wider public sector and industry that leads the research and development of new clinical technologies and devices.

An imaginative partnership strategy will help us to recognise and disrupt any strategic and organisational rigidities that could stand in the way of rapid innovation.

We increasingly acknowledge the leading role that we play in the local knowledge economy, and actively support local businesses with our expertise and through access to research settings.

Innovate and improve – example

What it was like

Hassan is worried. He slipped on some water on his kitchen floor yesterday, he put out his right hand to break his fall. It was a little painful and he thought nothing of it. But after a fitful night's sleep, he woke in the morning to find it heavily bruised and swollen. It is not desperately painful if he keeps it still but he is worried he has broken it and he needs a diagnosis. It is a Saturday morning and he won't be able to see the GP until Monday morning and even that may not be possible because the GP always seems to be booked up these days.

He knows the wait at A&E will be long so he may as well go now and be seen this morning. If he leaves it until later, A&E will start to get busier. He arrives to find the waiting room completely full. There is nowhere to sit. He is seen by the triage nurse within an hour but she tells him the wait for an X-ray will be at least three more hours.

What it's like now

Hassan notifies the hospital of his need for urgent care via the hospital app. His wife takes two picture of his arm which show the extent of his bruising. He describes the circumstances of his accident and describes his symptoms. Hassan notices that the app also allows him to do this by voice message if he prefers. He can also enter the information, if he prefers to in Urdu, which he speaks and a number of other languages.

He receives a call from the triage nurse who advises him that he needs an X-ray. The waiting time is long but they will assign him a slot as soon as possible and send him a message via the app. He will receive a reminder of when to leave home based on his location and mode of transport. The app will direct him to the hospital location for his examination.

Hassan waits at home and can catch up with some work on his laptop and watch the television until he is notified of his slot at the X-Ray department in 45 minutes. He takes the twenty-minute drive and by the time he has parked he can walk straight into the department and is seen straight way.

Next steps

A radiologist has been scheduled and is in attendance. He tells Hassan that it is a sprain and that the swelling and bruising will disappear soon. He is prescribed some painkillers. The prescription appears on his app and he can collect them from the pharmacy near his home.

Later Hassan received an image of his x-ray and the radiologist's report, his GP has been notified of his attendance.

Two days later, he receives a message on the app asking him if his condition is improving. If it is not, another radiologist will look at his scan and confirm the diagnosis. The hospital will schedule an appointment for him at his GP who will re-refer him if necessary.

Digital innovation

Partnership working

Building the digital foundations

We need to get ready to achieve our digital ambitions

The outline roadmap that we have produced shows the general direction and rough sequencing of technology adoption and integration. Elements of the roadmap will need to be planned in more detail and must be driven, primarily, by clinician and operational imperatives.

There will be constraints concerning what is desirable or practical as we move forward. The establishment of, for example, AR/VR surgical training, will emerge only if our surgeons drive its use. It will further only progress if clear advantages can be evidenced in the form of qualitative and economic benefits.

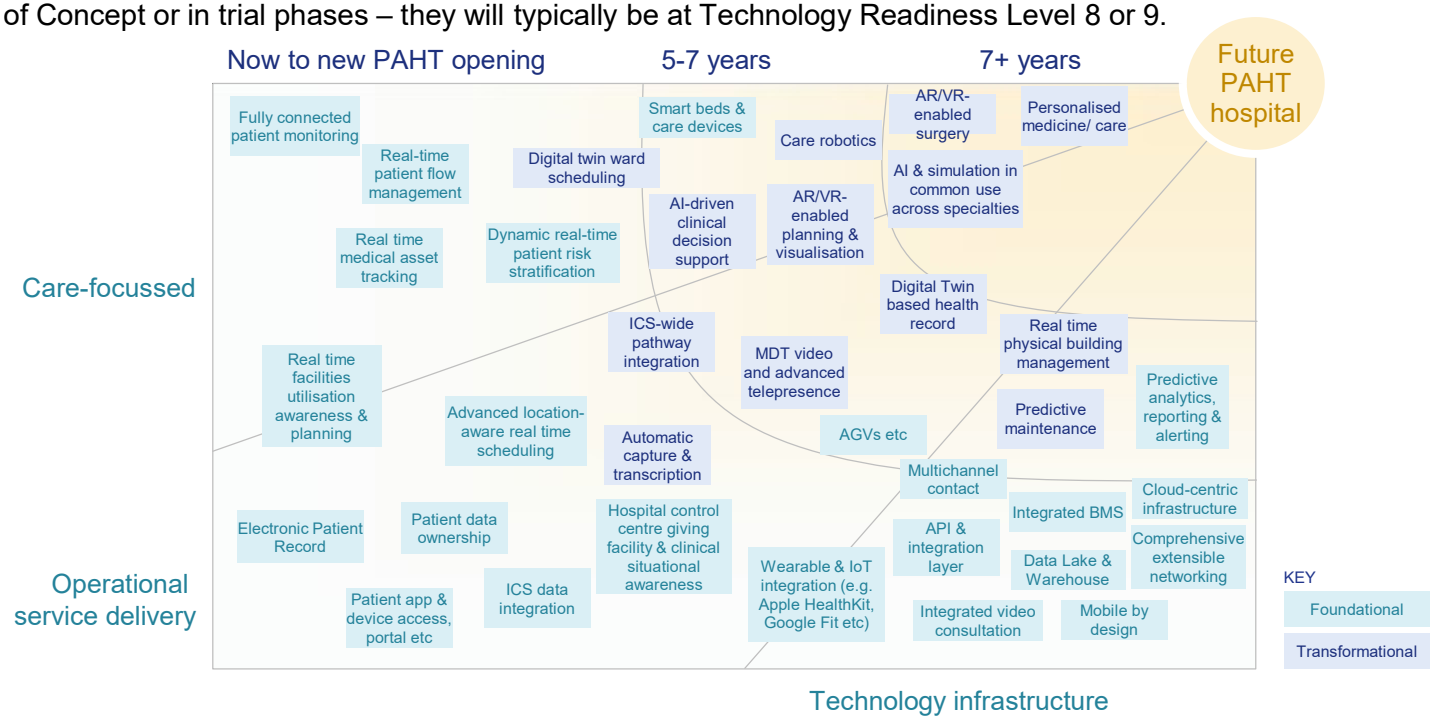
The technology strategy will need to be updated periodically and some amount of obsolescence should be expected in any long-term technology roadmap and we should remain flexible and adaptable to disruptive innovations.

What do we need to prepare for our digital journey?

- A roadmap that prepares us for the new build
- Technical principles to base our future decisions on
- Technology architecture considerations
- The building blocks for a digital foundation
- Understand how ready we are
- Keep an eye to the future
- Note our affordability considerations
- Note our physical space requirement

Our digital roadmap has been designed to support our preparation for the new build

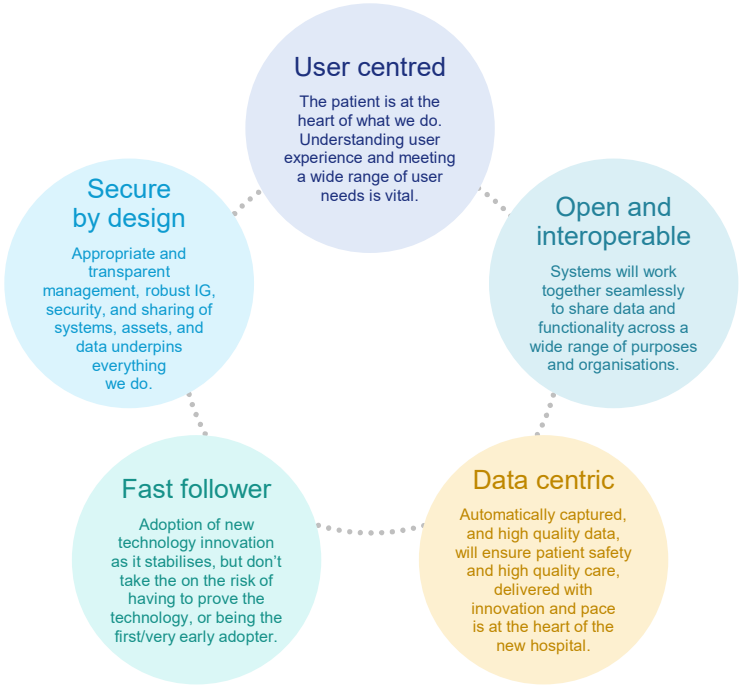
The building blocks displayed will be proven technologies, integrated into the organisation, and in common use, not Proof of Concept or in trial phases – they will typically be at Technology Readiness Level 8 or 9.



Guiding technology principles

In order to guide a clear vision for the future hospital, we have identified 5 key technical principles.

The consistent application of these principles informs the technical vision and will help to ensure that technical decisions contribute to our desired future state.

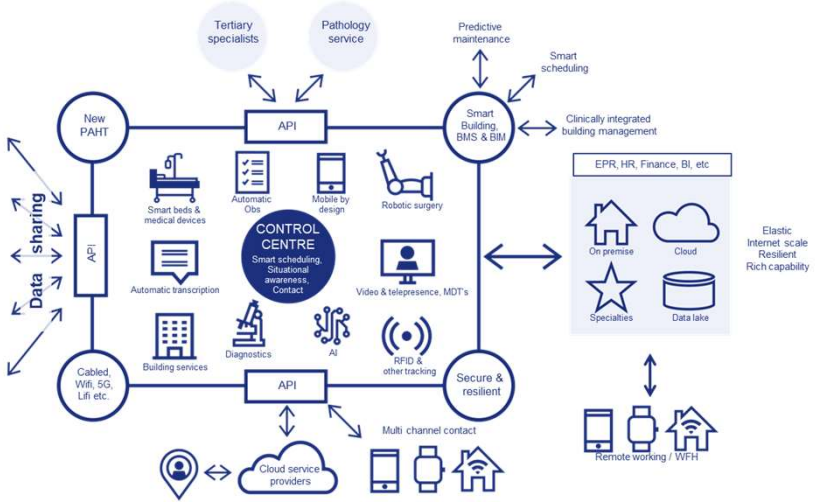


Our clinical and business transformation needs to be underpinned by an architecture that addresses the following technical considerations

Technical considerations

- **Security, availability and resilience** underpin the data and interfaces that flow between PAHT and others; ensuring availability and resilience of services is crucial when providing digital capabilities.
- **Interoperability with external systems** allows data to flow between organisations, but must be loosely coupled, but controlled and secure; defining how this interoperability evolves over time is vital in maintaining services.
- **Development/integration of patient and staff applications** as described previously; this is a capability that needs to be developed or procured.
- **Flexibility/scalability at internet scale**, from anywhere, is expected, with little or no degradation of service regardless of load (elasticity).
- **High volumes of video interactions** will be the norm, as with other high bandwidth, low latency forms of communication, and need to be planned for in network infrastructure.
- **Connectivity to 'things'** will enable the smart building and other smart infrastructure; these need to be highly resilient and secure as the cyber-threat surface massively increases as IoT is deployed. Connectivity and processing also needs to be low latency, but able to deal with very high velocity data.
- **Distributed clinical functions** (e.g. Radiology) will become the norm, with large networks of specialists working across multiple organisations. Information assurance, connectivity, identity management and workload balancing will be crucial here.
- **Collaboration/research with external organisations** will expand, again requiring good cyber discipline and controls, but provide the right access to research and collaboration partners with the minimum of friction.

The rich picture illustrates a potential digital vision that incorporates these technical considerations.



We need to build our digital foundations to create a strong technical platform that enables us to achieve our digital ambitions

Foster and establish a digital culture

- Our whole organisation needs to understand the importance of digital transformation and the associated need for change.
- Commitment to paperless environment is being led from the top down.
- A clear understanding how to measure the digital maturity of our user base.

Implementation of an electronic health record

- A cloud-based electronic health record will.
- Provide high quality data combined with resilience and simplicity of integration.
- Provide highly tailored care, along with automation and analytics.
- Enable workload automation and intelligent scheduling that will help improve clinician well-being by balancing demands and interruptions.
- Enable information to be available to users regardless of location or device, and is tailored to their needs.

Effective management of data is critical to improving the delivery of healthcare

- Data created and used within the healthcare system, including EPR, IoT and wearables, video, scan data, and the ever increasing range of diagnostic modalities.
- Enables a wide range of analytics and reporting to give actionable insight to clinical and operational users.
- Data warehouses and data lakes allow the integration and interrogation of a wide range of data sources.

We need to build our digital foundations to create a strong technical platform that enables us to achieve our digital ambitions

We need to establish seamless Integration

- Enable integration with the digital healthcare ecosystem using Application Programming Interfaces (APIs), to include PAHT systems, NHS partners, commercial, and other external organisations.
- Cloud deployment will allow us to rapidly test and adopt new apps and services without long setup times, cost, and disruption of traditional IT projects.

