Beginning a joint digitally enabled transformation and learning journey in the English National Health Service

Full Report of the Independent Evaluation of the Global Digital Exemplar (GDE) Programme

Submitted to NHSX

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on behalf of GDE Evaluation team

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Arden&GEM
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Competing interests

All authors are investigators on the evaluation of the GDE programme (https://www.ed.ac.uk/usher/digital-exemplars).

Aziz Sheikh was a member of the Working Group that produced *Making IT Work* and was an assessor in selecting GDE sites.

Bryony Dean Franklin recently supervised a PhD student partly funded by Cerner, unrelated to this work, and works at Imperial College Healthcare Trust, which is one of the GDE sites, although not one of the in-depth study sites.

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No competing interests are reported for any other authors.

Foreword

The scale and complexity of the Global Digital Exemplar Programme has presented an exciting challenge for the Independent Evaluation team. Our work was only possible due to the cooperation of the participating provider organisations and from the Programme leaders who were extraordinarily helpful, sharing a wealth of information and experience. We have sought to capture and draw key lessons from this – summarised in this report as well as wider publications. We hope that this will help ensure that the valuable lessons (from difficulties encountered as well as striking achievements) can be carried forward and applied across the NHS.

The remarkable openness we experienced from programme leaders and participating organisation is a pointer to the positive culture of sharing that was established within the GDE Programme as it sought to foster a learning ecosystem to support a programme of digital transformation. Deepest thanks to the many individuals and organisations involved for their cooperation over the three years of the evaluation which continued beyond the COVID-19.

Robin Williams on behalf of the GDE Evaluation Team

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The Steering Committee included: Will Smart, Alex Chaplin, Tim Ellis, Andy Howlett, Mike Jones, Ann Slee, Rob Parker, Craig Baxter.

The Academic Advisory Group included: Professor Anthony Avery (chair), Professor Gordon Schiff, and Dr Philip Scott.

All data requests should be submitted to the corresponding author for consideration. Access to anonymised data may be granted following review.

Executive summary

Please note: the evaluation team continues to produce outputs, so these findings need to be viewed as evolving.

An ambitious and transformative initiative

- The Global Digital Exemplar (GDE) Programme is an ambitious first-of-type national initiative seeking to:
    1. *advance digitally enabled (service) transformation in selected exemplar NHS England provider organisations* already characterised by relatively high levels of digital maturity and bring them up to an international level, and
    2. *create a national learning ecosystem to spread the knowledge acquired*.

- The Programme was launched after the 2016 Wachter Review proposed a phased approach to digitising the English NHS as the scale of investment required to bring all provider organisations to digital maturity greatly exceeded available resources. The Wachter Review therefore recommended creating a cohort of digitally advanced exemplar provider organisations (hereafter GDEs) who would pass on their learning to less digitally-mature 'Fast Follower' provider organisations (FFs) and thereby catalyse large-scale digitally enabled transformation of the wider English NHS.

- Provider organisations that were shortlisted were invited to propose ambitious portfolios of digital change, to be implemented over two to 3.5 years. Provider organisations were selected in several tranches from December 2016. The GDE Programme involved 51 provider organisations including 3 ambulance provider organisations, 33 acute provider organisations and 15 mental health (MH) provider organisations. Of the 48 acute and MH provider organisations, 23 were GDEs and 25 were FFs, paired up to share knowledge.

- GDE acute provider organisations each received £10 million and FFs received £5 million. Mental health GDE organisations received £5 million, mental health FFs received £3 million, and three ambulance organisations shared £5 million. Central investment across all 51 provider organisations in the GDE Programme came to £302 million. Although significant, this represents a relatively small share of the total NHS digital transformation budget between 2016-17 and 2020-21 of £4.7 billion.[1] All organisations were required to secure internal matched funding. The internationally recognised Healthcare Information and Management Systems Society (HIMSS) Electronic Medical Record Adoption Model (EMRAM) was chosen as one of the guiding benchmarking criteria for the GDE Programme, with the expectation that GDEs and FFs would respectively achieve HIMSS Level 6 (with a plan for 7) and HIMSS Level 5 or equivalent accreditation by the end of the Programme. Limitations of this model and its applicability to the NHS were recognised, for example, by setting a lower EMRAM target (Level 5) for GDE mental health providers.

[1] https://www.nao.org.uk/press-release/digital-transformation-in-the-nhs/

- In addition to supporting digitally enabled transformation within selected provider organisations, the GDE Programme offered central support for the establishment of programme governance and delivery assurance arrangements as well as supporting various mechanisms for sharing learning, including the establishment of GDE-FF partnerships, Blueprinting (documents summarising implementation experience) and various learning networks to capture and share implementation experiences.

A learning programme

- *The GDE Programme learnt from earlier programmes*. It followed several years after the National Programme for IT (NPfIT), in which centrally procured frontline systems did not achieve optimal or anticipated local ownership and adoption thus limiting the value for money achieved. Learning from this and subsequent initiatives such as the Safer Hospitals Safer Wards, Nursing Technology Fund and the Integrated Digital Care Fund, the GDE Programme was a national initiative designed to optimise local ownership and accountability by allowing provider organisations flexibility on routes to digital maturity, within a structured framework of accountability (e.g. funding gates, progress monitoring and targets) to achieve digitally enabled transformation of services rather than merely to fund technology adoption.

- In keeping with the recommendations of the Wachter Review, an *independent evaluation* was commissioned. This evaluation has explored Programme processes and outcomes in real-time. Programme leadership incorporated feedback and recommendations from this evaluation and from other stakeholders throughout the Programme. Fifteen provider organisations were not included in the agreed scope of the evaluation (nine FF provider organisations that joined the Programme later, three that merged with other provider organisations in the course of the Programme, and three ambulance provider organisations).

- The independent evaluation was undertaken by a team from the University of Edinburgh, University College London, and NHS Arden & Greater East Midlands Commissioning Support Unit.[2] Its work was overseen by an Independent Steering Group chaired by Professor Anthony Avery from the University of Nottingham. The relationship between the evaluation team and Programme leaders was productive, open and honest, facilitating productive working relationships that helped to shape the Programme throughout.

- This report summarises processes, outcomes and lessons learnt to date. It is important to bear in mind that the outcomes of major digitally enabled transformation frequently occur in unanticipated ways and only become fully apparent in the long-term. In addition, the COVID-19 pandemic has affected the final year of the Programme as both an agent for acceleration of progress and a disrupter.

[2] see https://www.ed.ac.uk/usher/digital-exemplars/project-team

Findings

Beginning the journey to digitally enabled transformation

Overall, our work shows that the *GDE Programme largely achieved what it set out to do*, namely stimulating digitally enabled transformation and the sharing of knowledge between participating provider organisations and with programme managers. It also helped organisations to develop a roadmap of digitally-enabled transformation (and achieve international standards of excellence), engage clinical users, and establish baselines of digital maturity against which they could assess progress (defined by nationally developed measurements including the Definition-of-Done). The Programme was also seen to have demonstrated the safe delivery of digitally-enabled outcome-driven transformation at pace and lower cost. It achieved this through promoting an ethos of learning and sharing and through an adaptive programme strategy, facilitated by a range of knowledge sharing mechanisms that worked together to promote Programme aims.

> *"We spent, you know, a two-hour session understanding, with the right people in the room, what (their GDE partner) did… it's taken them five years to develop it and we did it in, you know, in one year." (FF, clinical digital leader)*

> *"We've only been able to do that because of the GDE and the reason being the savings involved in working with other trusts and understanding pitfalls, and not making the same mistakes over and over again, means we had the most rapid rollout of observations ever done for that company." (FF, clinical digital leader)*

The GDE Programme also demonstrated the value of broadening the traditional conception of technology programmes from merely IT deployment towards digitally enabled transformation, changing care and work practices to efficiently deliver safe high quality care.

> *"I think one of the legacies of GDE is a broader or a wider understanding of the potential of digital and I think we need to continue that debate and actually make the case that if you want to make substantial structural changes and savings in the cost base, you have to invest in digital." (GDE, non-clinical digital leader)*

Provider organisations successfully implemented ambitious programmes of digitally enabled transformation

The *provider organisations implemented ambitious programmes of digitally enabled transformation*, in most cases revolving around major upgrades in core information infrastructures such as Electronic Health Record (EHR) implementations. Sites implemented multiple projects, in many instances as part of a bigger integrated care agenda, with relatively modest additional external funding. Provider organisations with an existing long-term digitisation strategy were able to use the GDE initiative to accelerate digitally enabled transformation substantially. The Programme enabled GDEs and FFs beginning their digital maturity journey to develop a digital vision and a roadmap towards achieving digital maturity and substantially advance digitally enabled transformation. Participating provider organisations achieved significant advances and most are on track to achieve their planned delivery as determined by international benchmarks. A wide range of benefits are materialising and feeding through into improved care delivery and outcomes including

significant unanticipated benefits – most strikingly an enhanced capacity to respond to the challenges posed by COVID-19.

> *"[We have] made much progress with deployment, for example [Advanced Patient Monitoring technology]. This took six months and since completion the [provider organisation] reported a reduction of 16 cardiac arrests over a four-month period and intensive care unit patients have seen a drop of 10% in mortality rates from 64% to 54%." (FF, clinical digital leader)*

Critical success factors contributing to the success in achieving digitally enabled transformation

Several inter-related features of the GDE Programme have contributed to its success in achieving digitally enabled transformation. These included:

- High level ownership at board and divisional levels and clinical ownership across the organisation
- Dedicated multi-year external funding, released as plans were fulfilled, and the requirement for matched internal funding ensuring organisational commitment to the digital journey
- Governance structures around digitally enabled transformation. This included securing executive commitment and the creation of internal structures to manage the implementation of a programme of digitally enabled change.
- Status and reputational benefits associated with succeeding in the competition to join this prestigious Programme which motivated organisation members and provided greater leverage with vendors
- The growth of digital transformation expertise (exemplified by the appointment of Chief Information Officers, Chief Clinical Information Officers and Chief Nursing Information Officers)
- Development of an internal vision and strategy for digitally enabled transformation and targets linked to accreditation.

These features also contributed to the development of expertise and experience among clinicians, and expanded IT teams.

> *"It feels like you've been given recognition as an organisation that you're really taking ownership of it, it feels like winning something, we won the prize, we're the GDE, we're the special ones."* (GDE clinical specialist)

> *"So, it's a tiny, tiny percentage of our turnover. It's had a massive impact… on people's attitudes and way of working." (FF senior digital lead)*

> *"Many [provider organisation]'s IT programmes are led by IT people; but we feel that we deliver because we're clinically led. We're a clinical programme that's clinically led. So, being under the CCIO for us we think gives us all of those benefits and allows us to deliver, because any sort of blockages or misunderstandings get dealt with." (GDE, non-clinical digital leader)*

Establishing the foundations of a learning ecosystem

The GDE Programme also helped to establish the foundations for a learning ecosystem through:

- Establishing formal knowledge transfer through GDE/FF partnerships and mechanisms around the creation and circulation of Blueprints (documents capturing technical and implementation knowledge) and some funding for formal GDE Learning Networks.
- Additional informal networks, motivated by the mutual (learning and reputational) benefits of knowledge sharing, greatly strengthened the effects of formal networking structures. Knowledge sharing took place through many channels including: email exchanges, site visits, teleconferences and staff secondments. A distributed web of stakeholders acted as knowledge bridges, translating their implementation experience to would-be adopters in other organisations. Effective exchange was promoted by common technological platforms, geographical proximity (notwithstanding caveats against regional monopolies), shared clinical services and pathways, and institutional and cultural alignment, which enhanced learning benefits and reduced networking costs.
- Knowledge transfer, promoted through national initiatives, has helped to strengthen both formal and informal skills and capabilities in change management and hybrid clinical informatics skills as well as technical capabilities. The broader process of professionalisation of digitally enabled transformation expertise contributed to these developments (see below).

A culture of learning, partnerships and information-sharing emerged between provider organisations and with programme managers across the GDE Programme. There was also openness and learning through engaging with the evaluation work, which enabled the evaluation team to gain insights and share these with Programme leadership.

> *"A lot of our team members, nothing is really very formal any more. They will pick up the phone and phone [our GDE] and ask how they are doing it. So, it's those informal relationships that I think are really beneficial." (FF, GDE programme staff)*

The GDE Programme was reinforced by and contributed to developments in the wider environment

- Concurrent initiatives including other programmes such as the Local Health and Care Record and Health System Led Investment programme, the NHS Digital Academy, Learning Networks, and the growth of professional networks (e.g. for Health Chief Information Officers and Chief Clinical Information Officers) helped to facilitate and reinforce the aims of the GDE Programme.
- Common challenges faced in the COVID-19 crisis reinforced online working (particularly locally) and helped digitally mature sites to utilise digital infrastructures in agile ways to respond to new challenges. The enhanced response of digitally mature provider organisations to the unprecedented challenge of COVID-19 demonstrated the benefits of digitally enabled transformation, bringing the latent benefits of digital maturity to the fore.

- The emerging development of Integrated Care Systems (ICSs) during the programme promoted regional collaboration and the collaboration established through the Programme facilitated the development of ICSs.

> *"What we've done is we've transformed one site, a couple of areas. … what we set ourselves a target to do is transform the whole of the ICS [integrated care system]. Now, you're really into the boiling the ocean territory there and I don't think when we … first met each other we thought that's what the gig was. We thought we were deploying EPR [electronic patient records], right, but actually it's turned into, could you transform the health and lives of 1.6 million people? And you think, oh right, wow. And so that's at high level what GDE has done to the people that work in the organisation."* (GDE clinical digital leader)

> *"I think what you're seeing through COVID is just how much a small amount of digital spending can make a big difference to actual end user care. And I think it would have been a very different situation if we hadn't done some of these things at the beginning of the programme. (FF, clinical digital leader)*

Major transformation programmes inevitably face complex challenges and tensions

Challenges and tensions will inevitably emerge in large, complex digitally enabled transformation programmes like the GDE Programme due to the need to manage often opposing or competing stakeholder needs and priorities; tackle unanticipated impacts and issues; and manage risks and dependencies. The key recommendations (below) highlight ways these challenges might be managed and risks mitigated in future programmes/initiatives. Key areas requiring negotiation and flexibility, within a programme management framework during the GDE Programme included:

- ***Digital maturity targets***: Participating provider organisations committed to achieving technological functionality objectives as part of the accreditation process at the end of the Programme. Most stakeholders recognised the value of digital maturity measures, such as the HIMSS EMRAM, as they helped them map the journey towards digital excellence. However, mandating particular technological functionality targets had complex consequences as these did not necessarily align with local priorities and patient outcomes. Changes in benchmarking criteria and measurement tools over the course of the Programme were perceived by some as disruptive. Whilst the HIMSS model had perceived value, there is an ongoing debate about scaling this approach across the NHS.

- ***Progress/outcome monitoring and benefits realisation***: There was broad overall agreement on the ethos of demonstrating the achievement of milestones to show due diligence and to develop an evidence base. Requirements to identify planned benefits encouraged organisations to pursue service enhancements, rather than merely implementing IT. There was some contention however in relation to benefit management tools and methods. The resources needed to collect benefits/outcome data locally were high, and fell upon organisational members who did not experience benefits from their use. The content and timing of information collected differed

from existing organisational reporting systems, despite attempts to standardise reporting. Some organisations re-used data collected to report to their boards and to encourage clinical engagement. Some organisations also recognised the value of the benefit management approach in implementing change and pursuing quality improvement. The existing literature suggests that it is very difficult to attribute short-term outcomes to digital interventions. This is especially relevant in large infrastructure upgrades such as Electronic Health Records, which take a long time to implement and progressively optimise. As a result, there is a long lag before cost savings or health outcomes can be detected. Towards the end of the Programme, and in responding to COVID-19 demands, organisations were able to leverage existing infrastructure investments and benefits were immediately apparent.

- ***Long-term planning*:** The short-term nature of annual funding cycles and relatively short duration of programmes (often three years or less) are at odds with the long timeframes required for the digitally enabled transformation journey. The challenges of digital transformation, such as the financial planning of long-term investments in core EHR upgrading, require a longer-term strategy, between 5–10 years. These difficulties in resourcing the digital journey are compounded by a policymaking environment that favours creating new programmes over continuing existing programmes. GDE Programme managers and provider organisations had to devote considerable effort to mitigating the instability of the policy and funding environment in order to pursue long-term digitisation strategies.

- ***Market management:*** This was a recognised area of importance during the Programme. Associated initiatives developed during this period have helped to promote a system-wide approach to encouraging diversity and quality of technology supply. The GDE Programme helped strengthen engagements between adopters and vendors collectively, by promoting user groups, as well as individually. There was a shift away from devolved procurement (adopted in reaction to the difficulties experienced with central procurement under the NPfIT) towards concerted procurement with stronger collective engagement between vendors and provider organisations. However, these important developments are still at the early stages of an inevitably gradual transformation. Transforming this market will inevitably be a long-term process that needs to be supported by long-term signalling, shared intelligence and strategic deployment of the procurement power exercised by provider organisations. The slow adoption of health information technology standards for using codified data and limited development of protocols for interoperability between different systems has hampered progress in procurement, implementation and optimisation of systems throughout the Programme and remains an area requiring greater focus and prioritisation.

The GDE Programme has clearly influenced the future of digitally-enabled transformation in NHS England and strengthened the position and understanding of the value of digital technologies in delivering and developing NHS services. GDE/FF partnerships were seen to have allowed provider organisations to achieve major changes and deliver quality improvements reliably, at greater pace and lower cost. To ensure the progress achieved by the GDE Programme does not dissipate, future initiatives should ensure they build upon the

Programme to maintain momentum to support the learning ecosystem that has been created, achieve longer-term impact in participating provider organisations, and carry forward learning across a wider range of provider organisations not participating in the Programme (as envisaged in the Wachter Review). This will require a degree of central coordination to keep focus on the overarching vision, and support and buy-in from emerging local structures. It needs to be reinforced through longer-term knowledge sharing for continuous improvement, and by maximising the impact of various interrelated knowledge sharing mechanisms identified in this evaluation.

What next? Lessons to carry forward

The progress achieved and lessons learned from the GDE Programme need to be carried forward to inform the development of the broader NHS ecosystem:

1. **Risk of loss of national organisational memory**: To ensure that the learning achieved under the GDE Programme is taken forward, it is important to build long-term organisational memory around large-scale digitally enabled transformation initiatives. This includes consideration of how to retain, sustain and best utilise the capabilities and experiences that have been accumulated within national and local organisations during the Programme. Clear national recognition of what the sites have achieved in the Programme is needed, accompanied by an outline of how the NHS will draw on this learning to inform future programmes.

2. **Addressing the digital divide**: Lessons learned from the GDE Programme should inform the development of the broader NHS learning ecosystem and ongoing initiatives to address the existing digital divide across organisations. Although some experiences may not easily transfer to organisations with lower digital maturity, others will.

3. **Early involvement of participating provider organisations and cumulative development of programme management tools:** Programme management tools need to be iteratively refined and streamlined, with stakeholder input, to simplify and reduce the burden associated with a multiplicity of programme management and reporting tools. A shared understanding of and capability in planning and using these tools is essential as an intrinsic aspect of digitally enabled transformation. Benefits realisation tools need to be developed jointly across user groups and applied from the outset to plan changes. The learning that widespread engagement delivers transformation therefore also applies to the co-development of appropriately rigorous programme governance arrangements.

4. **Retaining and developing transformation expertise**: Developing, retaining and re-using digitally enabled transformation and programme management expertise is important to enable strengthening/sustaining and wider utilisation of valuable, expensively acquired, experience-based learning. There is an opportunity here to look at the role GDE/FF staff can play in wider networking/buddying to support other organisations to mature and/or link to the Digital Academy and a growing digital alumni network.

5. **Institutional design**: Current proposals to shift programme management roles to regions will bring benefits from greater proximity between managers and providers, but may risk dispersing valuable national capacity. There is also a risk that regional actors will not have sufficient intensity of engagement needed to establish specialist expertise. Institutional design needs to consider trade-offs between central and local deployment. Some specialist functions may best be undertaken centrally (e.g. oversight of markets); some expertise may best be maintained by a system-wide division of labour (e.g. procurement) but could be deployed through a matrix of regionally located stakeholders coordinated through ICSs and Integrated Care Partnerships (ICPs).

6. **Establish a visible national function to support market management:** The GDE Programme has contributed to establishing a national function to manage the market. Managing the market is a long-term project impinging on all digital programmes. This function now needs to be made visible at local level through expansion and formalisation taking into account long-term investment into the market (i.e. to attract newcomers and increase competition), while setting interoperability standards and priorities to help nudge the market toward a more agile, platform-based approach to EHR. It also needs to facilitate and support collaborations between provider organisations within existing user groups.

7. **Long-term vision, strategic support and consistent senior leadership to sustain digital transformation**: Vision and senior leadership support is required both in provider organisations with senior digital transformation leadership represented at board level, and nationally, to ensure local organisations can follow a stable overall vision of digital health system transformation. The extension of the NHS Digital Academy is likely to accelerate this. Strategic decision makers need to consider how to ensure the momentum established by the GDE Programme and related initiatives can be sustained i.e. how to establish a self-sustaining ecosystem. There is a need for a long and thin funding stream to establish infrastructures (particularly in less digitally mature organisations), maintain momentum and reinforce the legacy of the GDE Programme. Resources and incentives are needed to support this and the regions may be able to facilitate these developments.