We need robust connectivity capability

- Provision of an ultra-high bandwidth wired and wireless network throughout is crucial, and will support seamless movement between 5G and hospital-hosted network infrastructure.
- High bandwidth connectivity to cloud services and wider internet will be increasingly important.
- Adoption of technologies such as WiFi 6/7 and Cat8 will likely be the prevailing standards, and specific care requirements will defined in detailed building planning and design.

We need to develop apps

- Development of a PAHT Patient app will integrate services such as remote consultation, scheduling, location and wayfinding, and automatic data capture to support the patient's care.
- It should enable support of Apple and Google's health ecosystems, and technology such as VR and AR as they mature.
- Development of a PAHT Staff app will give access to clinical data and alerting, plus self-service access to back office functions, such as e-portering, scheduling, rostering, communication, and business functions such as HR, finance etc.

We need to get ready and prepare for our digital journey

To prepare for the transition to the new build we need to consider the readiness of our Trust before embarking on implementation of technology.

The ability to deliver the benefits associated with the implementation of technology is directly linked to the readiness of an organisation to implement and establish a robust transformation programme.

Are we strategically aligned with all the organisation and wider health economy.

Do we have the right structure and culture in place to deliver and sustain digital transformation initiatives.

Do we have the appropriate workforce and skills in place to realise our digital transformation ambition.

Is our technical infrastructure fit for purpose and able to meet our current and future requirements.

Do we have the right approach to structured decision making across our organisation to manage a digital transformation programme.

Do we have a suitable approach to benefits identification, management, and realising technology enabled benefits.

We need to keep an eye to the future technology building blocks and include these in our future plans

Big data and analytics

- In order to be able to store and utilise data in the most effective way, modern data tools need to be adopted. These will include cloud deployment of data stores and lakes, an ever increasing focus on data quality and automatic acquisition of data.
- Without strong governance and curation of data into the data lake, there is a significant risk of it becoming a ‘data swamp’, where data becomes untrusted, unlinked, and ultimately devalues the data already present.
- This analysis of this data then forms, for example, the core of the Learning Health System, allowing us to rapidly determine effectiveness of particular actions and embed them in working practice.
- Use of technologies such as encryption will protect data both at rest and in motion, and the use of advanced technologies such as blockchain and smart contracts can help enforce consent and appropriate use of data.

Central control and analysis

- To enable more seamless command and control of the smart hospital, integration of systems across the technical and physical domains will allow a comprehensive nerve centre, or ‘Hospital Operations Centre’.
- All performance aspects of the technical and operational facility can be viewed, giving real-time ‘situational awareness’.
- The Operations Centre will also include the multi-channel contact centre facility, which will allow the hospital to communicate with patients, staff and other stakeholders consistently across channels (web, app, phone, video, etc).

We need to keep an eye to the future technology building blocks and include these in our future plans

Artificial Intelligence (AI) and machine learning (ML)

- Our future hospital will be an intelligent hospital, applying AI techniques and technologies to improve both operational and clinical efficiency.
- This will be linked closely to intelligent automation of hospital management such as intelligent logistics, supply chain management, and core clinical processes (such as highly personalised and integrated pathways), including automatic tracking of staff, patients and assets to ensure they are in the right place at the right time, optimising usage and reducing potential infection risk.

Advanced end user devices

- Displays and other devices can be built into the building fabric such as smart assistants, whole-wall touchscreen displays, simulation rooms, haptic feedback, support for VR, AR and MR environments.
- EUDs will be context-aware and able to automatically capture key information (e.g. automatic transcription, patient stats, images etc).
- These technologies will assist in creating a richer telemedicine experience beyond simply video consultation, for example to create hybrid synthetic and mixed reality training for clinical teams.

We need to keep an eye to the future technology building blocks and include these in our future plans

Tracking capabilities

- Automatic tracking of people and assets allows real-time situational awareness, and better operational and clinical oversight. Areas such as contact tracing for infection control can be automated – for example, the system will know where patients have been, and who and what they have.
- interacted with throughout their visit to hospital, allowing a clear picture of potential infection risks and interactions in real time.
- Tracking can be explicit through the use of RFID-type tracking tags and devices, through apps, or through technologies such as gait or facial recognition, or hospital campus-level such as Automatic Number Plate Recognition.

Integration of IT and physical systems

- The smart hospital connects all aspects of the physical environment, (heat, light, temperature, humidity etc) and can be controlled and managed at an individual area (or room) level for efficiency and optimal patient care.
- Automated capture of data from connected Internet of Medical Things (IoMT) devices such as monitors, smart beds and wearables, and smart infrastructure will be standard.
- Through the use of 3D building models and digital twin simulations of the hospital, PAHT can carry out ‘what if’ infection scenario planning, helping to pandemic-proof the hospital.

We need to keep an eye to the future technology building blocks and include these in our future plans

3D scanning and printing

- Access to 3D scanning for rapid information capture and 3D printing technologies including polymer, laser-metal sintering, and bioprinting for example.
- This will be vital in the future hospital for delivery of personalised medicine, clinical appliances and devices.
- It can also play an operational and facilities role, in fabricating parts or supplies on an on-demand basis.

We need to consider the affordability of technology investment

Our strategy identifies that investment in technology is critical. There are three areas that should be considered before committing to investment.

Will there be improvements to productivity

Is there evidence to show that an investment in technology will:

- ✓ Reduce the footprint of the estate and offset build and maintenance costs.
- ✓ Save operational costs (manpower, consumables, services, others).
- ✓ Provide cost savings that can be associated or driven to identified income streams/tariffs.
- ✓ Contribute to improvements in other parts of the system and shared with the Trust.

Will there be any qualitative improvements?

Is there evidence to show that an investment in technology will:

- ✓ Reduce the cost of complaints.
- ✓ Enable reductions in risk which reduce costs of litigation (patient/ staff/supplier/etc.)?
- ✓ Enable improvements in service likely to promote demand.

What commercial benefits are there?

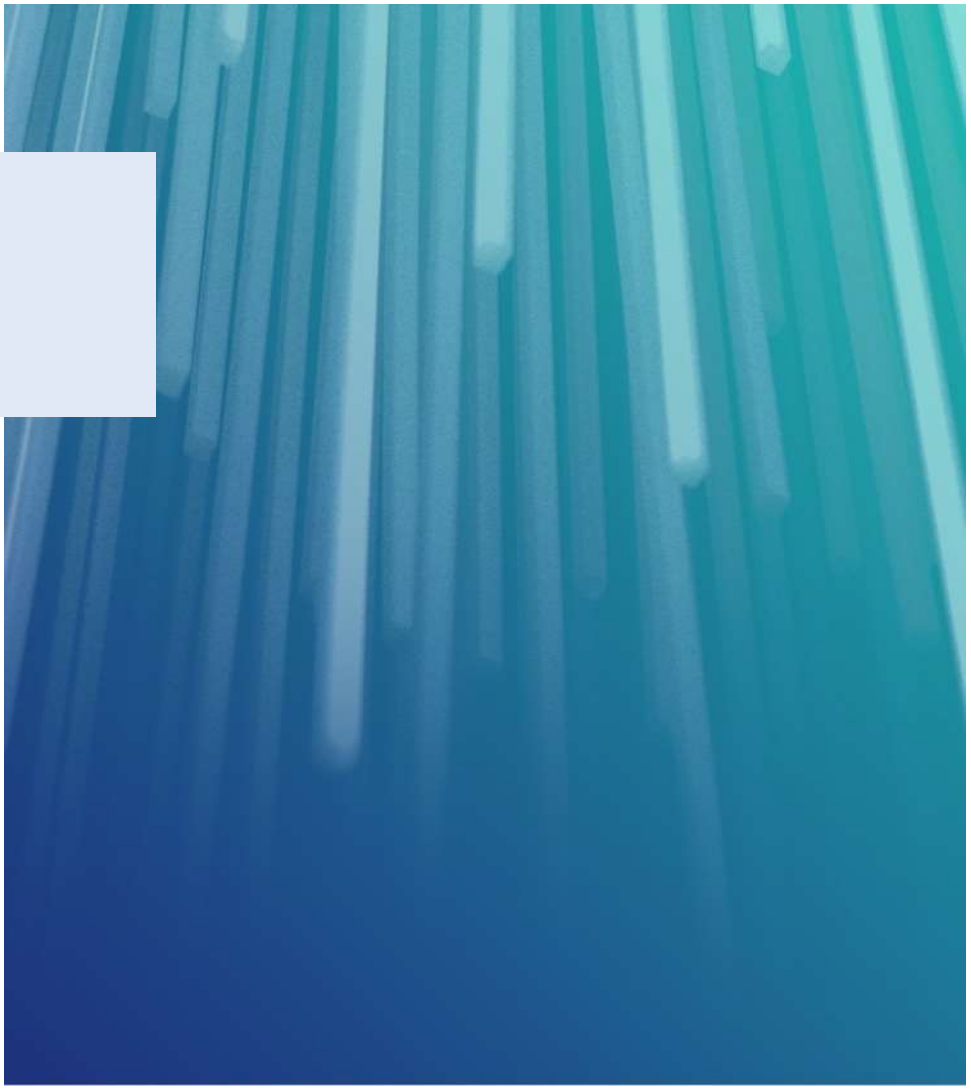
- ✓ Can contracting improve cashflow? (e.g. per use = spend in line with income, flat fee per month = lower capital outlay and predictable monthly cost).
- ✓ Can risk sharing arrangements drive new sources of activity/revenue?
- ✓ Are tax benefits available (e.g. VAT on equipment but not service based deals).
- ✓ What advantage is there for buy vs lease?
- ✓ Are there national funds available?

We need to consider the technology impact on the schedule of accommodation

Immediate implications for the new hospital build need to incorporate the required schedule of accommodation needs:

- **Adequate provision for wired networking infrastructure**, including access ports – also bear in mind many of these will carry power to devices.
- **Data centre provision** – likely to reduce radically over time, but will require some provision locally – need to decide if on-site or take co-located space while migrating to cloud.
- **Communications cabinets** will need to be provided to accommodate networking equipment.
- Physical space for a **Control Centre**, including display and visualisation technologies and the communication/ contact centre (so may require audio isolation and privacy controls).
- **Pervasive high density wireless networking** requires the selection of materials that allow transmission of wireless radio signals (WiFi, 5G, etc), and exclusions, where clinically indicated.
- Support for provision of a wide range of **connected sensors, security controls, and actuators,** most of which will require power and physical or wireless connectivity.
- **Recharging and storage/parking facilities** for a wide range of devices (up to and including autonomous robots and other larger devices).

Strategic partnerships



To achieve our digital ambitions we need to develop partnerships to take advantage of cutting-edge health innovation

Achieving an ambitious technical eco-system will require the participation of numerous supplier organisations.

Engaging each directly will be time consuming and complex. Measuring individual accountability will be challenging.

There are different types of relationships, linked to the maturity and degree of integration between buyer and supplier; transactional, collaborative and strategic. Non-commoditised IT services typically require a higher degree of collaboration in order to derive maximum benefit.

What are our partnering objectives?

Our strategic partnerships will ensure that maximum value is received of our investment in suppliers.

Our objective will be to ensure that all contracts with suppliers support our digital needs including our existing partners and the ICS.

Our strategic partners will need to play a part in setting the technical direction for us, and it will be important that we engage properly and effectively.

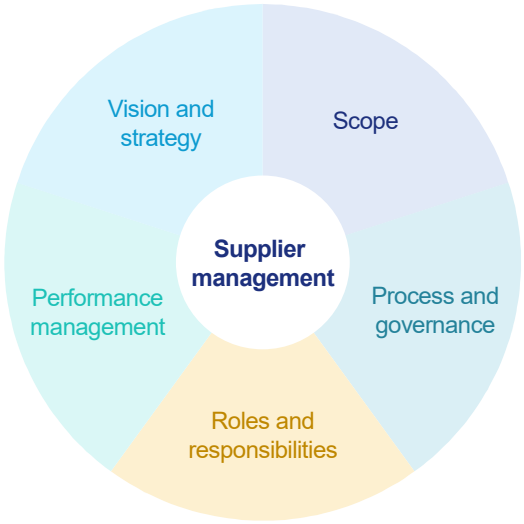
How will we identify who to partner with?

We will need to establish a framework that allows a measurable performance along the path of further supplier and partner integration.

Once this is in place it can be used to assess existing suppliers and partners and conduct market scans in order to complete our required capability and/or supplier portfolio.

‘Digitally excellent’ partnering will require seamless collaboration between us and our suppliers

A move towards effective strategic partnering will require a holistic approach that includes both the current operational needs and the new hospital build programme.



What do we need to do next?

Vision and strategy

Define our approach about how we will engage and work with suppliers.