8. **Ensuring that digital becomes mainstream, operationally and in terms of health and care strategy and policy.** This includes:

    a. **Alignment with other existing change programmes and digitally enabled transformation initiatives:** This includes digital transformation funding streams, skills development and networking activities but also, positive action to ensure organisations and systems consider where digital solutions can support sustainability and outcomes in broader service improvement and transformation;

    b. **Including digital capability in regulatory and assurance structures:** e.g. assessing and monitoring digital maturity of organisations and local health economies needs to become the norm;

c. **Digital capabilities in institutional operating environments:** top level governance support, new digital transformation/skills capabilities, informatics expertise, and clinical engagement.

There are real advantages for pace and scale of progress from ensuring that digital transformation priorities align with wider organisation and system priorities, allowing organisations to align different funding streams and change programmes to optimise impact around a clear shared vision.

9. **Maximising the value of formative evaluations**: Traditional summative evaluation methods, based upon discrete changes, do not effectively capture and guide complex, digitally-enabled transformation developments. This is because digital transformation involves extended chains of interaction around infrastructural changes that exceed reporting timeframes and create attribution problems. Formative evaluation approaches exploring processual outcomes (such as this one) feeding back emergent changes and helping to mitigate risks are key going forward.

Abbreviations

API - Application Programming Interface

BoB – Best-of-Breed

CCIO - Chief Clinical Information Officer

CDR - Clinical Data Repository

CIO – Chief Information Officer

CMIO - Chief Medicines Information Officer

CNIO – Chief Nursing Informatics Officer

CRS – Care Records Service

EHR - Electronic Health Record

EMRAM – [HIMSS] Electronic Medical Record Adoption Model

EPMA - Electronic Prescribing and Medicines Administration

EPR - Electronic Patient Record

FF - Fast Follower

GDE - Global Digital Exemplar

HEPMA - Hospital Electronic Prescribing and Medicines Administration

HIMSS - Healthcare Information and Management Systems Society

HIT – Health Information Technology

HITECH - Health Information Technology for Economic and Clinical Health

HSSF - Health Systems Support Framework

ICS - Integrated Care Systems

ICU - Intensive Care Unit

IM&T - Information, Management & Technology

LHCRE - Local Health and Care Record Exemplar

NHS – National Health Service

NPfIT - National Programme for Information Technology

PAS - Patient Administration System

SME - Small and Medium-sized Enterprises

STP - Sustainability and Transformation Partnerships

TCO - Total Costs of Ownership

TPOM – Technology, People, Organizations and Macro-environmental (evaluation framework)

TSSM - Trust System Support Model

WP – Work Package

Contents

Chapter 1: Background and context

Strategic context – provider digitisation in the NHS

Healthcare systems internationally strive for excellence. Excellence is often expressed through health systems achieving the "triple aim": better outcomes, better value and better experience.[3]

Policy initiatives throughout the developed world have sought to expedite the journey to achieve the triple aim through various digitisation strategies. These include for instance the Health Information Technology for Economic and Clinical Health (HITECH) Act in the United States (US), and Australia's National Digital Health Strategy & Framework for Action.[4,5]

However, these strategies have shown varying levels of success. For instance, the HITECH reform was successful in getting organisations to adopt Electronic Health Records (EHRs) but clinical benefits of these systems are difficult to demonstrate.[6] Similarly, the envisioned large-scale EHR adoption through centralised procurement of systems in the English National Programme for Information Technology (NPfIT) in 2002 was successful in laying the infrastructure that has underpinned much of the subsequent developments, but yielded unintended consequences, with early EHR systems showing difficulty fulfilling organisational and user needs, which ultimately led to a change in strategic direction to allow more localised input in decision making.[7] However, at least in England, digitisation without central direction between 2011 and 2016 was also not very successful as individual healthcare organisations had limited resources and capacity to implement and optimise digital systems. The widespread failure to recognise Health Information Technology (HIT) as an enabler for digital transformation geared towards wider service improvement strategies resulted in projects that viewed HIT as a 'back office' rather than a clinical function.[8] In addition, the continued lack of standards utilisation continues to threaten the interoperability agenda.[9]

The Global Digital Exemplar Programme

In 2016, the English government commissioned the US physician Robert Wachter to lead an independent review of the state and future strategic direction of digital health strategy in England.[10] One of the key recommendations from this was to invest limited central

[3] Berwick DM, Nolan TW, Whittington J. The triple aim: care, health, and cost. Health affairs. 2008 May;27(3):759-69.
[4] Blumenthal D. Launching HITECH. New England Journal of Medicine. 2010 Feb 4;362(5):382-5.
[5] National Digital Health Strategy and Framework for Action. Available from: https://conversation.digitalhealth.gov.au/framework-for-action (last accessed: 06/05/2021).
[6] Mennemeyer ST, Menachemi N, Rahurkar S, Ford EW. Impact of the HITECH act on physicians' adoption of electronic health records. Journal of the American Medical Informatics Association. 2016 Mar 1;23(2):375-9.
[7] Sheikh A, Cornford T, Barber N, Avery A, Takian A, Lichtner V, Petrakaki D, Crowe S, Marsden K, Robertson A, Morrison Z. Implementation and adoption of nationwide electronic health records in secondary care in England: final qualitative results from prospective national evaluation in "early adopter" hospitals. Bmj. 2011 Oct 17;343:d6054.
[8] A digital NHS? An introduction to the digital agenda and plans for implementation. Available from: https://www.kingsfund.org.uk/sites/default/files/field/field_publication_file/A_digital_NHS_Kings_Fund_Sep_2016.pdf (last accessed: 06/05/2021).
[9] Hunt announces £4.2 billion for NHS IT. Available from: https://www.digitalhealth.net/2016/02/hunt-announces-4-2-billion-for-nhs-it/ (last accessed: 06/05/2021).
[10] Making IT Work: Harnessing the Power of Health Information Technology to Improve Care in England Report of the National Advisory Group on Health Information Technology in England. Available from:

resources selectively to create a cohort of digital centres of excellence. Consequently, NHS England's Global Digital Exemplar (GDE) Programme was conceived in 2017 with £395 million national investment designed to support "selected digitally advanced mental health, acute provider organisations, specialist provider organisations and ambulance provider organisations, who through funding and international partnership opportunities [would] become Exemplars over two to three and a half years".[11] The underlying assumption was that digitally advanced sites would become international centres of excellence that could share their learning with later implementers. These Global Digital Exemplars (hereafter GDEs) were paired with somewhat less-digitally mature Fast Follower (FF) provider organisations to help them share knowledge that would be captured in Blueprints to leapfrog and accelerate the spread of this learning nationally. Our team was commissioned to evaluate the GDE Programme over a period of three years, with evaluation activities commencing in January 2018. We are also involved in delivering the NHS Digital Academy, a related initiative also emerging from the Wachter report. The NHS Digital Academy is a virtual organisation training NHS staff in digital leadership.

In December 2019, then health secretary Matt Hancock announced the NHS Digital Aspirant Programme to build on the GDE Programme.[12] This programme, which is still unfolding at the time of writing, is intended to build digital transformation capacity across a wider range of NHS provider organisations, each receiving much smaller amounts of funding than the GDE Programme.

The structure of this report

This report begins by describing the aims and methods of the evaluation (Chapter 2) and the dataset (Chapter 3). We then explore digital transformation within sites (Chapter 4), the spread of knowledge between sites (Chapter 5), and the creation of a learning ecosystem (Chapter 6). We conclude by exploring the overall legacy of the Programme, positioning it within the wider context (including political developments and the ongoing COVID-19 pandemic, Chapter 7).

Organisation of the evaluation

The evaluation was led jointly by Professor Robin Williams and Dr Kathrin Cresswell.
The research consortium comprised teams from The University of Edinburgh, NHS Arden & GEM Commissioning Support Unit, and University College London. In addition to local team meetings, we held three-monthly Management Group meetings and had intensive one-day analysis workshops every six months with all team members.

The Steering Group of the evaluation comprised senior national programme managers and internationally renowned academics. The role of this group was to consider formative feedback regularly and (where relevant) incorporate insights into strategic decision making.

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https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/550866/Wachter_Review_Accessible.pdf (last accessed: 06/05/2021).

[11] Available from: https://www.england.nhs.uk/digitaltechnology/connecteddigitalsystems/exemplars/ (last accessed: 06/05/2021).

[12] Matt Hancock announces new programme to help NHS trusts go digital. Available from: https://www.digitalhealth.net/2019/12/matt-hancock-announces-new-programme-to-help-nhs-trusts-go-digital/ (last accessed: 06/05/2021).

Members also helped to direct the research towards areas where it could achieve maximum impact. This group met quarterly throughout the evaluation, increasing in frequency towards the end of the work in order to maximise formative impacts and incorporation of findings into policymaking.

Chapter 2: Methods

Ethics and dissemination

This work was a service evaluation of a national programme and therefore did not require review by an NHS research ethics committee. We received institutional ethical approval from The School of Social and Political Science Research Ethics Committee at The University of Edinburgh, UK. We adhered to good practice and relevant ethical guidelines in obtaining verbal informed consent for participation, as well as anonymising individuals and sites prior to any dissemination. Data was stored on university servers, on NHS servers, and NHS Cloud space.

We submitted written reports of our emerging findings to our quarterly Steering Group meetings and published written reports on our publicly accessible website.[13] In addition, we disseminated key findings in academic peer reviewed journals.

An evolving framework

In line with the spirit of formative evaluation and the GDE Programme as a learning programme, the methodology evolved over time according to emerging need. For instance, the work initially included quantitative and economic assessments of Programme impact. Benefits realisation became an integral component of Programme management, so in collaboration with the Independent Steering Group it was decided that this strand would not be duplicated, but that the team would focus on value adding components around procedural issues. This also allowed us to examine additional issues of emerging importance, for example an international Delphi exploring definitions around digital excellence in healthcare and also the role of digital maturity in tackling challenges associated with the pandemic.