Scope

Identify the capabilities we need.

Process and governance

Establish the governance model to support the management of partners.

Roles and responsibilities

Create detailed roles and responsibilities for supplier management, including a review of detailed supplier management processes.

Performance management

Design and create a partner score card – example in Appendix.

What types of partnerships do we need?

	Characteristics	Responsibilities
Integration partner	• Track record of complex infrastructure delivery in NHS • Expertise in technical architecture design and delivery, integration, security, compliance	Maintain and upgrade infrastructure; secure resilient connectivity; manage overall security and access; ensure compliance with standards
Clinical systems partner	• Clinical software company with proven EPR/EMR system and track record in NHS/Healthcare • Scale and breadth of skills to enable integration with clinical and other desired systems with core	Maintain patient data and core clinical functions, support integration between clinical systems (own and others), upgrade software
Diagnostics partner	• Diagnostics company with leading edge radiology/pathology skills and ability to support the breadth of diagnostics; data capture, reporting, communications, process integration	Maintain and upgrade diagnostic equipment and software; provide usage and utilisation data

What types of partnerships do we need?

	Characteristics	Responsibilities
Infrastructure partner	• Track record of maintaining complex, enterprise wide technical infrastructure with high levels of resilience, continuity and security	Maintain and upgrade infrastructure management systems; provide performance data
Delivery partner	• Track record of complex delivery in NHS • Expertise in transformation and implementation	Clinical Service Delivery; Management of own tools and methodologies, collaborative ways of working
Academic partnerships	• Universities • Private sector • Other Hospitals • Collaborations of the above	Clinical Service Delivery; Research, Management of own tools and databases, collaborative ways of working (including technical integration)

What we need to consider in identifying a partner

Data ownership and control	Data is very valuable to a technology partner. Will we let them they use it for their own purposes? In what form? What is the value of the data to both parties? To what extent should data ownership/control be a part of the partnership deal?
Asset utilisation	With medical technology, many suppliers will consider different models, e.g. pay per use rather than transaction sale. What works best for us, what are the potential benefits and downsides?
Innovation	Technology suppliers are a valuable source of insight and innovation collaboration with us will offer them referenceable marketing collateral. Will a formal or informal arrangement be appropriate, how will we measure the value to the organisation?
Reference site	Suppliers will be very eager to have us as a reference site, especially when we achieve digital transformation using its systems and services. How should we formalise this?

Conclusions

To achieve our ambitions we need to start now

We have a significant opportunity to transform patient care for the people of Harlow and beyond. In order to achieve our ambition we must focus on planning and prioritisation.

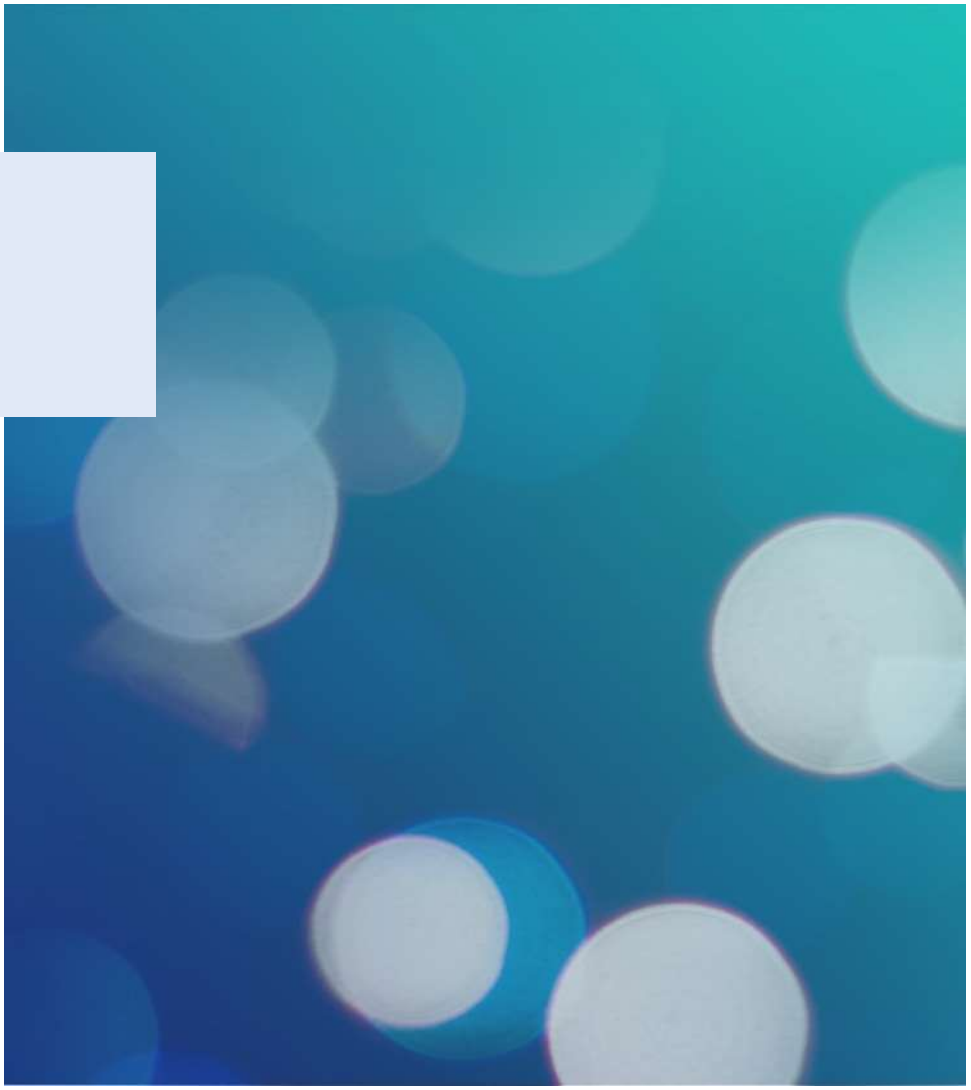
We need to ensure that our plans include, securing appropriate investment, powerful sponsorship and considered consultation with clinicians, managers and patients. Our digital ambition puts us at the centre of an ICS which secures the highest possible standards of care and patient participation, feeds intelligent systems which predict events and is the bedrock of medical research in the east of England.

Combined with our state-of-the-art building, we can be one of the best places to work in the NHS, with technology providing staff with innovative ways of communicating with patients, with each other and with collaborators anywhere in the world. The possibilities for a better work-life balance and agile working will be possible for all.

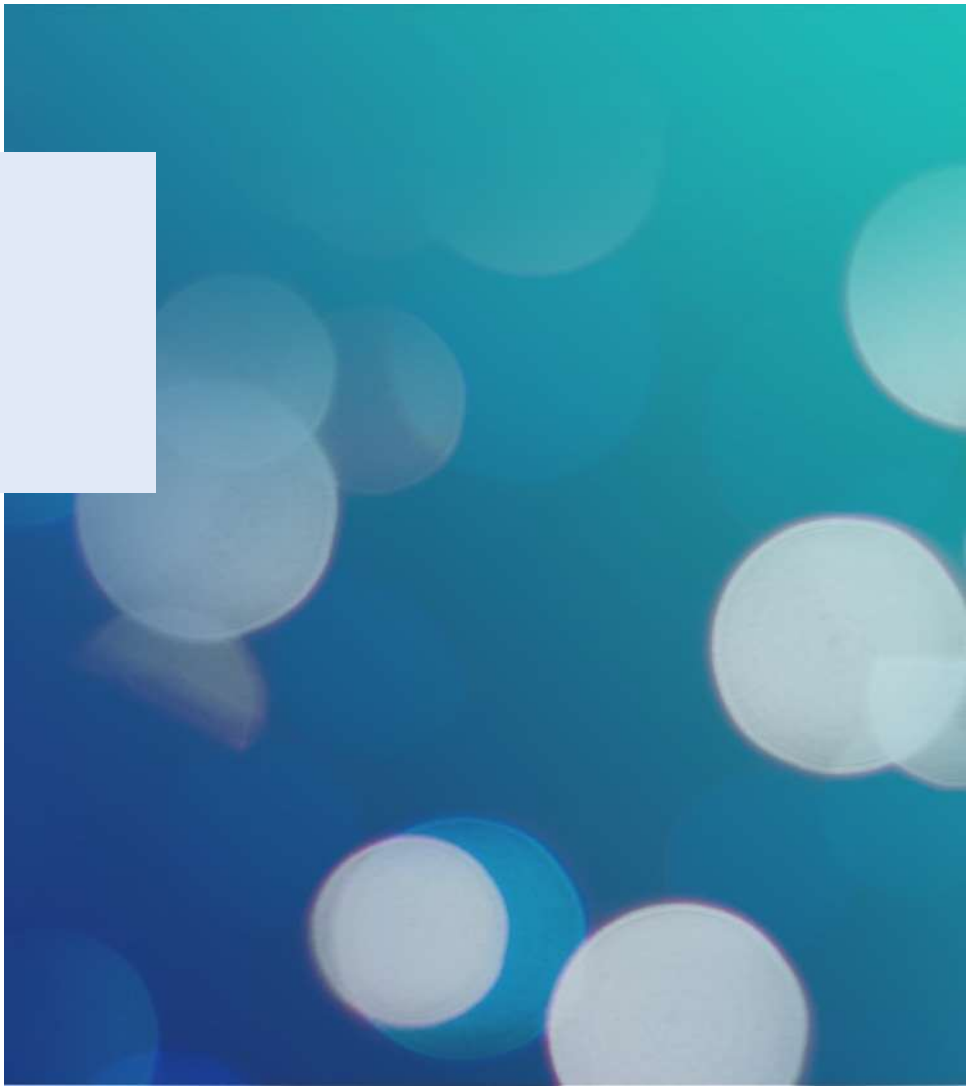
There are six things we need to start now

1. **Instil a digital culture**
   - Share our emerging digital vision
   - Commit to a paperless environment
2. **Establish and invest in a digital transformation programme**
   - Lead our digital journey
   - Engage widely with our staff patients and partners
3. **Evaluate our readiness for the journey**
   - Identify our risks to successful deliver our digital vision
   - Develop plans to address them
4. **Reorganise our functions and project structures**
   - Reflect what is needed to deliver our ambition
5. **Plan and build the digital foundations**
   - Including critical technology enablers such as the procurement and implementation of an EPR
6. **Plan our partnership model and approach**
   - Engage potential suppliers
   - Get their ideas, test their enthusiasm and commitment to be a part of the journey to achieve our vision