Methods and analysis

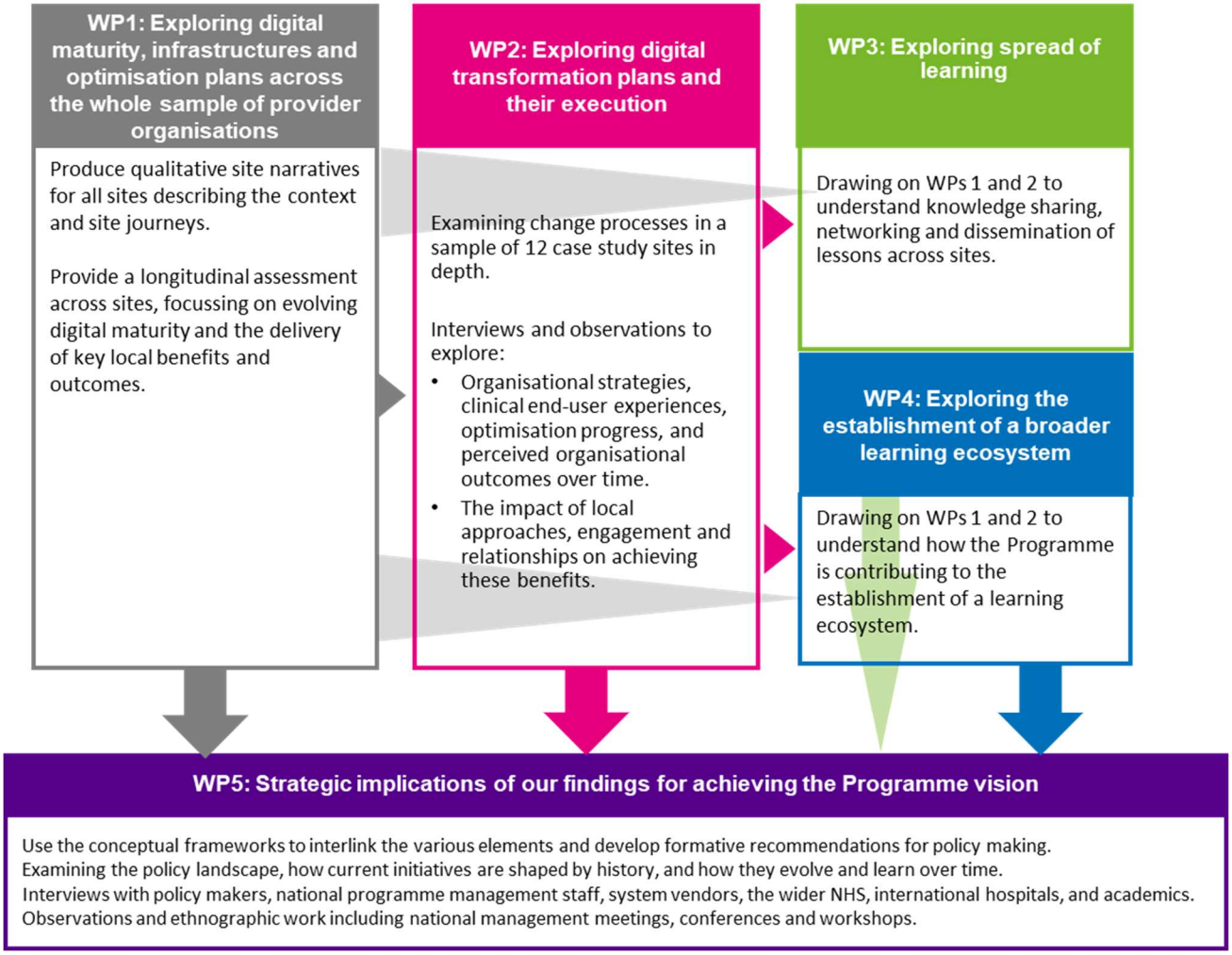
We conducted a longitudinal qualitative formative evaluation, in which GDEs and FFs were conceptualised as case studies.[14] This format allowed us to explore implementation, adoption and optimisation processes in context and to extract potentially transferable lessons associated with developments over time. For the purposes of evaluating the GDE Programme, we conceptualised each provider organisation as a case, where we could analyse context, processes and outcomes. Each case included a range of small-scale technology innovations as well as, in some instances, renewal of EHR infrastructures.

Our work took place in five complementary work packages (WPs), summarised in Figure 1.

[13] Global Digital Exemplar Evaluation. Available from: https://www.ed.ac.uk/usher/digital-exemplars (last accessed: 07/05/2020).

[14] Crowe S, Cresswell K, Robertson A, Huby G, Avery A, Sheikh A. The case study approach. BMC medical research methodology. 2011 Dec;11(1):100.

Figure 1: High-level overview of our methods in each of five work packages (WPs)



Setting and participants

The GDE Programme involved 51 provider organisations, including three ambulance provider organisations. The remaining 48 provider organisations comprised 23 GDEs and 25 FFs paired up to share knowledge involved 33 acute provider organisations, 15 mental health provider organisations. We collected in-depth data from a sub-set of 12 sites, and high-level data from 24 sites (9 FF provider organisations which joined the programme late, after the Evaluation was launched, and three which merged in the course of the programme were not included in the Evaluation). Summary data about the full sample of acute and mental health provider organisations is included as Appendix 2. This shows GDE-FF pairings, the main IT system each adopted, whether they were in the same regional groupings and other features of the institutional context (e.g. mergers).

The in-depth sites were sampled purposefully for maximum variation to represent a range of settings (e.g. acute, mental health, specialist) core EHR infrastructures, geographical locations, sizes, implementation timelines, and levels of digital maturity. In doing so, we sought representation of sites with large commercial integrated and Best-of-Breed (BoB) systems; sites located in the South, Midlands and North of England; teaching and non-teaching provider organisations; and comparatively low, medium- and high-levels of

baseline digital maturity. A combination of GDEs and FFs were included. Individual participants included programme management staff and senior leaders within provider organisations (clinical and non-clinical), system vendors, and national stakeholders (e.g. programme managers and policy makers).

Overall study design

We undertook in-depth qualitative investigations in 12 provider organisations purposefully selected from all acute, specialist and mental health GDEs and FFs (WP2 in Figure 1). Ambulance organisations were excluded as these were out of scope for this commission. We complemented these in-depth sites with more selective data collection across the remaining 24 GDEs and FFs (WP1 in Figure 1), in order to balance depth of findings with the breadth of insights required to draw meaningful conclusions. Work in study sites was complemented by data collection from the wider healthcare community, policy makers, vendors, and the international community (W5 in Figure 1).

We used qualitative methods (comprising semi-structured interviews, observations and documentary analysis) to gather data on technology selection, implementation and adoption, change management strategy, governance processes and stakeholder engagement. We also sought to explore the impact of contextual factors on change processes to facilitate the identification of critical success factors and dependencies so that we were able to provide outputs that had practical application to accelerate uptake and impact locally and nationally.

Analytical framework

A conceptual/analytical framework and methodology informed by pertinent contemporary theoretical developments is important to guide the research and generate generalisable insights for policy and practice. We therefore drew on a pragmatic application of a number of theories (Box 1).[15] [16] [17] This enabled us to build on existing knowledge through obtaining theoretical insights (and thereby allowing generalisations) without neglecting the more immediate need to provide formative strategic input. In integrating these approaches, we explored how various technological systems and social structures co-evolved over time shaping each other throughout a continuous process. This was achieved through applying a theory-informed coding framework developed in related work (see analysis section below).

[15] Cresswell KM, Sheikh A. Undertaking sociotechnical evaluations of health information technologies. Journal of Innovation in Health Informatics. 2014 Mar 18;21(2):78-83.
[16] Ciborra C, Braa K, Cordella A, Hepsø V, Dahlbom B, Failla A, Hanseth O, Ljungberg J, Monteiro E. From control to drift: The dynamics of corporate information infrastructures. Oxford University Press on Demand; 2000.
[17] Cresswell KM, Bates DW, Sheikh A. Ten key considerations for the successful implementation and adoption of large-scale health information technology. Journal of the American Medical Informatics Association. 2013 Jun 1;20(e1):e9-13.

Box 1: Conceptual approaches that we drew on

Our work was informed by a general ***sociotechnical approach*** – paying attention to social, technological and organisational processes and exploring how these influence each other over time.
Within this we developed an ***evolutionary perspective*** encompassing the evolving technology lifecycle – technology implementation, adoption and optimisation unfolds gradually over time offering opportunities for learning. These need to be examined over extended timeframes.[18]
We applied specific insights around the analysis of ***Information infrastructures*** - how contemporary digital technologies are combined to create "systems of systems" – and the particular challenges in establishing and developing information infrastructures.[19]

Our formative evaluation sought to provide insights into how the continuing development of the GDE Programme may be enhanced to promote positive impacts on provider digitisation and patient outcomes. We worked closely with policy makers to develop a detailed understanding of the existing stakeholders, policy landscape, and evolving approaches to Programme management, in order to avoid duplicating the significant efforts made by programme management to monitor substantive outcomes. This detailed understanding of processes helped us to refine our overall approach, focusing on emerging local and national priorities whilst being mindful of implementation timelines.

We now describe the methods used in each of the WPs in more detail.

WP1 - Exploring digital maturity, infrastructures and optimisation plans across all provider organisations taking part in the GDE Programme

Objectives

GDEs and FFs were at various stages of system implementation and optimisation, with a range of different information infrastructures in place. In this WP, we sought to make assessments surrounding the success of the GDE Programme and gain insights into progress (or lack of).

Design

In this WP, we collected qualitative descriptive data from the acute and mental health GDEs and FFs that were not selected for WP2 in-depth case studies.

Sampling

We included all acute and mental health GDEs and FFs in this WP and purposefully sampled members of the local programme team who had insights into existing systems and strategies (including chief information officers, clinical digital leaders, and their GDE

[18] Robin Williams, James Stewart, Roger Slack, Social Learning in Technological Innovation: Experimenting with Information and Communication Technologies, 2005, Edward Elgar: Aldershot.
[19] Pollock N, Williams R. E-infrastructures: How do we know and understand them? Strategic ethnography and the biography of artefacts. Computer Supported Cooperative Work (CSCW). 2010 Dec 1;19(6):521-56.

management teams). Sites were approached through established gatekeeper contacts already known to Arden and GEM Commissioning Support Unit.

Data collection

Data collection consisted of gathering and analysing a range of documentation including Funding Agreements detailing provider organisations' transformation plans, strategies and digital maturity assessments and conducting a series of one-to-one in-depth semi-structured face-to-face or telephone interviews, group interviews (where preferred by sites) and site visits (see Box 2 for indicative topic guides). We produced summaries describing the organisational context, technological systems, and digital strategies in each site. In order to assess individual journeys over time and to capture a longitudinal dimension, we visited sites at the start of their GDE Programme and re-visited sites at least six months after the implementation of GDE-related systems to gain insights into the evolving digital maturity and the delivery of key local benefits and outcomes. We also visited sites a third time towards the end of the Programme, although our ability to collect data was limited due to the COVID-19 pandemic.