Appendices



Appendix 1
Glossary



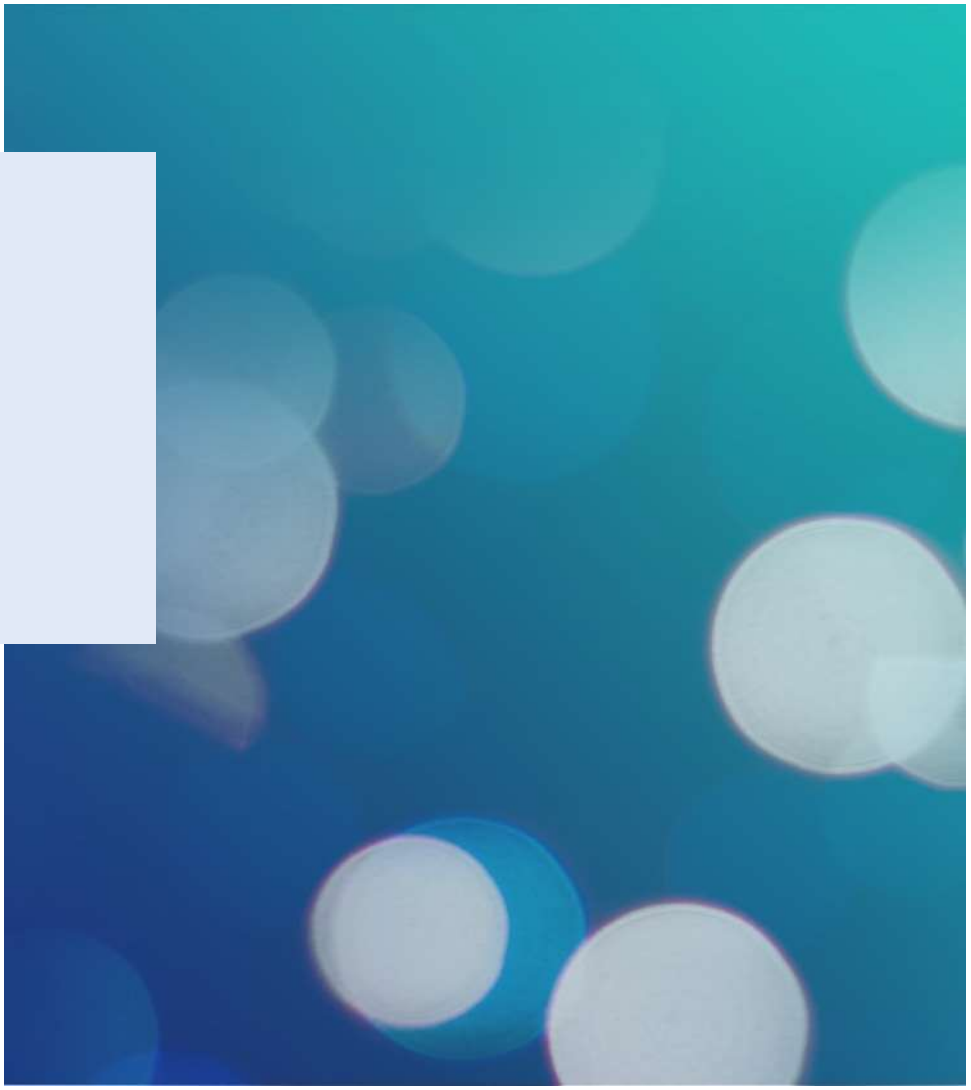
Glossary

Word	Explanation
AI (Artificial Intelligence)	The development of computer systems that perform tasks normally requiring human intelligence through the use of algorithms.
AGVs (Automated Guided Vehicles)	A portable robot that uses radio waves, cameras, magnets, or marked lines for navigation.
API (Application Programming Interface)	A software intermediary that connects two applications, allowing communication between the applications to be made.
AR/VR (Augmented Reality/Virtual Reality)	AR applies digital elements to a screen or other view and can superimpose graphics or objects to the user's view. VR is similar but performs a complete immersion, blocking out the real world. Both have been utilised for healthcare in recent years for example in 3D modelling or surgical training purposes.
BI (Business Intelligence)	A technology-driven process for analysing data
Digital Twin	A digital replica of a process, service or product. Digital twins are often used in healthcare to create a model of a patient's physical state.
EMR/EHR (Electronic Medical Record/Electronic Health Record)	A digital version of a patient's paper record. This has been recognised to be a crucial implementation for Trusts to efficiently and safely provide care.
FM (Facilities Management)	Facilities management involves the management of the hospital to keep it safe, secure and efficiently operating. An example may be preventing power outages.

Glossary

Word	Explanation
IoT (Internet of Things)	The connection and communication of any device to the internet. IoT allows for data to be transferred over a network without any human interaction.
Learning Health System	A system in which science, informatics, incentives, and culture are aligned for continuous improvement and innovation, with best practices seamlessly embedded in the delivery process and new knowledge captured as an integral by-product of the delivery experience. (IoM)
Lifi (Light Fidelity)	A wireless and mobile technology which uses light to transmit data between devices.
Machine Learning	An application of Artificial Intelligence that enables systems to automatically learn and improve through experience rather than being manually programmed to.
MOC (Model of Care)	The model by which health services and delivered. The model outlines the best practice care for patients as they progress through their patient journey.
Multi-channel contact/technology	The discussion of multi-channel contact and technology refers to technology that enables communication across various channels through the likes of telephony.
Real-time	Something that occurs live, and at present. This would indicate, for example, when data is entered in real-time, it is entered as the event happens.
RFID (Radio-frequency Identification)	RFID is a method of collecting data that automatically identifies objects through low-power radio waves. It provides many benefits to provision of care related to patient safety, tracking, and identifying problems in workflow.
Telepresence	A range of technologies can be used to make a person feel that they are present in a given situation. Tele robotics are often used via video and audio capabilities to make a person virtually present.

Appendix 2
The impact of technology illustrations



The impact of digital to an administrator (ward management)

Home	Hospital	Home
 	   	 
Sandra is a ward manager at PAHT,and is responsible for the smooth running of several wards. This morning, she has received an alert that one of her wards is close to breaching a KPI for patient throughput, potentially creating demand spikes elsewhere in the hospital system.	Once on site, she logs into the command centre to try to determine what is causing the breach. She is able to call up a visualisation of the last 24 hours in the ward in question and see in a 3D model the flow of patients, staff movements, key health system and care pathway processes, and other parameters in the ward that may impact the KPI in question. She quickly identifies that it's a simple issue: there is a possible delay in several patient care packages being approved by a care provider in the ICS, blocking the discharge of those patients. She rapidly reallocates resources from another less congested ward to balance the demand. This results in some medical devices and monitoring equipment being reallocated; FM are then automatically tasked to relocate these to the right place. Finally, after a brief online chat with her manager who is working from home, she approves the system recommendation to escalate the care package order to the downstream ICS partner.	When Sandra gets home, she checks her live ward performance dashboard through her PAHT app and sees that all KPIs are green. She also sees in her system dashboard that the patients awaiting care package provision have had their orders processed and have no impediment to discharge once they are well enough.

Telehealth & connected health
Paperless online system, Work anywhere access, Screening & triage, Remote monitoring e-Consultation, Telepresence,

Smart environment
Scheduling & wayfinding, automatic data capture and transcription, automatic observations, asset and equipment choreography, etc

Decision Support
Data analytics, recommendation systems, AI, dashboarding, reporting & alerting

One-stop diagnostics & test support
US/DXR/CT, pathology, etc, when clinically initiated

Data
Data sharing across ICS, EPR, HR data, advanced analytics and visualisation

The impact on the working day of a PAHT clinician

Home	Hospital	Home
		
Anil, a urology consultant, checks his PAHT App over breakfast to review his clinic list for the morning. He is directed to a system update alerting him to a post-operative patient who is in unexpected pain. He reviews the situation and approves the system's recommendation of imaging to determine the cause, which is scheduled for later that morning. He delegates the follow-up to one of his registrars, who is also online, and accepts it into her work schedule for the day. Arriving at hospital in his electric car, using ANPR and smart signs, he is directed to a free parking space with a charging point near to his first engagement.	Anil has a number of patients to see in his virtual clinic and decides on treatment plans for them based on their shared electronic records. These include tests and diagnostics carried out in local diagnostic centres and GP surgeries. He also then has several face to face consultations with patients who have been through the 'one stop' facility prior to meeting Anil, so all results are present for him to review with each patient. The equipment and materials he needs for each appointment are provided by AGV/robot. All the conversations are automatically transcribed, verified, and stored in the EPR, along with automatically captured sketches and diagrams he has drawn for patients. Following lunch, he has the usual AR-enabled ward round, with telepresence from some MDT members, then a surgical simulation session with team for tomorrow's image-guided/AR surgery. While driving home in his self-driving car, he reviews several cases of potentially deteriorating patients which have been detected by the system, which are then automatically tasked to the appropriate teams. Automatic AI-driven risk projections allow the system to dynamically reschedule workloads around achieving the best outcomes.	As part of his teaching role, Anil and his nursing lead run a virtual ward round simulation exercise in VR for a cohort of junior doctors and undergraduate medical students. He video-calls 2 of his recovering patients to ensure they are progressing satisfactorily. He checks his clinical dashboard, sees that the patient who was in pain overnight has been reviewed by the registrar and is stable; their risk stratification score has been revised by the system.

Telehealth & connected health
Paperless online system, Work anywhere access, Screening & triage, Remote monitoring e-Consultation, Telepresence,

Smart environment
Scheduling & wayfinding, automatic data capture and transcription, automatic observations, asset and equipment choreography, etc

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Data sharing across ICS, EPR, HR data, advanced analytics and visualisation

The impact of digital in pandemic resilience

Early stages, initial response


Infection cases continue to rise in England alongside a steady global rise in cases. PAHT Control Centre begins supply chain engagement to activate call-off arrangements for key supplies, drugs, and services.
The WHO, and the UK government declares a global pandemic; PAHT activates its Pandemic control centre protocols
The Control Centre provides real time situational awareness across the Trust and the wider ICS to understand projected infection rates and impact to the hospital through 'what-if' simulated scenarios.
All Outpatient appointments are re-tasked as virtual (if not already), elective procedures are rescheduled or cancelled. ICU monitoring and management, and required equipment provision, are expanded in line with projected demand.

Pandemic controls in place


Using simulations and the hospital 'digital twin' PAHT is able to rapidly clean the facility based on projected patient numbers and infection rates. Physical controls such as doors, locks, and lighting are re-tasked to provide clear visual indicators of infection status. Outpatient facilities are re-designated as potential ICU space and facilities teams are automatically tasked to make necessary arrangements, and less urgent tasks are re-prioritised. ED is re-tasked to accept only life-at-risk type emergencies, and the virtual triage rules are updated; everyone entering the hospital is remotely scanned for symptoms on entry, and are automatically routed to isolation areas if they appear to be symptomatic, and are tagged in the system. All patients, visitors, and staff are tracked throughout their time at the hospital using apps, RFID and face, gait, and other biometric recognition methods to ensure effective infection control is maintained.

Learning & refinement


Predictive maintenance forecasts are revised based on anticipated pandemic-related clinical activities and tasking automatically updated. Prioritisation of supplies and spares is determined by predictive modelling, accounting for anticipated loads and usage-adjusted expected failure rates.
PAHT is able to continue virtual consultations in order to triage, and safely manage higher risk patients.
Infection Control operates a tracking system based on real time data to determine where people are, have been, and who they have come into contact with. This, combined with their live real time test status, allows PAHT to quickly identify hotspots and apply effective track and trace, and re-tasking physical areas as needed. AGVs are used extensively to ensure minimal human contact.

Effective command & control


The Control Centre monitors and manages the effectiveness of the protocols in real-time, giving operational management and clinical coordination teams situational awareness of the hospital's response and readiness to the outbreak, allowing a planned response to the situation as it evolves, including scaling up (and down) critical care functions.
As the pandemic reduces severity, the Control Centre maintains a high surveillance posture, running forecasts and simulations to aid planning in case of infection resurgence and is ready to activate specific plans when risk thresholds breach limits, without needing to rely on the timeliness of external guidance.
Physical facilities are reconfigured in line with the projected future needs

Telehealth & connected health
Paperless online system, Work anywhere access, Screening & triage, Remote monitoring e-Consultation, Telepresence,

Smart environment
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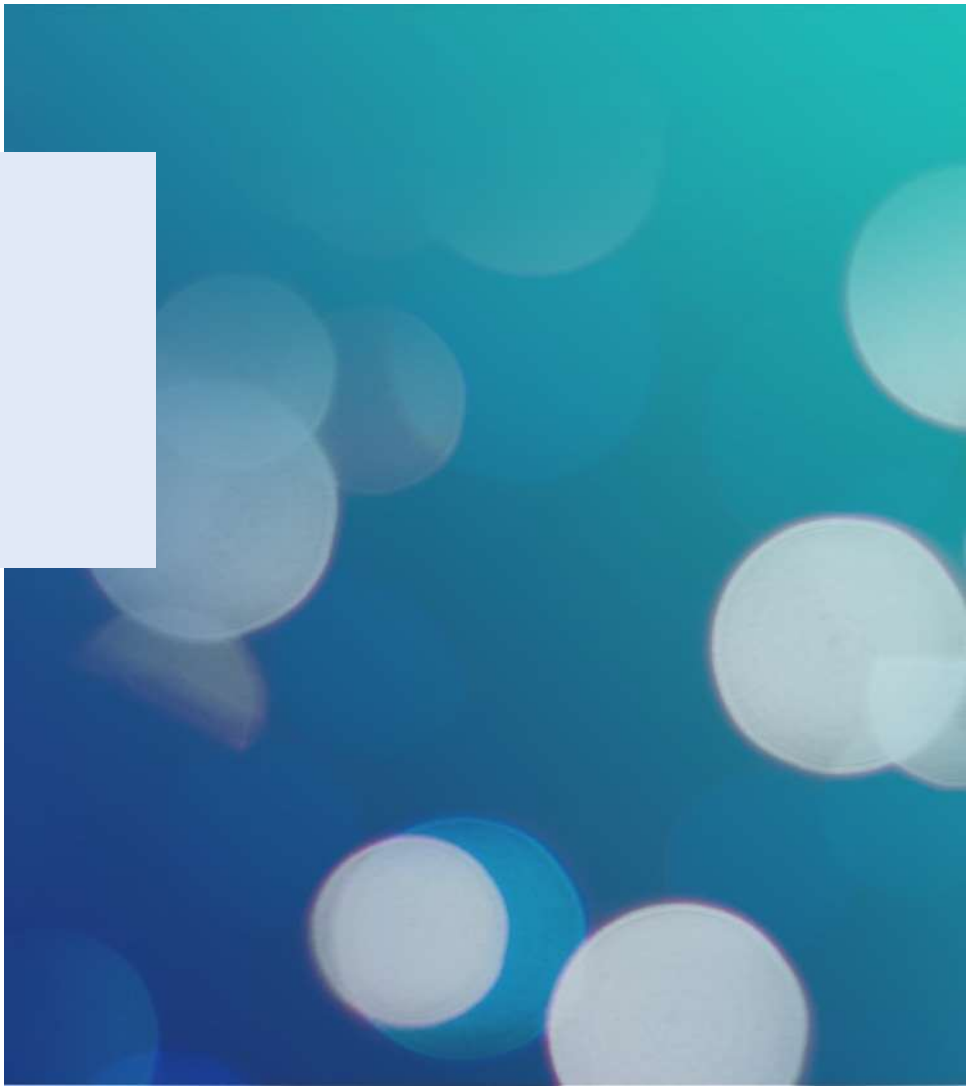
Appendix 3
Strategic Partnering