Box 2: High-level interview guide

Background
- Background and role of interviewee(s) (WP1, WP2)
- Digital trajectory/journey before Programme (WP1, WP2)

Strategy
- Details of change/implementation strategy and benefits realisation strategy (WP1, WP2)
- Implementation approach (resources, leadership, engagement, training, sustainability) (WP1, WP2)

Implementation progress
- Details of new digital functions being introduced as part of Programme and other current/recent changes (WP1, WP2)
- Progress in implementing these (WP1, WP2)
- Issues arising in implementation (WP1, WP2)

Overall thoughts on Programme (rationale, aims, how it has gone so far and what could be done better) (WP2)

Benefits realisation and reporting (WP2)
- Benefits achieved through functionalities
- Challenges in realising these benefits
- Facilitators for achieving benefits

Blueprinting
- Overview of Blueprint production and use (WP1, WP2)
- Experiences of the Blueprinting process (challenges, areas for improvement) (WP2)

Knowledge management, networking and learning (formal and informal)

- Existing networks/learning and key stakeholders (within Programme and outside Programme) (WP1, WP2)
- Relationship between FF and GDE organisations (WP1, WP2)
- Experiences and perceptions on what knowledge networks are most useful and why (WP2)
- Other relationships/sources of information (WP2)
- Perception of how national support can promote knowledge exchange and networking (WP2)

Vendors (WP2)

- Relationship with vendors
- Views on national digital health infrastructure

Lessons learnt and way forward

- Key lessons learnt to date (WP1, WP2)
- Perceived key benefits/legacy of the GDE Programme (WP1, WP2)
- Perceptions around what support is needed (WP 2)
- Best ways to spread learning (WP 2)
- View on the sustainability of benefits (WP 2)
- Perception of if/how benefits have been realised (WP 2)
- Unintended consequences (WP 2)

WP2 - Exploring digital transformation plans and their execution

Objectives

To measure progress in a more focused way, we examined change processes and specific clinical outcomes in selected settings in-depth.

Design

We used a combination of qualitative interviews and non-participant observation of strategic meetings to explore organisational strategies, clinical end-user experiences, implementation/use/optimisation progress, and perceived individual/organisational benefits/outcomes over time (Box 2).

Sampling

This WP was concerned with getting an insight into change processes in a sample of 12 purposefully selected case study sites, aiming for maximum variation as outlined above. Within each site, we sampled participants purposefully to represent a range of viewpoints (e.g. different clinical and managerial backgrounds) and levels of seniority. Gatekeepers were approached to help us establish initial contacts and snowball sampled based on these. As participants needed to have insights into the GDE Programme, we focused sampling on members of local strategic committees and IT management staff. We stopped recruiting

new participants when no new themes emerged and when we reached thematic saturation.[20]

Data collection

Data collection consisted of a combination of one-to-one semi-structured face-to-face or telephone interviews, group interviews (where preferred by participants), observations of GDE-related meetings and workshops, and collection of documents. Designated lead researchers collected data in in-depth case study sites in order to allow them to immerse themselves in the setting.

Researchers audio-recorded interviews and group interviews and prepared accompanying field notes. A professional transcribing service produced transcripts of these recordings. Interviews allowed us to gain detailed insights into participant attitudes towards the Programme, their expectations, local complexities, perceived benefits, unexpected consequences, challenges experienced, and lessons learnt.

Lead researchers conducted non-participant observations either in person or online. This approach allowed us to understand dynamics within sites (e.g. when observing meetings of local management groups). During observations, researchers took detailed field notes relating to content, social dynamics, and their own impressions, by considering the observation within the wider context of the overall evaluation work.

In addition to interviews and observations, we also collected local documents that helped us to understand strategies and implementation/optimisation plans. We used these as contextual background reading to inform interview topic guides and interpretations of observations.

WP3 - Exploring spread of learning

Objectives

To explore knowledge transfer and dissemination of lessons and networking activity across GDE and FF sites.

Design

We undertook secondary analysis of data collected in WPs 1 and 2 to explore mechanisms associated with knowledge transfer. This drew on qualitative data collected in WPs 1 and 2 to extract spread and sharing of knowledge between sites through formal and informal mechanisms produced through targeted programme activities identified in the analysis of documents. Key lines of enquiry included exploring instances where knowledge transfer and spread was perceived as successful/unsuccessful and exploring the underlying reasons why.

[20] Hennink MM, Kaiser BN, Marconi VC. Code saturation versus meaning saturation: how many interviews are enough?. Qualitative health research. 2017 Mar;27(4):591-608.

WP4 - Exploring the establishment of a broader learning ecosystem

Objectives

Here, we sought to understand how the Programme contributed to the establishment of a wider digital health learning ecosystem within and beyond the GDE Programme, including both the formal knowledge transfer mechanisms planned under the Programme and informal knowledge exchanges that emerged. We conceptualised a learning ecosystem as inter-organisational knowledge transfer and learning that occurred over time across the entire health system (i.e. not only the GDE sites).

Design

We conducted a secondary analysis of formal and informal means of sharing knowledge identified in WP3 and of data collected in WPs 1 and 2 to examine the formation and operation of learning and knowledge networks across the GDE Programme and with the wider NHS and other communities. Key lines of enquiry included examining stakeholder experiences and overall patterns to address the (variable) dynamism of learning, and the incentives for and barriers to effective knowledge transfer.

WP5 - Strategic implications of our findings for achieving the Programme vision

Objectives

This final WP was concerned with the integration and dissemination of findings from the evaluation. We worked to connect the results from WPs 1-4, with a view to mapping out the wider overall picture and establishing insights for those planning, managing, and participating in future digital health deployments.

Design

This WP was a qualitative longitudinal study comprising qualitative interviews, observations and collection of documents. Discussions with key stakeholders examined how historical and contextual factors shaped the processes underway and helped explicate implications of emerging findings for policy.

Sampling

In this final WP, we engaged with a wide range of stakeholders including policy makers, national programme management staff, system vendors, the wider NHS, international hospitals and partner organisations, and academics. These were recruited with the help of key national gatekeepers in our Steering Group or approached directly by us via publicly available email addresses.

Data collection

We conducted one-to-one semi-structured interviews with researchers taking detailed field notes. In addition, we conducted ethnographic fieldwork including attending all national programme management meetings, and national conferences and workshops that were related to the GDE Programme. Collection of national strategic plans complemented interviews and observations. This WP helped us position our findings within the existing

policy landscape and within the history of digital change in the NHS. It also allowed exploring evolving strategies and changes over time. We used our conceptual frameworks to interlink the various elements and develop formative recommendations for policymaking. These recommendations were fed back through written reports and face-to-face meetings with senior policy makers.

Data analysis

Data analysis was iterative and fed into subsequent data collection, using a combination of deductive and inductive methods.[21] We developed a theory-informed coding framework in which lead researchers coded qualitative data from all WPs, whilst allowing additional categories to emerge (Appendix 1). We drew on the Technology, People, Organisations, and Macro-environmental factors (TPOM) evaluation framework we have developed in related work (Box 3). This includes various sub-categories that were used as prospective criteria against which assessments were to be made.[22]

Box 3: Overview of categories in the Technology, People, Organisations, and Macro-environmental factors (TPOM) evaluation framework

Technological factors: usability; performance; adaptability and flexibility; dependability, data availability, integrity, and confidentiality; data accuracy; sustainability; security
Social/human factors: user satisfaction; complete/correct use; attitudes and expectations; engagement; experiences; workload/benefits; work processes; user input in design
Organisational context: leadership and management; communication; timelines; vision; training and support; champions; resources; monitoring and optimisation
Wider macro-environment: media; professional groups; political context; economic considerations and incentives; legal and regulatory aspects; vendors; measuring impact

Documentary, observation, and interview data was collated for each case by the lead researcher and coded against the TPOM framework, allowing additional categories to emerge. Documents, observations, and interviews from WP5 were analysed separately and integrated with findings from case studies. We sought to feed back and test emerging findings into concurrent data collection.

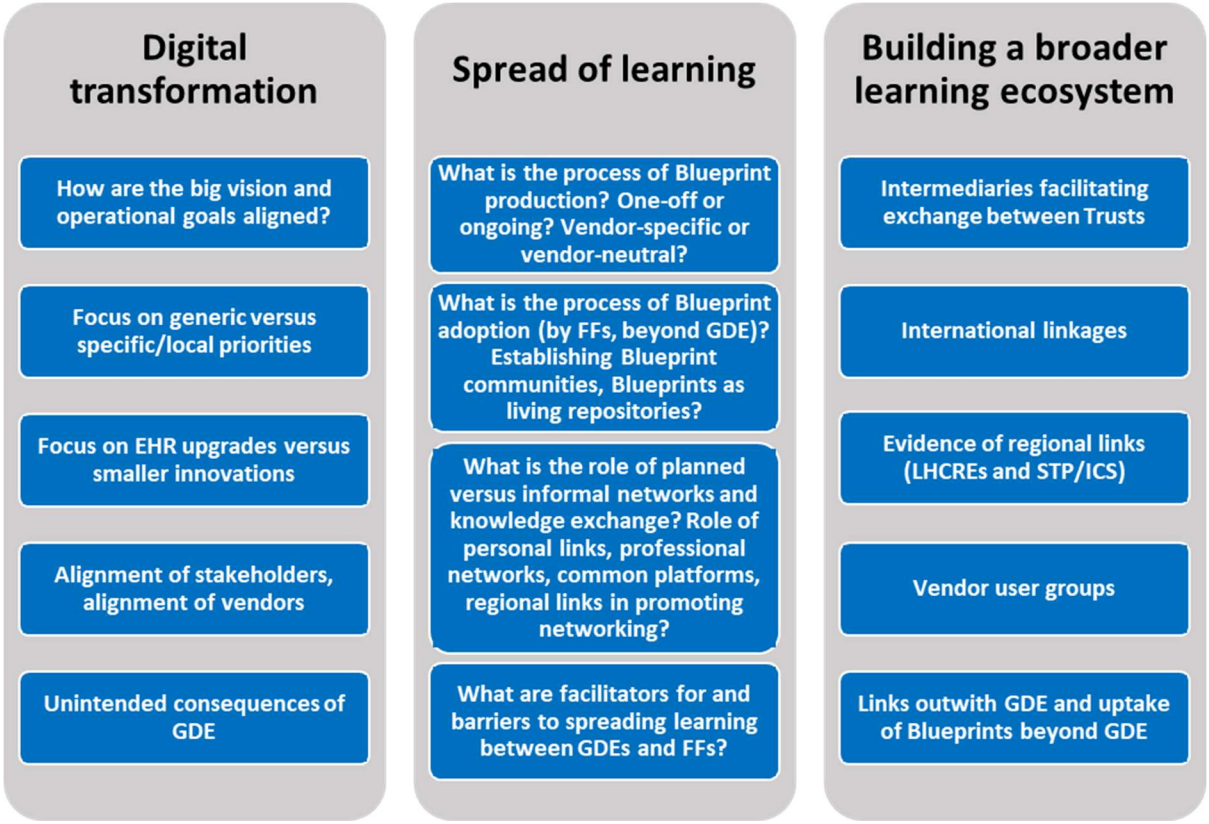
We used NVivo software Version 11 to facilitate the process of coding qualitative data.[23] During three-monthly intensive analysis meetings with the wider team (i.e. all of the authors), we discussed emerging findings and distilled implications for policymaking.