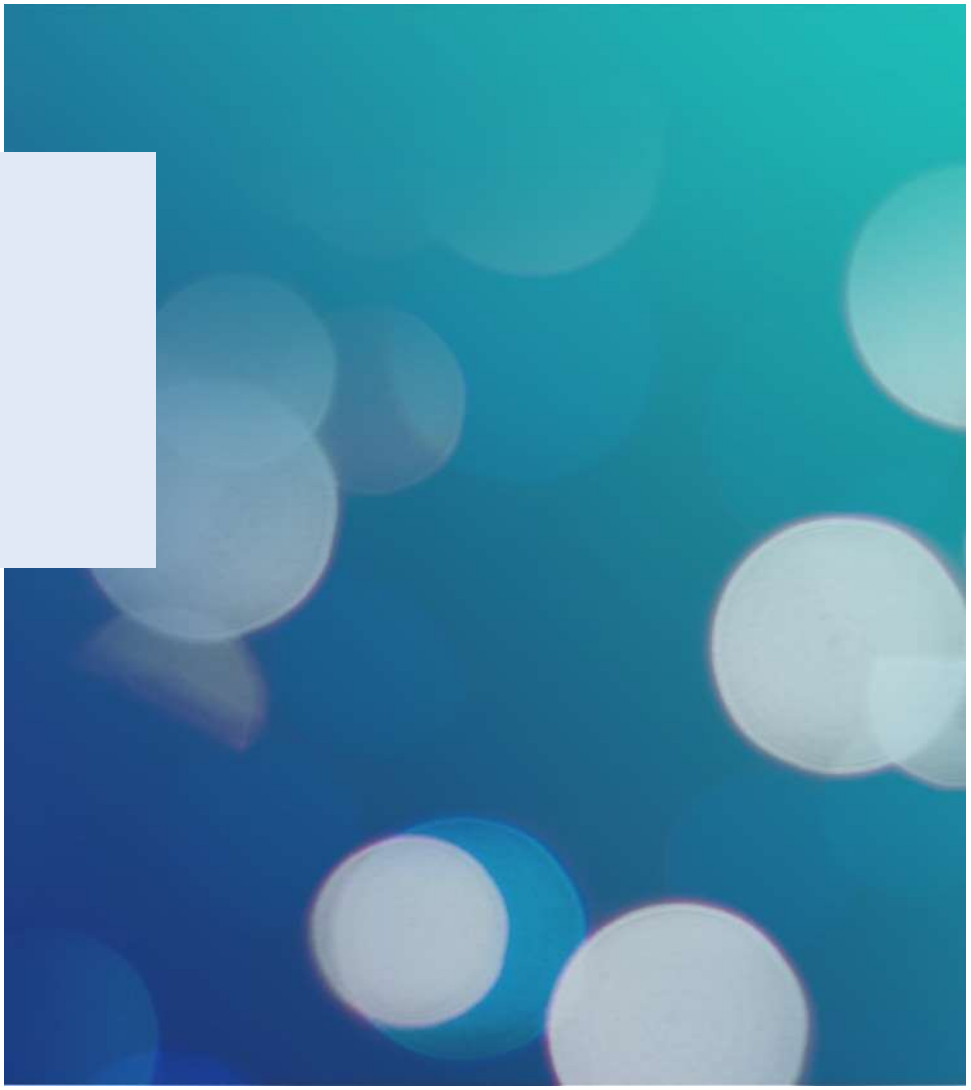


Strategic partnering – (example) supplier/partner scorecard

Reaching out to the market could be conducted in various ways, from generic through to specific. The supplier scorecard needs to be created for the specific situation, matching at our internal criteria.

Topic	Score	Basis for score
Vendor demonstration		
Timeliness		Extent to which the vendor adhered to the set deadlines for preparing and submitting material
Completeness		Extent to which all questions were answered and addressed in sufficient detail
Quality		Overall impression in terms of quality
Profiles		Breadth and quality of the resource profiles provided
Company information		
Company size		What is the size in terms number of employees, and how did that develop over the last 5 years?
Company turnover		What is the company turnover, and how did that develop?
Areas of expertise		What different areas do they operate in, and to what extent is that aligned with our Digital agenda?
Staff turnover		In %, but more important to know to what extent this is the case for the capability in scope.
Relevant experience		What similar type of work for the requested capabilities have they completed in the last 3 years?
References		Did the company provide references and/or opportunities for reference interviews?
Partnerships		What (technology) partnership ecosystem does the organisation have?

Appendix 4
Solutions considered for the models of care



Appendix 4: Solutions considered for models of care

The following slides describe the examples of digital solutions and were used as references in the Models of care workshops to help illustrate how existing technology solutions are in use the following areas:

- Diagnostics
- Maternity
- Neonatal
- Paediatrics
- Oncology
- Outpatients
- Surgery
- Women's Health
- Urgent Care

Ibex Medical Analytics

Diagnostics, Cancer

AI-based decision support tool reducing cancer diagnosis error rates and improve efficiency.

The Challenge

There's constant growth in the number of diagnostic tests each year, but no growth in the number of pathologists, leading to capacity issues. The majority of labs are run manually, but digital tools can reduce the average time a pathologist spends on the simpler cases and allow them to spend more time on the more complex ones.

While it's difficult to know the real rate of error in pathology, errors are estimated to occur in 0.5-5% of cases. A missed cancer ("false negative" error) may result in significantly poorer prognosis, whilst false positives cause avoidable stress for the patient.

The Solution

Ibex applies AI to cancer to reduce diagnostic error rates and improve efficiency. The company's AI-based algorithm analyses biopsy images and can detect and grade cancer and other anomalies. It is the first-ever AI-based cancer diagnosis solution in routine clinical use in a pathology lab.

The Benefits

Ibex increases accuracy at pathology labs by using AI-based decision support to focus pathologists' attention on the cases with higher probability of being cancerous and using AI-based quality control on 100% of cases (currently, quality control is performed randomly on 0-10% of cases)

Ibex helps reduce the average time pathologists spend on cases, reduce costs and shorten processing times

Source: http://www.ibex-ai.com

LifeBox

Diagnostics, Surgery

Digitises patient assessment for surgery, increasing efficiency and improving outcomes.

The Challenge

All surgical patients must undergo a pre-assessment to ensure suitability for the procedure and inform them of the benefits and risks of undergoing it. It is a labour and paper intensive process, which is inefficient. Twelve million people undergo procedures each year with an estimated cost of between £54 -£74 per assessment.

The Solution

Founded by hospital doctors, software engineers and business managers, LifeBox digitises patient assessment for surgery. It drives clinical excellence into pre-assessment, increasing hospital efficiencies and clinical outcomes and reducing costs.

The Benefits

LifeBox has the capacity to save the NHS over £500m if cost savings are repeated.

In LifeBox's first hospital contract, which lasted three years, it made cost savings of over £56,000 per 5000 patients and delivered a return on investment in just six months

In its second contract, after one month, the staff time taken in pre-assessment was cut by one third, releasing time and increasing capacity

Source: https://lifeboxhealth.com

White Swan

Diagnostics

Accelerates the path to diagnosis for undiagnosed people with symptoms

The Challenge

In the UK, 20% of GP consultations deal with medically unexplained persistent symptoms (MUPS). This equates to 68M GP appointments, approximately 5M sufferers, and an NHS cost of £3.06bn per annum.

This does not include the 20-50% more outpatient costs and 30% more hospital visits that MUPS sufferers generate. Rare diseases in particular have a long delay to diagnosis – on average 5.6 years, 8 clinicians, and 3 misdiagnoses before the correct rare disease is identified.

The Solution

White Swan is a registered charity which accelerates the path to diagnosis for people with symptoms. It improves treatment effectiveness and helps to prevent illness. It leverages proprietary technology and leading-edge data science to work across a variety of areas including mental health, dementia, arthritis, and rare diseases.

The Benefits

Reduces the cost to the NHS of treating people with medically unexplained persistent symptoms (MUPS), by expediting diagnosis.

Reduces anxiety in MUPS sufferers relating to a lack of diagnosis.

Prevents conditions escalating, leading to fewer invasive exploratory procedures

Source: https://whiteswan.org.uk/

SkinVision

Diagnostics

Skin cancer diagnosis as accurate as a dermatologist, using a smartphone

The Challenge

Skin cancer is the most common kind of cancer in the UK, with its incidence rising rapidly. The prognosis is highly dependent on whether the cancer is detected at an early stage and treatment costs vary from £600-100,000, depending on the stage.

The UK also has a shortage of dermatologists, and with many unnecessary referrals made to them via GPs, there is building pressure on dermatology diagnostic services.

Skin cancer treatment costs for the NHS are predicted to be £180M in 2020, plus another one billion on consultations.

The Solution

SkinVision drives early detection of skin cancer by transforming your smartphone into a medical device that is as accurate as a dermatologist. SkinVision's CE certified machine learning algorithm analyses an image of a skin spot and gives a risk assessment within 30 seconds.

The Benefits

SkinVision enables healthcare professionals to spend more time treating and supporting patients with malignant skin lesions. It:

Reduces 70% of GP visits for a suspicious skin spot that are unnecessary

Reduces urgent referrals to a dermatologist, of which over 50% are unnecessary

Drives early detection of skin cancer, which improves health outcomes, and could halve the overall cost of skin cancer treatments.

Source: http://www.skinvision.com

Transnasal Endoscopy

Nottingham University Hospitals NHS Trust

The Challenge

The current demand for upper and lower qastro-intestinal endoscopy services alongside pathology, which provides key diagnostic tests for cancer, is high and continues to increase. This has been amplified with the faecal occult blood test, now replaced by a Faecal Immunochemical Test test.

The NHS Long Term Plan (LTP) has laid-out a strong commitment to the improvement of cancer services, with ambitious targets in place to increase survival rates, likely to place further demand on services.

This demand, coupled with a serious lack of capacity to match the need both in infrastructure and staffing, is resulting in a knock-on effect on waiting times across endoscopy departments in the UK.

The Solution

One way to help ease the burden on endoscopy services, and meet this LTP aim, is through the introduction of a *Transnasal endoscopy service*. An alternative to conventional oral gastroscopy, Transnasal endoscopy utilises a super slim scope which can be inserted through the nose, avoiding the gag reflex and making the procedure more comfortable for patients.

The Benefits

A Transnasal procedure requires minimal, or in the majority of cases, no sedation, enabling quicker patient recovery and reducing personal inconvenience.

This also leads to an increase in throughput, allowing the hospital to carry out more gastroscopies per session, reducing cancer waiting lists and freeing-up procedural time and resource for more complex procedures.

Transnasal service can also be delivered in an outpatient setting; this presents an opportunity to free-up vital clinical space within the dedicated endoscopy unit. As a result of changing the clinical setting, a trust can prioritise more urgent cases, which could also ease waiting times.

A further benefit associated with outpatient Transnasal services is the potential to upskill and champion the role of Nurse Endoscopists. With the challenge to maintain staffing levels, Nurse-Led Transnasal services could have a positive impact on the cancer outcomes laid-out in the LTP

Source:
https://gut.bmj.com/content/67/Suppl_1/A42.2?utm_term=consumer&utm_content=012020&utm_campaign=usage&utm_medium=cpc&utm_source=trendmd

https://bmjopen.bmj.com/content/9/12/e030467

Pathology-Flow Cytometry

Diagnostics

Cambridge University Hospitals NHS Foundation Trust

The Challenge

Pathology in the UK is facing considerable challenges with demand increasing. Consolidating the provision of services into a 'hub-and-spoke' model is expected to deliver sustainable savings and greater flexibility to meet future needs.

In this model, the 'hub' laboratories serve as centres for handling specialised and non-specialised analyses across providers and the 'spoke' labs afford the necessary on-site services and capability for the turnaround of essential point-of-care tests. With an ageing population and new diagnostic tests, volumes are expected to rise year-on-year when there are already significant stresses on laboratory capacity, processes and staff. It is unlikely that incremental improvements in current processes will be sufficient to cope with the future system needs.

The Solution

The laboratory team at Addenbrooke's Hospital, Cambridge has demonstrated how a collaborative approach to meeting future needs can help.