Analysis meetings initially had a relatively broad focus, with increasing depth over time, focusing in on issues identified as important by the Steering Group and the research team.

[21] Miles MB, Huberman AM. Qualitative data analysis: An expanded sourcebook. Sage; 1994 Jan 12.
[22] Cresswell K, Williams R, Sheikh A. Developing and Applying a Formative Evaluation Framework for Health Information Technology Implementations: Qualitative Investigation. Journal of Medical Internet Research. 2020;22(6):e15068.
[23] NVivo. Available from: https://www.qsrinternational.com/nvivo-qualitative-data-analysis-software/home (last accessed: 07/05/2020).

In line with the aims of this work, we initially explored digital transformation within sites, before analysing spread of learning across GDE and FF sites, and then analysed how the Programme has helped (or not) to establish a wider learning digital health ecosystem (see Figure 2). We focused on challenges and unanticipated consequences in most detail. The in-depth case studies allowed us to get detailed insight into local dynamics that we then tested across the wider sample, seeking confirming and disconfirming evidence.

Figure 2: Key lines of enquiry



Chapter 3: Overview of the dataset

We conducted 358 one-to-one and 137 group interviews, observed 113 meetings, and analysed 277 documents in 36 participating provider organisations (Tables 1 and 2). We also conducted 68 high-level interviews with policymakers and vendors; 104 observations of national meetings, workshops, and conferences; and analysed 112 national documents.

Table 1: Our dataset

Data collected in the in-depth case study sites (GDE: Global Digital Exemplar; FF: Fast Follower)		
12 provider organisations	8 GDEs: 6 acute, 2 mental health 4 FFs: 3 acute, 1 specialist FF	309 interviews 136 documents 94 meetings observed
Data collected in the broad case study sites		
24 provider organisations	15 GDEs: 10 acute, 5 mental health 9 acute FFs	247 interviews 141 documents 19 meetings observed
Data collected elsewhere		
72 high-level interviews with policy makers and vendors Non-participant observations of 104 national meetings, workshops, and conferences 112 documents		

Table 2: Description of the samples in the GDE Programme landscape

	Included in in-depth studies	Included in broader studies	Omitted due to late admission to Programme	Omitted due to FF merging with GDE	Total
Overall number of GDEs (excluding ambulance GDEs) – 16 acute and 7 mental health	8	15			23
Overall number of FFs – 17 acute and 8 mental health	4	9	9	3	25
Totals	**12**	**24**	**9**	**3**	**48**

Note: the number of overall Global Digital Exemplars (GDEs) and Fast Followers (FFs) differ from those included in our study which did not include the 9 FFs that joined the programme after the start of the evaluation and 3 provider organisations that merged during the Programme.

In our broader sample, 19 pairings of GDEs/FFs had a common core system and 15 organisations were in the same local strategic groupings (including Sustainability and Transformation Partnerships (STPs) and Integrated Care Systems (ICSs)) coordinating collaborations of healthcare organisations and local authorities). These local strategic groupings were developing in parallel to the Programme. In our 12 in-depth case studies, six pairings were located in the same local strategic grouping, and 10 had the same core system as their FF.

Chapter 4: Digital transformation within GDE/FF sites

The GDE Programme has accelerated digitally-enabled transformation

The GDE Programme has built on experience of earlier programmes that identified the importance of digitally-enabled transformation of services (rather than IT deployments), clinical engagement, envisioning benefits, programme governance, and leadership.

"It's not about the IT it's about what do we need to do to make this more efficient and then using the digital tools to deliver that. Rather than building it around what we've already [had]...always done. So, it's about exploiting [digital technologies]...it's clinical transformation."(Site B, FF, in-depth case study, non-clinical digital leader)

"Obviously GDE Programme coming into (Site M), I think it's a great thing because it's making people realise that we do need to work differently and involve clinicians at an early stage. I'm hoping by doing that, going forward, the projects will improve because it's people that have been here for a while in (Site M) that are starting to realise that there are benefits of getting clinicians involved."(Site M, FF, in-depth case study, GDE project staff)

"So, I think it's changed the nature and structure of digital leadership in the organisation, so there's greater depth and breadth in clinical engagement, and those posts persist, so we've been able to transition the CCIO [chief clinical information officer], CNIO [chief nursing information officer] funding into Business As Usual, so that is maintained." (Site H, GDE, in-depth case study, clinical digital leader)

The GDE Programme has delivered a boost to digital transformation through external (and matched internal) funding and securing senior hospital leadership engagement. Funding and reputational benefits resulted in alignment of efforts within provider organisations and in clinical buy-in. This has helped to create a cadre of digital leadership within provider organisations, which was also facilitated by the NHS Digital Academy.

*"I think all in all GDE is obviously a positive programme because of the increased investment and we're probably going to be standardising our methodology and approaches across [*provider organisations*]. We've got definable outcomes and defined benefits as well so we need to deliver on those, and obviously there's a big push, there's a big digital agenda within the [*provider organisation*] and that's obviously coming down from the Department of Health and NHS England" (Site B, FF, in-depth case study, clinical digital leader)*

"What is different [about the GDE Programme] is the whole governance structure, so we've got the digital hospital, the design authority, the digital adoption committee, they were all set up on the basis that we're becoming a GDE Fast Follower, this is how [GDE] have got their governance structured, and a lot of these changes that we are implementing, there's adoption and transformation there on the clinical side, it's all hearts and minds. So, it's not just IT being done to the clinicians, it's the clinicians and the management within the hospital, driving the hospital forward for these new initiatives, which just happen to be enabled by IT. (…) So, having that digital hospital, and the digital adoption committee in place, meant that we had senior management buy in. They designed the programme, they signed up to the business case, they were aware of the GDE programme and all the governance around that." (Site L, FF, in-depth case study, GDE programme staff)

The Programme also included important work on the Definition of Done and encouraged the development of local digital roadmaps at the outset. This was, however, not sustained and there was a resort instead to the HIMSS (Healthcare Information and Management Systems Society) EMRAM (Electronic Medical Record Adoption Model) model of digital maturity, which focused on internal capabilities of (mainly acute and some mental health) providers. Although HIMSS delivered a roadmap for sites and programme managers, it largely reflected the shared agenda of US acute hospitals and vendors and did not allow for local flexibility and experimentation. HIMSS, which was updated during the course of the Programme with added capabilities and benchmarks, included some elements that were expensive to achieve and which were out of alignment with provider organisations priorities. HIMSS EMRAM was also not well-aligned with integration of health and social care, the patient centred agenda, mental health, and UK vendor capabilities.

"So HIMSS is primarily an American organisation and they focus on things in a very American way. So some things make more sense and some things make less sense in the UK. (…) So I think if you're saying how can you be sure that what HIMSS is measuring actually will improve outcomes, I'm much less clear lower down the HIMSS thing than I am at the top, but the top is really difficult for large UK [provider organisation] to achieve because it's enormously expensive and the complexity of doing it and maintaining it is really high. And whether that really is where you should…if you wanted to maximise the clinical benefit per pound I'm not sure that that is the right way to do it. There are other things that I think would be more useful, give you better safety advantages. (…) For example, the business case for closed loop blood is never going to stack up in this [provider organisation] because a) they waste very little blood and b) we have very, very few mis-transfusions. So, are we going to show clinical benefit from putting it in the system? No, we're not. So, we're doing it because it's in HIMSS rather than in my heart of hearts I know it's going to make patients safer. Not in HIMSS is having a healthy information exchange that covers the whole region, because in America that's undeliverable, because they don't talk to each other and they're all competing businesses. But that's really important in terms of patient safety. So HIMSS is not a good reflection of where objectively based on the evidence you invest all your money." (Site G, GDE, in-depth case study, clinical digital leader)

HIMSS EMRAM over time became a key element of GDE accreditation.[24] However, towards the end of the Programme some sites considered digital maturity from a different perspective not linked to HIMSS in their strategy going forward as this gave them flexibility to address local priorities and/or new challenges (such as COVID-19).

"So I put a change request in to move away from closed-loop meds administration to look at a place-based care model, so a new model of care which meant that we could do care in the community in a much better way, so i.e. keep citizens away from the hospital. The [Site H] board, I went to the exec directors in July [2020] who supported it, so I put a Change Control Notice into NHS Digital and they were supportive of it. And we decided to move away from HIMSS and concentrate on supporting the pandemic and moving towards interoperable place-based care." (Site H, GDE, in-depth case study, GDE programme staff)

"I think pursuit of HIMSS has hindered us in our development. I think it's delayed some things that we wanted to do and could have done sooner because we've had to focus on HIMSS" (Site 19, GDE, broader study, clinical digital leader)

The level of strategic drive associated with the GDE Programme has further mobilised and delivered clinical engagement. There is now an overall greater number of clinical and managerial staff actively engaged in digital transformation than pre-GDE. This increased engagement with clinicians experiencing benefits of digitisation and in turn became a driver for digital transformation.

"We were starting to see people embrace it [digital transformation]. But just recently, particularly when we've linked it with clinical safety and we've linked it with the multi-professional teams coming together, I see as though we've suddenly crossed that. You can really see that people are very engaged and they see it as something very positive. They see it as, this is a plus, you know, [Site B] being a GDE fast follower and really bringing that now to the forefront." (Site B, FF, in-depth case study, focus group, clinical digital leader, operational staff, senior managers)

The success of the GDE Programme was accompanied by a significant growth in capability and the establishment of clinical informatics as a credible profession - development of strategic vision/leadership, and development of clinical digital capability and careers (also facilitated by the NHS Digital Academy). CNIOs were non-existent pre-GDE but are now much more widespread. The nature and function of CNIO, CCIO and chief information officer (CIO) roles has also changed with more visibility and influence. Increasing recognition of the value of clinical informatics expertise and experience has enabled the formation of a digital transformation learning ecosystem.

"More and more in nursing press and a lot of clinical documentation, the word digital nursing is becoming bigger and bigger and bigger, and there are more and more opportunities for nurses to move into the digital side of nursing within their own current practice, which is really exciting, you know. And certainly, the CNIO type role is really starting to come into its fore. Most hospitals now have a CNIO regardless of what system they're using or what stage they're at in a procurement phase they are now looking... So digital nursing is definitely on the rise, isn't it? There's much more out there now." (Site A, GDE, in-depth case study, clinical digital leader)

The GDE Programme was further associated with central market management efforts. There have been efforts to make markets and vendor capabilities more transparent through formal initiatives such as the Trust System Support Model (TSSM) and important informal work to support and assist provider organisations in procurement. There are long-standing concerns to sustain a diverse and plural market. The GDE Programme seems to have accelerated a change in the market (increased/accelerated the presence of US vendors and especially Cerner), but has not necessarily increased the plurality of supply.