A new technology: flow cytometry was trialled, involving equipment, which comprised of a sample preparation unit linked to a sample analysis unit. During the trial, the equipment reduced the number of manual processing tasks by 67% and reduced the number of critical error prone steps (errors that could affect the patient) per run by 100% (from 25 to 0) 25.

The Benefits

The sample processing time and in particular the variability in time to results was reduced, alongside significant improvements in sample, reagent and process traceability with a shift from paper to electronic records helping meet KPI and ISO compliance. The solution proposed also freed staff time to focus on more patient-centric care – diagnostics not paperwork

Source: https://jcp.bmj.com/content/56/2/129.share

MRI Compressed Sensing

The Challenge

The UK has fewer MRI and CT scanners per capita than most OECD countries, yet, the number of patients referred for diagnostic testing continues to rise. This is having detrimental impacts on the radiology workforce, with radiologists and radiographers showing signs of stress and burnout in part due to longer working hours, a factor in taking an early retirement or a change in career. The use of MRI is predicted to increase further, due to an increase in chronic conditions.

The Solution

Since its introduction, magnetic resonance (MR) has been challenged by the time needed to reach a diagnosis. Today, the imperative to shorten MR examinations without reducing image quality has become even more urgent due to the increase in chronic conditions and an increase in productivity is therefore critical. Compressed sensing is a signal processing technique built on the fact that signals contain redundant information. In magnetic resonance this technique is used to reconstruct a full image from severely under -sampled data) more quickly, whilst maintaining high image quality.

The Benefits

The latest advanced systems deliver better image quality, even for challenging patients, and perform MRI examinations up to 50%[1].

Faster with acceleration for all anatomies in both 2D and 3D scanning. Furthermore, immersive audio-visual experience is delivered to calm patients and guide them through the scan.

Through advanced compressing sensing, radiographers and radiologists can accelerate their imaging examinations while maintaining image quality.

This approach increases productivity, precision and diagnostic confidence, whilst delivering an enhanced patient experience.

References: 1-Based on Philips Compressed SENSE versus imaging without Compressed SENSE; information on file with Philips Healthcare UK.': https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4984938/

Blood Culture Incubator

Neonatal, Diagnostics

The Challenge

The NHS Long Tern Plan (LTP) has set an ambitious target to achieve a 50% reduction in neonatal mortality by 2025.

At present, early onset neonatal sepsis is a significant cause of neonatal mortality and morbidity. The early initiation of antibiotics in babies suspected of having the condition is critical. Once 36-hour blood culture results are available, and provided that the neonate remains well with reassuring C-reactive protein levels, antibiotics can be stopped.

Delays in the availability of 36-hour blood culture results can lead to prolonged and unnecessary hospital stay of clinically well neonates and their mothers who have been started on antibiotics because of risk factors and have reassuring CRP levels. These delays have been put down to two main reasons:

Delayed transportation (Non-specific and variable collection times dependant on availability of hospital porters)

Blood cultures not placed in incubators out of hours (Lack of on-site microbiology staff out of hours to place samples in the incubator).

The Solution

Blood culture incubators can be utilised to eliminate these delays. The system allows blood cultures to be placed immediately into the incubator by clinicians taking the samples from the neonates. It provides data management with enhanced blood culture observation, in and out of the laboratory, helping reduce workflow interruptions and communicate preliminary or final results to caregivers.

The Benefits

Enables the timely availability of results for neonates who are clinically well and awaiting results prior to stopping antibiotics and being discharged.

Improved patient care through quick discharges from hospital,

Improved hospital bed turnover and antibiotic stewardship by preventing unnecessary prolonged antibiotic treatment.

Significantly reduce the median time of hospital stay by 20.4 hours.

Source- https://adc.bmj.com/content/103/Suppl_1/A169.2

Badger in Paediatric ICU

Paediatrics

Alder Hey Children's NHS Foundation Trust

The Challenge

Alder Hey Children's NHS Foundation Trust, a specialist children's hospital that provides acute and community services to over 275,000 families annually in the North West of England and Wales. PICU is the 3rd largest PICU in the country, 24 bedded (21 open beds) with 1000 admissions per year.

The goal was to develop the neonatal electronic patient record system BadgerNet for use in the Paediatric Intensive Care setting. When the system was initially deployed it was brought in as the Trust computer system was not fit for purpose and did not answer the needs of modern 21st century healthcare.

The Solution

The Medical Summary system was deployed which allowed medical documentation including admission, clinical summary and discharge letters to be completed. Workflows for each staff group were created to calculate potential time saving benefits and on paper/printing costs/searching for notes. Robust patient journeys and support from the Clevermed team about the wider possibilities for Badger (such as report creation) were trailed. The next phase after EPR is digital patient care record. This encompasses all the patients observations, blood results and often links several systems together to allow clinicians a view of everything known about the patient in a convenient and concise way.

The Benefits

A full clinical record is recorded and saved as a Care Episode. All the clinical, nursing and allied health notes are saved in one place. There are interfaces to blood results, blood gases and observations (including ventilator data) which give a complete picture of the patient's stay

The Badger system is well established in neonatal services in Great Britain so we benefit hugely from all their data coming into our system. We can see when lines were placed, review their clinical records and see patients who have been transferred back to a neonatal unit following surgery. This detail would be impossible without a joined up system.

Badger links a patient's record to their NHS number so that wherever on the system they are, if a care location has cared for them they can access a read only view of their other records. This has been invaluable for many of our neonatal patients and allows for on-going holistic care. Also referring clinicians are able to see all the observations and results in real-time from their own computer.

Source: Global Digital Exemplar

https://alderhey.nhs.uk/application/files/2215/6450/2932/Digital_Futures.pdf

Andiamo

Paediatrics

A medically effective orthosis solution using big data and 3D printing

The Challenge

Current 3D scanners are not easily used due to the subject being scanned having to stand and also the use of land marking. A scanner and appropriate techniques needed to be developed that combined high-speed data capture, accuracy, universal data format, the ability to pick up different skin tones, ease of use, affordability and transportability for use in places such as the child's home or school.

This would change the way of acquiring orthotics for disabled children and thereby reduce the waiting time from 13 weeks to 48 hours.

The Solution

Andiamo is a healthcare solutions using big data and 3D printing for disabled children a platform that utilises artificial intelligence (AI), 3D scanning, simulation and 3D printing to deliver custom-made orthoses to children with conditions such as cerebral palsy, spina bifida and scoliosis.

Using advanced technology enables the company to deliver orthoses with significantly improved functionality and at a lower cost, when compared to those built using more established processes.

Software platform that rapidly standardises the patient's information and turns it into a file that could be 3D-printed

The Benefits

As of 2 March 2020 Andiamo completed a two-year project with Barts Health NHS Trust on the feasibility of implementing this in the NHS.

They are waiting for the peer review of that research, but early indications point to a very positive outcome

Source: https://andiamo.io

https://develop3d.com/profiles/empathetic-engineering-andiamos-awesome-orthotics/

MIRA – Musculoskeletal

Paediatrics

Over 20 UK organisations using it

The Challenge

Physiotherapy can be a difficult and sometimes painful process. Treatment plans can be cumbersome and a slow recovery dis-empowering. This, in turn, often results in patients not following their recommended exercises, delaying recovery even further. To help keep individuals engaged in their therapy, MIRA is taking a new approach, providing tasks as entertaining activities.

The Solution

MIRA turns physiotherapy exercises into video-games, making therapy easier to follow. It uses simple motion capture technology to assess and track patients during their exercises, while providing gaming environments for the patients to “play” their exercises in. In this way, patients are playing, when actually following the recommended therapy treatment.

MIRA is designed as a tool for the therapists, allowing specialists to easily customise MIRA to fit their patients’ conditions. This offers a greater accessibility, leading to consistent uptake and speedy recovery for the patients. It also supports therapists, reducing workload and waiting times at clinics.

The Benefits

MIRA can be used for different musculoskeletal (MSK) or neurological conditions and is suitable for use by patients aged two and above.

Over 20 organisations across the UK are using MIRA. The Royal National Orthopaedic Hospital NHS Trust have successfully piloted the system and Great Ormond Street Hospital NHS Foundation Trust are using it since summer 2018.

Makes physical therapy more engaging for patients recovering at home or at the clinic.

Makes physical therapy more manageable for clinicians, allowing them to better keep track of their patients.

Allows customers to expand their market reach, reduce costs and offer innovative and high-quality care.

Source: http://www.mirarehab.com

Digital solutions enabling outpatients service delivery

These Video consultation platform and home monitoring providers are NHS compliant and have been regulatory-approved typically via national Academic Health Science organisations

Video consultation platforms
Livi -GP mostly, but have offer for secondary care
QDoctor - GP mostly, but also already working with 111 in Leeds and virtual Cardiology Outpatients in Lewisham
Push Doctor - GP mostly, but have offer for secondary care
Visionable - flexible platform that share multiple data feeds, not just video, e.g. they are piloting “smart ambulances”
Attend Anywhere - specifically for virtual outpatients, have national contracts with NHS England and NHS Scotland
Ortus iHealth - specifically for virtual outpatients. Have a more comprehensive offer than the above, for managing all outpatient activities end-to-end. Used at Barts, London
Dr Julian - mostly aimed at IAPT services but they can offer just the video platform or can provide therapists for more complex patients
Home monitoring (with smart measuring device for home, coupled with a clinician dashboard for remote monitoring)
Medopad - generic platform, broadly applicable
Inhealthcare - generic platform, broadly applicable
Ampersand Health - mostly inflammatory disease/rheumatology
Living With - mostly urology
SmartMed - broadly applicable but has specific modules for gestational diabetes. Smaller presence in UK huge in Malaysia
Hampton - specific to pre-eclampsia and gestational diabetes
Spirit Digital - non-Accelerator. Specific to COPD
myCOPD - Have lots of other versions of my[disease] apps too
CarePredict – Wearable for seniors monitoring daily activity and behaviour patterns

Technology to improve attendance

Imperial College Healthcare NHS Trust

By Q2 2019, the Trust's DNA rate had fallen to 10.7%, and was the lowest amongst comparator trusts in London. Email is now the route of communication for 27% of follow up, and 22% of new appointment, letters sent by Xerox. Patients receiving email appointments are 25% less likely to DNA than those that receive letters in the post

The Challenge

In September 2014, the CQC rated Imperial's outpatient services as inadequate, citing the Trust's 17% did not attend (DNA) rate and the "poor administration of appointments".

The Solution

To improve their communication with patients they have embraced electronic solutions.

A text reminder service was introduced in early 2015 and in Autumn 2016, appointment letters started going out via the Xerox hybrid mail system, which sends documents by email where there is a valid email address available and by post if not.

In September 2018, they adjusted their kiosk outpatient check-in process so that verifying an email and mobile number automatically triggered an invite to register for the north west London patient portal.

The Benefits

By Q2 2019, the Trust's DNA rate had fallen to 10.7%, and was the lowest amongst comparator trusts in London.

Email is now the route of communication for 27% of follow up, and 22% of new appointment, letters sent by Xerox.

The use of email is effective and cost saving: patients receiving email appointments are 25% less likely to DNA than those that receive letters in the post and the hybrid mail system is on track to deliver £1m of savings over the four year Xerox contract.

30,000 patient have now registered for the Care Information Exchange patient portal.

Imperial now has centrally funded access to four 'attend anywhere' waiting rooms for 12 months, to offer patients the option of a video consultation (VC) in place of a face to face outpatient appointment. This pilot represents a very timely opportunity to enable the Trust to deliver on its strategic commitment to have 25% of follow up outpatient appointments carried out virtually.

Source https://shelfordgroup.org/using-technology-to-improve-attendance-at-imperial-college-healthcare-nhs-trust/

AI to predict DNAs in outpatient care

University College London Hospitals

High Dimensional models may not only predict attendance, enabling targeted intervention, but also prescribe it by matching detailed appointment and patient characteristics

The Challenge

Failure to attend hospital appointments needlessly delays clinical care and consumes resources better spent on improving quality.

The Solution

The fact that attendance rates have remained relatively unchanged over the past 10 years suggests the problem is anything but simple.

Combining machine learning with large-scale data allows UCLH to create rich, complex, high-dimensional models able to operate within wider causal fields.

Such models may not only predict attendance, enabling targeted intervention, but also prescribe it by matching detailed appointment and patient characteristics.

By capturing individual variability better, they may also be used to infer systemic, modifiable hospital causes of non-attendance currently obscured by the many other factors in play

Focusing on an important exemplar of hospital outpatient scheduling – magnetic resonance imaging (MRI) – we sought to answer two related questions: what is the relationship between the complexity of predictive models of attendance and their predictive performance, and can sufficient predictive performance be achieved to render targeting cost-effective?

The Benefits

Models were trained and evaluated on an unselected set of 22,318 consecutive scheduled MRI appointments at two of the Trust's hospitals.