"In terms of supplier management, I thought that [the GDE programme] was a double-edged sword. Yes, without a shadow of a doubt, there were many suppliers who would be willing to be much more flexible, to be much more helpful with us because we're a GDE. Sadly, I don't believe [vendor] was one of those. I think the problem was that [vendor] themselves got [number] of the [number] GDEs and in my view it was too many. What that meant was that often there wasn't enough resource in [vendor] to deliver the needs of the GDE partners" (Site 19, GDE, broader study, clinical digital leader)

Earlier digitalisation efforts in some provider organisations have focused on particular areas. Many GDE sites saw the Programme as an opportunity for transformation of the entire organisation and therefore as a driver to alignment of interests of various stakeholders. The GDE Programme presented an opportunity for sites to upgrade core (EHR/EPMA) infrastructures and embark upon a range of other more local (and perhaps more innovative) digitisation projects.

"The principal thing really that I think the GDE Programme helped us with on a number of fronts. One was, the main thing we used, it was to further the work around progression towards barcode medicine administration, to also strengthen some of our analytics reporting, and also to progress some of the work towards both an upgrade of our infrastructure and our [system's name] programme, although those were more secondary. It aligned with the HIMSS EMRAM requirements becoming more stringent, and over time they do evolve, and so in that regard the GDE Programme was helpful in enabling us to meet those more stringent requirements." (Site A, GDE, in-depth case study, clinical digital leader)

Framing and measuring digital excellence and digital transformation

Digital excellence in change programmes

There are various ways to conceptualise and measure digital excellence in health care.[25] [26] These approaches vary in scope from highly specialised models, focusing on a specific technological subsystem to those assessing digital transformation across an entire hospital, and others encompassing the wider integrated health and care ecosystem.[27] [28] The origin of these models is also diverse, including international health care industry organisations, national health care providers, and academic groups. Common to all existing frameworks is the concept of digital transformation progressing towards advanced levels of digital maturity through a defined set of stages associated with different technological capabilities. Perhaps the best known of these is the HIMSS EMRAM, Box 4).

Box 4: HIMSS Analytics Electronic Medical Record Adoption Model (EMRAM)

The HIMSS EMRAM classification evaluates the extent to which electronic medical records (EMRs) have been adopted within a hospital over eight progressive stages (Levels 0-7).
A hospital's digital transformation begins at Level 0, in which no electronic laboratory, pharmacy, or radiology systems are installed. The hospital then moves through Levels 1-7 by progressive adoption of various aspects of EMRs. These include limited ancillary departmental systems (Level 1), and adoption across an increasing number of hospital departments (Levels 1-6), culminating in a virtually paperless environment with complex EMRs implemented in over 90% of the hospital's departments (Level 7).
A hospital can be assessed against the HIMSS classification to establish its current HIMSS Level, which in turn highlights what further technological capabilities the hospital needs to reach the next level of the HIMSS classification. HIMSS Level 7 is often considered a 'gold standard' for the digitisation of hospitals and an aspirational endpoint guiding the design of a hospital's digital strategy.[29]

Policymakers and health care organisations commonly use these frameworks for baseline assessments of current levels of digital maturity and as a roadmap for a desired future state of maturity. As such, these frameworks actively shape the direction of digital transformation.

The key limitations of HIMSS EMRAM (and related approaches) are an almost exclusive focus on technological functionality rather than human and organisational capabilities and a failure to ensure that these are contextualised as enablers of transformation. HIMSS EMRAM also focuses on improving the efficiency and effectiveness of data exchange within hospitals rather than with other healthcare organisations or settings such as primary and

[25] Carvalho JV, Rocha A, Abreu A. Maturity Models of Healthcare Information Systems and Technologies: a Literature Review. J Med Syst 2016 Jun;40(6):131.
[26] Gomes J, Romão M. Information System Maturity Models in Healthcare. J Med Syst 2018 Oct 16;42(12):235.
[27] van de Wetering R, Batenburg R. A PACS maturity model: a systematic meta-analytic review on maturation and evolvability of PACS in the hospital enterprise. Int J Med Inform 2009 Feb;78(2):127-140.
[28] Grooten L, Borgermans L, Vrijhoef HJ. An Instrument to Measure Maturity of Integrated Care: A First Validation Study. Int J Integr Care 2018 Jan 25;18(1):10.
[29] Krasuska M, Williams R, Sheikh A, Franklin BD, Heeney C, Lane W, Mozaffar H, Mason K, Eason S, Hinder S, Dunscombe R. Technological Capabilities to Assess Digital Excellence in Hospitals in High Performing Health Care Systems: International eDelphi Exercise. Journal of medical Internet research. 2020;22(8):e17022.

social care, which is fundamental to the provision of integrated care - often thereby neglecting innovation in service delivery models and social innovation. The portrayal of a single pathway towards excellence, achieved through a series of stages, may also unhelpfully distort priorities. Thus, a hospital could achieve HIMSS EMRAM Level 7 based on having a closed-loop prescribing and administration system, but lack expertise in maintaining it or interrogating the data it generates. In addition, the costs of achieving closed-loop prescribing, which may be justified in terms of improving safety within a hospital, might not be the most pressing priority when considering patient pathways across an "integrated" health service.

> *"I think the other problem that we would describe with GDE, is that it has established a range of targets, so closed loop medicines administration. We are required to do that, to meet our GDE commitment, but that doesn't give any consideration as to whether we want to do that, or whether that would be a key priority for us at this moment in time. So, it is creating a tension between what we want to do and what we need to do." (Site H, GDE, in-depth case study, non-clinical digital leader)*

Although cost is a key driver for procuring digital systems in healthcare, which may be reinforced by models such as HIMSS EMRAM Level 7 focusing purely on technological capabilities, there is now also increasing evidence that cost savings are unlikely to materialise and that the introduction of complex systems can have undesired consequences.

The notion of digital excellence serves an important purpose, providing a vision that can help motivate stakeholders and coordinate activities towards the pursuit of the quadruple aims of improving population health, controlling costs, enhancing patient experience, and improving the working life of healthcare providers.[12] However, new frameworks for assessing digital maturity in relation to these complex and often contradictory goals are needed. These should facilitate setting clear targets and establishing ways to assess progress across diverse providers and settings, while also being agile allowing targets to be updated throughout this journey.

Digital maturity in the GDE Programme

There was no shared model of technology adoption in the NHS and provider organisations had adopted change in a piecemeal manner based on where their priorities aligned with solutions that emerged in the market. However, the GDE Programme required a measure of progress. Therefore, NHS England developed a Digital Maturity Index as a basis for measuring baseline levels of digital maturity.[30] The index was developed in 2013 based on HIMSS EMRAM but included additional dimensions of interoperability, technological readiness, and infrastructure. It was used as a self-assessment for provider organisations to establish baseline levels of digital maturity. Later, it evolved into a Definition of Done including outcomes that GDEs and FFs were expected to achieve during the Programme.

[30] Digital Maturity Assessment. Available from:https://www.england.nhs.uk/digitaltechnology/connecteddigitalsystems/maturity-index/ (last accessed: 06/05/2021).

Over time, this Definition of Done was overtaken by HIMSS EMRAM as a guiding benchmarking criterion for the GDE Programme. The expectation was that GDEs and FFs would respectively achieve HIMSS Level 6 with a view to 7, and HIMSS Level 5 or equivalent accreditation by the end of the Programme. Limitations of this model and its applicability to the NHS were recognised, for example, by setting a lower EMRAM target (Level 5) for GDE mental health providers.

eDelphi study to identify and reach consensus on a defined set of internationally relevant technological capabilities for hospitals

Despite substantive worldwide efforts to promote digital excellence, there is no consensus on how to conceptualise it, what capabilities characterise a digitally excellent hospital, and how to best measure progress in a changing environment. New models are beginning to emerge that acknowledge the importance of locally formed priorities and the changing nature of what constitutes digital excellence over time. We therefore sought to identify and reach consensus on a defined set of internationally relevant technological capabilities for hospitals in order to address current gaps in approaches to conceptualising and assessing digital excellence. Our full study can be viewed elsewhere.[31]

The outcomes of this eDelphi process marked a significant departure from existing tools such as HIMSS EMRAM and the NHS Digital Maturity Index. First, our results pointed to a shift away from the description of purely technological functionalities towards digital transformation capabilities and highlighted a need to be cognisant of cultural and strategic factors, such as skills and resources, to support the digitally enabled transformation of health care. Second, our findings indicated that the concept of digital excellence moved beyond the physical boundaries of acute hospitals. Thus, once a certain level of digitisation and data sharing is achieved within hospitals, strategic direction needs to shift towards sharing data and integration across local/regional/national ecosystems that encompass primary and social care providers and enable patient self-management.

Benefits realisation management in the GDE Programme

Tight coupling of national and organisational benefits realisation

Benefit realisation activities were tightly coupled with release of national funding and with accreditation targets for organisations participating in the Programme. Programme-wide reporting systems were put into place and various initiatives were developed to facilitate reporting (electronic reporting tools, benefits realisation specialists [‘Leads’] seconded to sites). However, provider organisations were already required to submit various sets of reports to their own boards and to national reporting systems. These varied considerably in terms of the content of information collected, frequency, and reporting dates. The requirements of the central reporting system inevitably differed from these many pre-existing organisational reporting systems as these had different informational goals and operated within different timeframes of realising and baselining these.[32] The new reports thus imposed a degree of additional burden.

[31] Krasuska M, Williams R, Sheikh A, Franklin BD, Heeney C, Lane W, Mozaffar H, Mason K, Eason S, Hinder S, Dunscombe R. Technological Capabilities to Assess Digital Excellence in Hospitals in High Performing Health Care Systems: International eDelphi Exercise. Journal of medical Internet research. 2020;22(8):e17022.
[32] Karsh BT, Weinger MB, Abbott PA, Wears RL. Health information technology: fallacies and sober realities. Journal of the American medical informatics Association. 2010 Nov 1;17(6):617-23.

"Yes, there's lots of duplication and I think what they've done is focused on the inputs rather than the outputs so it becomes very labour-intensive to keep it all up-to-date which you wouldn't mind if there was a benefit to it, if it produced your reports, if it produced the outputs they're looking for, but it doesn't." (Site D, GDE, in-depth case study, clinical digital leader)

Programme managers hoped that the new reporting tools could be used to fulfil existing reporting requirements. However, the diverse stakeholder information and reporting requirements were difficult to consolidate, and the content and timing of information collected and programme reports required inevitably differed from existing organisational reporting and project management systems. The apparent duplication of reporting and the fact that reporting systems did not meet local reporting requirements led local stakeholders to emphasise the perceived burden of reporting without obvious local benefit. The resources needed to collect benefits/outcome data locally were high and fell upon organisation members who did not experience benefits from their use.