Optimal predictive performance required 81 variables.

Simulations showed net potential benefit across a wide range of attendance characteristics, peaking at £3.15 per appointment at current prevalence and call efficiency.

Source: https://shelfordgroup.org/university-college-london-hospitals-using-ai-to-predict-dnas-in-outpatient-care/

Patient Portal and Video Clinics

University Hospitals Birmingham NHS Foundation Trust

Utilising remote access to clinical information has improved the patient experience and time efficiencies, as well as the trust benefiting from improvements in capacity and administration.

The Challenge

To explore the benefit of technology in outpatients through a Patient portal for remote access to clinical information and use of Video technology for outpatient consultations.

The Solution

myHealth@QEHB is a leading-edge patient records portal to allow patients to remotely access some of their clinical information held by the Trust – for example letters, appointments and laboratory results.

Patients can submit information direct to their healthcare professional, allowing them to instantly see the updates and respond. Patients can store and share files pertaining to their health on the system, view and add their own appointments at and away from the hospital, as well as receive reminders, etc.

Video clinics (myVideoClinic), allows patients and consultants to engage in online, voice and text chat conversations for follow up appointments as part of their care. This service is to improve patient and clinician experience and utilise clinic capacity more efficiently.

The Benefits

myHealth@QEHB saved over 54% of responders a call to the hospital which, on the assumption of five mins per call, this equates to saving almost a week of NHS employee time

Patients who live miles away from the hospital with chronic conditions have reported that having access to myHealth@QEHB and having a direct line of communication with the hospital has allowed them to manage their conditions without having to be at the hospital in person.

There are nine specialties using Video Clinics and there are already a benefits that are being seen including reduction in travel time and expenses, less time off work, improved record of consultation, greater involvement in healthcare and more clinic capacity.

Source: https://www.wmahsn.org/programmes/view/myhealthqehb

Virtual care for patients referred to ENT services

Manchester University NHS Foundation Trust

The combined impact from a series of capacity releasing initiatives for ENT procedures, will increase capacity in excess of 1,000 additional appointments per year

The Challenge

Ear Nose and Throat (ENT) is a challenged speciality for Referral to Treatment (RTT) and has a high demand for consultant-led outpatient appointments.

The Solution

The service identify opportunities for releasing capacity to see new patients by:

Mapping booking and scheduling pathways

Analysing data for all sub-specialties including activity and capacity and demand

Interviewing staff to identify areas of good practice and opportunities to improve

Reviewing compliance against national guidelines and identifying potential new models of care.

Workshops were held with both clinical and operational staff to identify the actions required for each improvement area and to identify alternative models for outpatient appointments.

The Benefits

Advice and guidance service for GPs and GP referral protocols for Globus patients to reduce the number of patients discharged at first appointment due to inappropriate referrals..

Hoarseness and general balance MDT clinics to increase the capacity of the number of patients that can be seen in consultant-led clinics

Increase in ENT diagnostic reporting capacity, prompt for safety blood requirements on the diagnostic laboratory request system and local phlebotomy to reduce delays due to diagnostics

Head and neck cancer follow-up schedules and nurse-led follow-ups, allergic rhinitis one stop clinics, and well-defined discharge criteria for Globus patients to reduce the number of consultant-led face to face follow-up appointments.

Chronic rhinitis open access follow ups to reduce DNA rates due to greater patient choice

Source: https://shelfordgroup.org/expanding-the-range-of-virtual-care-for-patients-referred-to-ent-services-at-manchester-university-nhs-foundation-trust/

Buddi Wearables to promote self care in diabetes patients

Across south east London

The Challenge

King's Health Partners, the Academic Health Science Centre for South East London, works with three large trusts and the primary care systems in south east London to support advancements in research and patient outcomes. The Institute for Diabetes, Endocrinology and Obesity has worked with the national diabetes prevention team to trial the impact of wearables for patients with type two diabetes

Type 2 diabetes currently causes around 22,000 early deaths in the UK each year and costs the NHS £1 million per hour. It is estimated that there will 42% more people with diabetes in London by 2025.

The Solution

King's Health Partners and Buddi, a pioneering technology company, have joined forces to help prevent type 2 diabetes in those patients most at risk of developing the disease. The one-year randomised control trial, partially funded by Innovate UK, worked with 200 patients in the London boroughs of Lambeth and Southwark.

Patients with prediabetes are at a critical point where rapid intervention to promote lifestyle changes can help prevent the onset of diabetes and thereby avoid medication and associated health complications

King's Health Partners and Buddi are aiming to demonstrate that a wearable technological intervention coupled with personalised motivational information can reduce weight and increase physical activity; the two important risk factors for type 2 diabetes.

The Benefits

To test this, Buddi has developed a digital health system which gathers patient data on activity, eating behaviours and feelings about their diabetes self management. The system will then analyse and feed back supportive and motivational interventions to encourage the patient to change their behaviours.

Source https://shelfordgroup.org/introducing-wearables-to-promote-self-care-in-diabetes-patients-across-south-east-london/

CarePredict – wearables for seniors

USA-based

The world's first wearable for seniors that autonomously observes changes in their daily activity and behaviour patterns uses (AI) and machine learning.

The Challenge

Seniors suffer from proportionality worse health in various …. Seniors are 2-4 times more likely to suffer from depression than younger adults are (1). Malnutrition also affects up to 25% of seniors at home (2). It has been discovered that in every 19 minutes, an older adult dies from a fall (3). The appeal to reduce inpatient attendance has led to a requirement for advanced outpatient support, particularly for the vulnerable, older population.

The Solution

CarePredict is a wearable device that tracks small changes that may indicate a serious issue, before it happens. The wearable device can track a vast array of patterns including food consumption, sleep, location pattern, and activity tracking such as cooking and bathing. Such activity tracking enables early indication of risks such as depression, falls or malnutrition. The device is powered by AI which monitors the user's activity and can produce overall activity scoring, pattern identification and also enables over time tracking to compare against normal patterns.

The Benefits

The CarePredict model enables preventative care for outpatients whilst they are in the home setting. By targeting some of the leading risks of health disadvantage in older persons, before the risk happens, it can support prevention of ill-health or falls.

The device contains smart sensors that recognise, oearn and track daily activities, even UV light exposure. These intelligent sensors detect falls and provide location insights. The wearable also has a built-in alert button and a two-way audio facility. It is easy to use and easy to charge – with a simple swappable battery meaning it never has to be taken off to charge.

Sources:

1/2 International Journal of Community Medicine and Public Health

3 National Council on Aging

Digital solutions enabling, Women's Health, Urgent Care, Oncology, Elective Surgery

Category name
Telemedicine fetal ultrasound - Ultrasound screening and diagnosis of fetal abnormality
OWise Breast Cancer - allowing people with breast cancer to have more control
Online Elective Surgery Preoperative Assessment - enable patients to answer questions about their health before surgery
MyPreOp® Patient-driven Preoperative Assessment- general health and medical history, digitally submitted by patients
A&E Online - virtual A&E- "artificial intelligence triage" patient online check
Virtual Fracture Clinic - Virtual triaging the most urgent cases prior to presentation in the fracture clinic.
SHREWD WaitLess- mobile app that will help patients make an informed decision about where to get the best and quickest

Telemedicine fetal ultrasound services

Newcastle upon Tyne Hospitals NHS Foundation Trust

The Challenge

Ultrasound screening and diagnosis of fetal abnormality and wellbeing is universally offered with the aim of providing parents with accurate information to inform timely intervention. The caseload and complexity of pregnancy complications that can be managed locally in obstetric units is dependent on the availability of healthcare professionals with the expertise required to interpret fetal ultrasound images and provide appropriate counselling. Women are referred from their local obstetric unit to a specialised fetal medicine centre when a fetal anomaly is suspected or intensive fetal monitoring is required.

The Solution

A fetal telemedicine ultrasound service led by the Newcastle upon Tyne Hospitals NHS Foundation Trust (NUTH) was successfully implemented in 2015, linking the Fetal Medicine Unit with West Cumberland Hospital (WCH) in Whitehaven, Cumbria (North Cumbria University Hospitals Foundation Trust). Prior to the service being initiated, women living in Cumbria had significant journeys to access fetal medicine expertise at NUTH, with some families travelling up to six hours. The service was designed to improve access and reduce costs for women in Whitehaven who required a fetal medicine assessment and to enhance the standard of local obstetric ultrasound by developing local sonographers through telemedicine training.

The Benefits

The fetal ultrasound telemedicine service is fully established and currently provides one telemedicine clinic per week for women and families in Whitehaven, Cumbria.

To date, there have been 287 consultations successfully undertaken using the link, resulting in a substantial reduction in patient travel times and family costs.

There are plans to extend the service to include paediatric nephrology outpatient consultations and to establish fetal telemedicine links with other hospitals in the North East and North Cumbria region

Source: https://www.hra.nhs.uk/planning-and-improving-research/application-summaries/research-summaries/evaluation-of-fetal-ultrasound-telemedicine-service/

https://www.kingsfund.org.uk/sites/default/files/media/Elaine_Bidmead.pdf

OWise Breast Cancer

Women's Health | Oncology

The Challenge

Allows people with breast cancer to access to a range of tools and useful information about their condition in one place.

The Solution

OWise is the first mobile app and website to offer breast cancer patients personalised medical information throughout their treatment.

The app allows users to access their personal and treatment details wherever they are. Further, users can record how they feel, note down questions, keep a record of medical treatments and read information about treatment options within the app.

OWise is also designed to provide practical support with the aim of allowing people with breast cancer to have more control over their circumstance.

The Benefits

OWise is created by medical professionals, and has been selected by the NHS Innovation Accelerator and is listed in the NHS Apps Library. It was the first oncology app to be used as a case study by the National Institute of Health and Care Excellence (NICE). OWise has also undergone substantial scientific validation resulting in collaborations with renowned academic researchers and publications in peer-reviewed medical journals.

Evaluation\;

https://owise.net/uk/evaluating-digital-tool-for-supporting-breast-cancer-patients-a-randomized-controlled-trial-protocol-adapt/

https://owise.net/uk/patients-and-health-care-providers-opinions-on-a-supportive-health-app-during-breast-cancer-treatment-a-qualitative-evaluation/

Source: https://owise.net/uk/ and

https://www.owise.uk/pages/11/News.html: http://vimeo.com/67466501

https://owise.net/uk/evaluating-digital-tool-for-supporting-breast-cancer-patients-a-randomized-controlled-trial-protocol-adapt/

Online Elective Surgery Preoperative Assessment

Elective Surgery

Sheffield Teaching Hospitals NHS Foundation Trust

The Challenge

Sheffield Teaching Hospitals, with stakeholders, has established a project to support a reduction in the amount of time and number of visits patients make to the pre operative assessment clinic, while also aiming to help clinicians get as much information as possible about a patient's health and condition in advance of surgery.

The Solution

An electronic online questionnaire was developed by clinicians to enable patients to answer questions about their health before surgery. Questions were designed to get the maximum amount of information as possible and be consistent with a face to face nursing assessment.

Computers were set up in the pre-operative assessment areas to allow patients direct access following decision for surgery. All questionnaires are reviewed by clinicians to provide safe and effective care.

The Benefits

There have been over 12,000 patient completions to date with a high patient satisfaction and saving time and money for patients through reducing unnecessary appointments.

The Trust has also seen a reduction in unnecessary pre-operative investigations using an evidence-based approach and a saving of around 500 nursing hours per month.

This has helped direct resources to those who need face to face assessments and also helped to reduce waiting times for surgery by up to two weeks.

Source: http://epaq.co.uk/Home/PreOp

MyPreOp® Patient-driven Preoperative Assessment

Elective Surgery

The Challenge

Before an operation a person's fitness needs to be assessed by a registered nurse. A lot of time is spent collecting information from the patient. Many hospitals have paper-based systems which cannot automatically process the information or give guidance to the nurses about what preoperative tests and actions might be needed.

The Solution

MyPreOp® provides a patient-owned, cloud-hosted solution to these problems. Through the programme, the patient completes a comprehensive assessment of their general health and medical history, which is then digitally submitted to the healthcare provider. The clinical summary report highlights areas of concern and flags patients with complex co-morbidities who will need further consultations.

By facilitating one-stop preoperative assessment, MyPreOp® helps patients potentially avoid a further hospital appointment and saves time for healthcare professionals.

The Benefits

30% of patients completing MyPreOp® avoid having a face-to-face appointment

In the NHS this could save 1m outpatient appointments per year

78% of patients said they would be extremely likely or likely to recommend MyPreOp®

Avoiding an appointment saves mileage, carbon and patient transport costs.

Source:https://www.ultramed.co/mypreop

https://nhsaccelerator.com/portfolio/mypreop/

Online virtual A&E

University Hospitals Birmingham (UHB)

The Challenge

As part of a drive to reduce the use of A&E and outpatient appointments, UHB has decided to use online – live and automated – chat services, online symptom checkers and video consultations with doctors and nurses to help relieve the “unsustainable” pressure on services.

The Solution

People thinking about seeking help at A&E will be encouraged instead to undertake a two-minute online check of their symptoms before they go to hospital. The “artificial intelligence triage” will then tell them if they need to seek treatment or not.

Patients will also be able to talk to their consultant using their smartphone at home or work and not have to go to the hospital itself for an outpatient appointment. Consultations done that way would be more convenient for many patients, but would mean they no longer undergo a physical assessment of their health.

The Benefits

“The way patients access and receive healthcare in Birmingham will be unrecognisable in five to 10 years’ time, with technology playing a hugely enhanced role,” said Dr David Rosser, the trust’s chief executive. “This is the first case of technology of this kind being deployed at such a scale to aid the hospital sector.

The aspiration is to get 70% of our 2 million outpatient appointments on to this way of doing things within two to three years.

The trust also hopes to relieve the pressure on the A&E units at the four acute hospitals it runs in Birmingham by persuading the 30% of people it deems “avoidable attendances” because they have minor ailments to use the symptom checker instead. It will be branded as “A&E Online” or “UHB Online”.

Patients using the new ways of engaging with the NHS would avoid long queues in A&E, or be reassured that they do not need any medical attention after all, or be advised to see a GP or pharmacist instead.

Source

https://www.theguardian.com/society/2019/may/23/birmingham-to-begin-accident-and-emergency-online-chat-service-in-tech-revolution-for-nhs-care

https://onecall24.co.uk/nhs-to-sign-up-patients-for-virtual-ae-in-tech-revolution/

SHREWD WaitLess

Urgent Care

East Kent, Northamptonshire and Dorset

The Challenge

Performance against emergency departments' waiting time goals has declined over several years, with targets serially missed. Bed occupancy in our acute hospitals is hovering around 90%. Media stories describe overcrowded departments, long trolley waits, and ambulances stacked outside.

The Solution

Co-designed with the Encompass MCP and patient groups in East Kent and supported by East Kent CCGs. Drawing on Shrewd's access to real time feeds from minor Injury units and A&Es, WaitLess is a mobile app that will help patients make an informed decision about where to get the best (and quickest) access to minor injuries care with the combined shortest waiting and travel time.

The data drawn from NHS systems used by the different NHS providers, is combined with up-to-date travel information using google mapping and geolocation to help patients make an informed decision about where to go to get the quickest treatment for minor injuries.

The Benefits

Independent evaluation of the WaitLess app carried out in east Kent by the University of Greenwich, as part of the NHS Innovation Accelerator programme

This showed a 5% reduction in the number of people using levels 3 and 4 emergency departments

An 11% increase in the number with minor injuries or illnesses using urgent treatment centres.

Source:

https://www.bmj.com/content/366/bmj.l4495

https://www.transformingsystems.co.uk/shrewd-waitless/

Virtual Fracture Clinic

Urgent Care

King's College Hospital NHS Foundation Trust

The Challenge

Traditionally at King's, following assessment in A&E, all patients with an acute bone injury not requiring immediate on-call review, were booked into a fracture clinic. There was no method of triaging the most urgent cases prior to their presentation in the fracture clinic. Due to the overbooked clinics, for some patients their first appointment in fracture clinic could be two weeks following their injury

The Solution

Following the introduction of the Virtual Fracture Clinic model (VFC), all patients are now referred into a virtual review which takes place within 72 hours of their attendance at A&E.

There are written guidelines for the management of the most common injuries, so the care is standardised between all clinicians on both sites. The most appropriate treatment for their injury is now started immediately.

The VFC has run for six months at the Denmark Hill site and for three months at the Princess Royal University Hospital. It is expected to see approximately 10,600 patients each year across both sites.

The Benefits

Following VFC review, 48% of patients no longer require a face to face fracture clinic review. Most patients are on a self-management plan, or managed in hand therapy or physiotherapy.

All patients are advised to contact the VFC team if they do not improve as expected, for further review to be arranged, although very few require this. This shows a great reduction in the number of new patients in the fracture clinic.

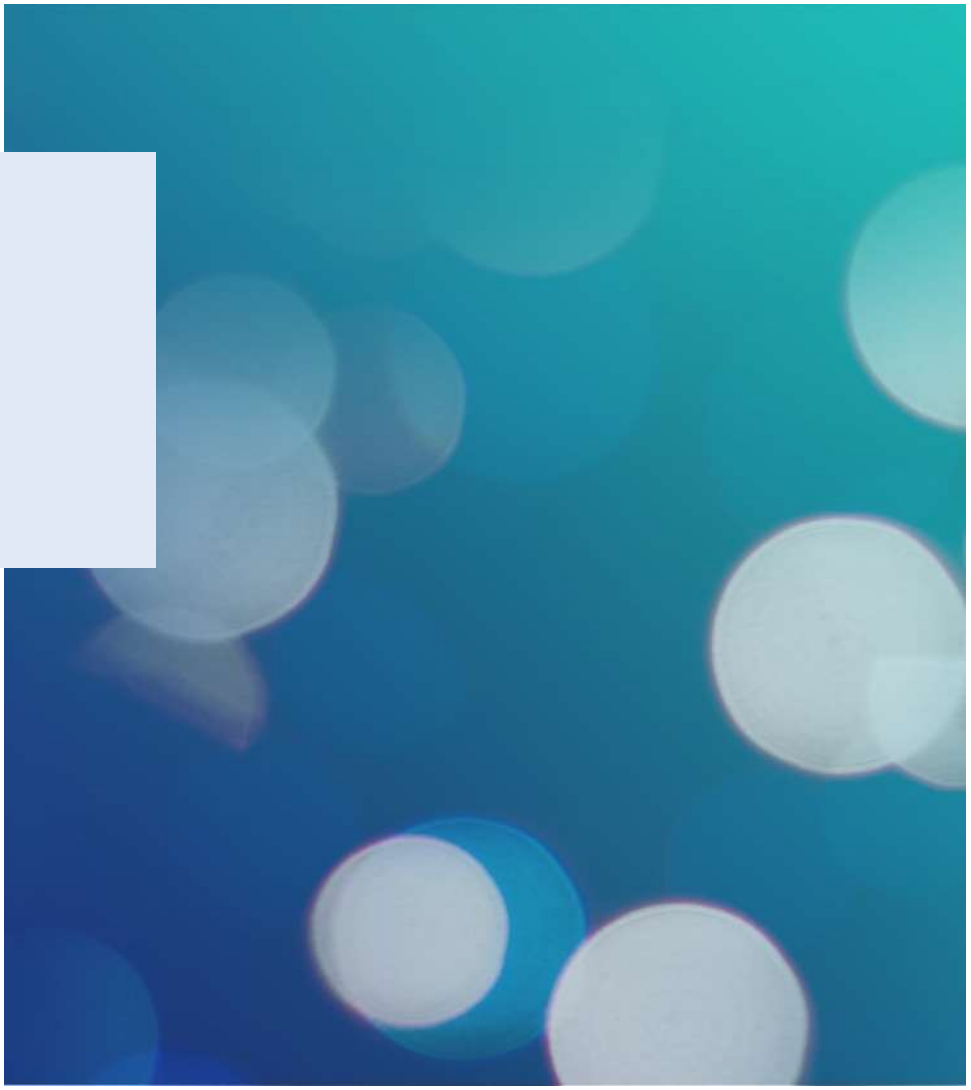
The VFC team worked with the Electronic Patient Record repatriation team to digitise the process. Electronic reports were also created for the VFC team to monitor and audit the referrals.

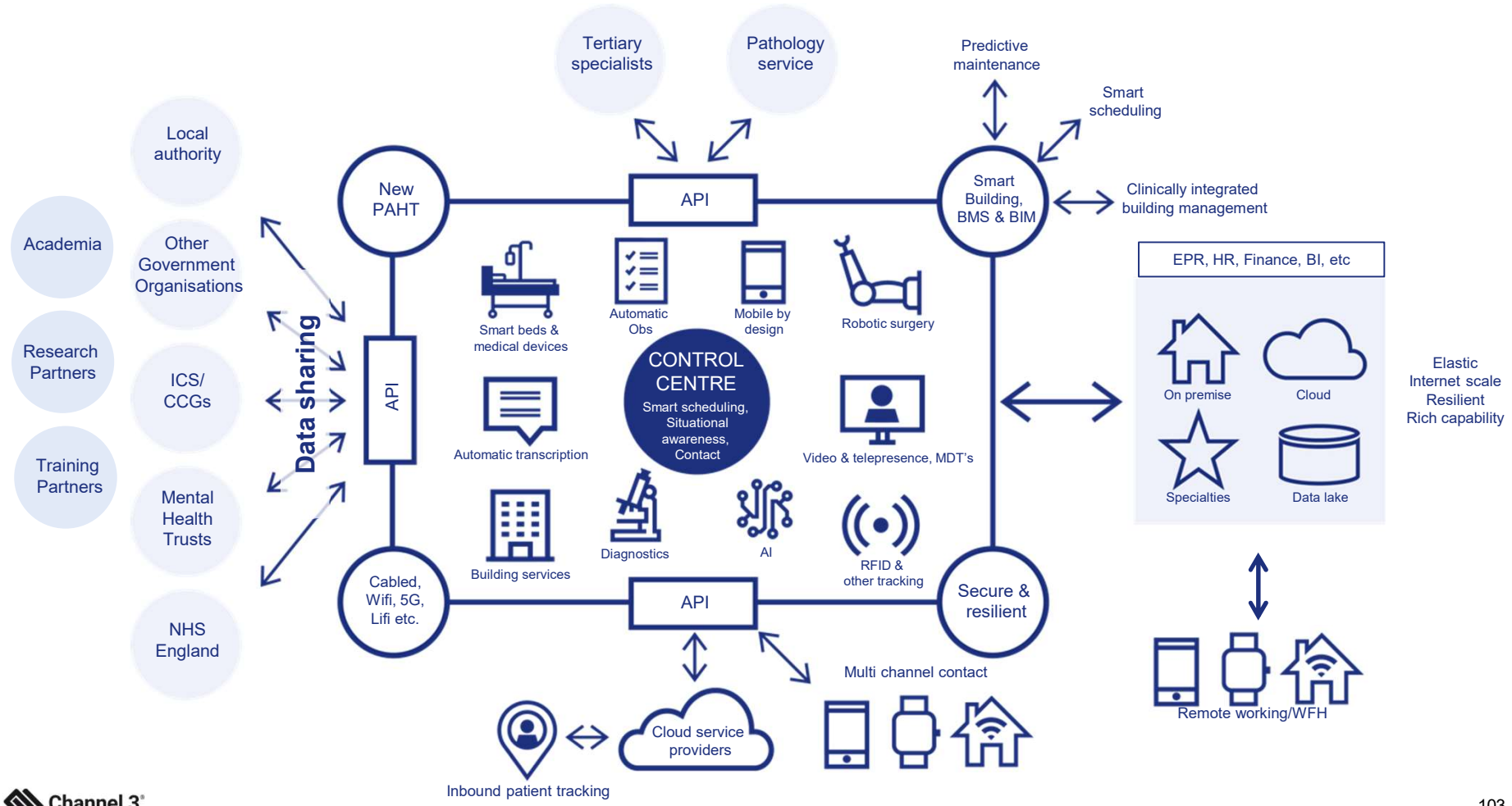
Each group within the team has a clear set of activities to complete and document within the system leading to standardisation of practice. The VFC team know the status of every patient referral. The data they enter into the system automatically adds to the GP letters meaning there is no re-entry of data and it is easily auditable VFC referral data.

Source: https://shelfordgroup.org/delivering-a-virtual-fracture-clinic-at-kings-college-hospital-nhs-foundation-trust

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5457647/

Appendix 5
hospital of the future
rich picture




Tertiary specialists
Pathology service
Predictive maintenance
Smart scheduling
Local authority
Academia
Other Government Organisations
Research Partners
ICS/ CCGs
Training Partners
Mental Health Trusts
NHS England
New PAHT
API
Smart Building, BMS & BIM
Clinically integrated building management
EPR, HR, Finance, BI, etc
Data sharing
API
Smart beds & medical devices
Automatic Obs
Mobile by design
Robotic surgery
CONTROL CENTRE
Smart scheduling, Situational awareness, Contact
Automatic transcription
Video & telepresence, MDT's
On premise
Cloud
Specialties
Data lake
Elastic
Internet scale
Resilient
Rich capability
Building services
Diagnostics
AI
RFID & other tracking
Cabled, Wifi, 5G, Lifi etc.
API
Secure & resilient
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Remote working/WFH
Cloud service providers
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