"… [Programme office] wouldn't insist on that as part of the assurance and if that wasn't linked to the release of funding, then I'm not sure it would get done to that degree, with that degree of rigor. With the best will in the world, you know, if there wasn't a bit of a carrot and stick scenario, I'm not sure how far we'd get with that, so I can completely understand why they've done it, and it is important, just is a very bureaucratic process and takes a lot of time." (Site M, GDE, in-depth case study, GDE programme staff)

As a result, many provider organisations perceived benefits reporting to the programme office as burdensome, time-consuming and resource intensive.

"We knew we had to do benefits and stuff but the amount of work that it's actually taken… It's a bit like the governance or the documentation we have to do, or the benefits stuff we have to do, has almost outweighed the amount of work on projects." (Site F, GDE, in-depth case study, GDE programme staff)

Challenges associated with consolidating various information requirements in a single data collection procedure

Issues also arose about the different informational requirements and criteria of provider organisations and the array of external stakeholders involved in monitoring the GDE Programme (including Her Majesty's Treasury).

The various local and national stakeholder groups had differing responsibilities/concerns. They therefore had varying rationales for benefits realisation and informational needs and placed value on different types of benefits. For example, whilst provider organisations prioritised specific local service improvements, national programme managers were seeking to demonstrate high-level public benefits in order to justify future investments to the treasury and secure prioritisation for digital transformation. They needed post-hoc validation of investment for retrospective assessments of spend and prospective validation of investment for creating future business models. In doing so, they sought to link local

programme outcomes to the health system-wide missions (e.g. improving population health).

> *"So, this is all the cash releasing, non-cash releasing or public money, it's all the money intertwined so it may not necessarily mean cash back to the organisation, it covers it as a whole." (Site E, GDE, in-depth study, GDE programme staff)*

The benefits realisation process operated as if these diverse needs could all be met within a single concerted information collection procedure. However, different constituencies sought different kinds of information to answer different questions. As a result, provider organisations, although understanding the rationale behind the overall approach, struggled with the decontextualised nature of benefits measurement and the demand to link local benefits to high-level national mission/targets. For instance, national stakeholders sought to validate overall outcomes of the programme to demonstrate benefits of digital transformation investment. They were therefore keen to be able to point to aggregate changes e.g. in productivity and quality of care. In contrast, the local experience of qualitative benefits in care delivery, which were of great importance to site members, were more difficult to link to accreditation criteria.

> *"Also this whole thing around benefits realisation is really a bugbear of mine. Because if they want a good qualitative evaluation, then we need to do that separately rather than look at it from a milestone perspective and also give it time to embed to see whether it benefits people." (Site F, GDE, in-depth case study, clinical digital leader)*

> *"I get the point of it and I understand why they do it and I understand that actually they've got to choose some way of measuring me and I can see why they would choose that way of measuring it but it's so…somethings are just so quality driven rather than quantity driven." (Site J, FF, in-depth case study, GDE programme staff)*

Programme managers were acutely aware of the tensions emerging from the burden for organisations because of central reporting requirements. In order to address this issue and consolidate national and local data collection, they revised the benefits realisation process and changed the reporting tool over time from a spreadsheet to a designated automated reporting tool that was upgraded throughout the Programme.

Programme managers envisaged the reporting tool to become a real-time evidence base of IT benefits that could be used to guide national and local investment decisions. This rationale was largely understood and supported by provider organisations. There was a hope that it might be a means to harmonise reporting requirements, and thereby reduce duplication of data collection, but only limited progress had been made in this direction at the time of our work.

The new tool required data migration work from the provider organisations and also additional training work on how to use this new technology.

"We started last year before [new reporting tool] was ready, or some of that wasn't ready, or we weren't using it, so the benefits… we did it one way and then we did another. We did it all on a spreadsheet and we did it all… copy and paste all that in there so you get used to one way and then you do it another way; so with the other reporting it was done on paper and then it was done in the system and… so that was all still developing which didn't help, and just confused me, frankly" (Site M, FF, in-depth case study, GDE programme staff)

This was exacerbated by perceived shortcomings in the usability of the national reporting tool, although there were attempts to address these usability issues and attempts to tailor it to local needs.

"We've had a lot of issues with [tool]. I'd say that [tool] probably gives [programme managers] what it needs, but from a [provider organisation] perspective, we don't like [tool]. It's just the layout of it and everything else, it's very, very different from what we'd probably previously looked at. I mean, it was a big change for us, we had the training and everything, we knew what we needed to do, and even now it's not as user friendly as we would like it in a hospital setting. So it's quite cumbersome really." (Site B, FF, in-depth case study, GDE programme staff)

Broad agreement on the rationale for benefits realisation and uses of data

Despite these challenges, we observed a broad overall agreement across stakeholder groups on the ethos of demonstrating the achievement of milestones/benefits to show due diligence that public money was appropriately spent, and to develop an evidence base supporting the value of digitally-enabled transformation.

Provider organisations, with limited existing benefits realisation capabilities, had to buy in people and employ intermediaries to assist with these activities and help to satisfy national reporting requirements.

"It almost becomes somebody's full-time job just to manage feeding [programme management office] with information." (Site D, GDE, in-depth case study, GDE programme staff)

GDE programme managers had put in place various structures to facilitate benefits realisation, some of which evolved during the Programme. These included a requirement for provider organisations to produce a Statement of Planned Benefits before embarking on programme activities, and appointment of national and local benefits realisation managers who managed the measurement and tracking of benefits over time. This national support and guidance was greatly appreciated by organisations, as benefits realisation expertise was in short supply. Sites also appreciated the support of the national team to help them meet accreditation requirements.

"The support that I've had from the [national Programme] team has been really good in the fact that they've trained me and they've been a constant source of support and resource really when I've needed it." (Site B, FF, in-depth case study, GDE programme staff)

In addition, benefits realisation work was perceived to facilitate the setting of a common direction of travel.

> *"You can have the best system in the world that all works, but unless you sell the story and direction of travel, I think sometimes there is a fascination to get, let's just go for this bit here, and you don't sell them the whole story… I don't think we record the benefits as well as perhaps we should... I don't think enough work goes, which you can then publish to allow others who are embarking down similar programmes to go, wow, that's fantastic." (Site I, GDE, in-depth case study, non-clinical digital leader)*

The national team worked with provider organisations to collate and validate benefits information. Although this was an expensive process, the team leveraged value from the data and used it in new ways (for example to inform other initiatives such as Blueprinting).[33] Towards the end of the Programme, national programme managers had also established a map of baseline measurements and benefits associated with digitally-enabled transformation initiatives at provider organisations. The accumulated resource helped them to support national business cases for future funding of digital transformation programmes.

Embedding of benefits realisation approaches in provider organisations over time

Many burdensome benefits realisation roles in provider organisations were given to temporary appointments, who left at the end of projects. Some sites over time, recognised the benefits of local capabilities and reported increasing embedding of benefits realisation approaches driven by the GDE Programme recognising the value of the approach in implementing change and pursuing quality improvement. This was particularly true for organisations that had coupled quality improvement with benefits realisation from the start and invested in appropriate baselining of benefits information.

> *"We've gone through the right processes and we are focusing on getting solid baseline data." (Site D, GDE, in-depth case study, clinical digital leader)*

Some also mentioned that the benefits management approach encouraged reflection and enabled them to engage in detailed and integrated strategic planning activity, guided by what they wanted to achieve through digitally-enabled transformation from the start.

> *"I think as an IT department, the [provider organisation] has probably learnt that we need to consider how we're putting systems in and not just to put systems in and launch them, so to consider all what's needed, what are the benefits of putting it in, what will the benefits to the [provider organisation] be. So I think that has made us stop and think a bit more about that side of things, rather than just going out there and launching new systems and putting new pieces of kit into places." (Site F, GDE, in-depth case study, GDE programme staff)*

[33] Williams R, Sheikh A, Franklin BD, Krasuska M, Hinder S, Lane W, Mozaffar H, Mason K, Eason S, Potts HW, Cresswell K. Using Blueprints to promote interorganizational knowledge transfer in digital health initiatives—a qualitative exploration of a national change program in English hospitals. Journal of the American Medical Informatics Association. 2021 Mar 11.

The nationally supported approach to benefits realisation was also seen to help promote clinical engagement locally, as managers could demonstrate the achievement of clinical benefits attributable to new digital systems and thereby motivate clinical users to use these systems.

> *"When people are wary of change, we remind them of what a difference it can make to their lives as clinical operational people. So we found that really, really useful." (Site B, FF, in-depth case study, non-clinical digital leader)*

In addition, organisations realised over time that the benefits narrative created by programme managers helped them in making cases for future local funding for digital technologies, as it promoted an increasing recognition of the value of benefits realisation activities in ensuring digitally-enabled transformation as opposed to focusing on technology acquisition.

> *"Well we have to do efficiency as well because they all cost and that's…we know that if we're going to put in closed loop medication to get to stage six, that's going to become a huge cost and there's going to be a revenue trail to that as well." (Site E, GDE, in-depth case study, clinical digital leader)*

Conclusions

Although most stakeholders agree on the overall importance of benefits realisation approaches to support evidencing of investments and facilitating a common direction of travel, the tight coupling of national and organisational benefits created tensions. Here, different stakeholders prioritised different types of benefits and sought evidence about outcomes over different timeframes. These requirements were difficult to harmonise in one reporting tool, and as a result, organisations perceived recording data which was not immediately useful to them as burdensome. This was exacerbated by a perceived lack of usability of the reporting tool - only partly mitigated by improvements to the tool and the increasing Benefits Realisation Management (BRM) capability (and familiarity with the tool) within provider organisations.

The impact of the GDE Programme in promoting digital transformation in provider organisations that took part in the Programme

Impact of the GDE Programme on stimulating digital transformation locally

The GDE Programme accelerated/advanced digital transformation in participating provider organisations. This was principally achieved through participating provider organisations using the resources provided by the Programme to upgrade their digital infrastructure often by procuring/implementing complex information infrastructures (such as EHRs and ePrescribing systems) as well as a portfolio of smaller scale applications.

> *"[The GDE Programme] empowered something we were going to do anyway and allowed us to jump very quickly and get an EPR [Electronic Patient Record] rolled out across [multiple] hospital sites. It paid for a lot of things like the wireless infrastructure that needs to then support that." (Site 12, FF, case study, clinical digital leader)*

Relatively modest central funding, coupled with the perceived status of being selected for the programme, helped to change attitudes and foster a positive culture within and between participating organisations.

> *"So, it's a tiny, tiny percentage of our turnover. It's had a massive impact… on people's attitudes and way of working." (Site 4, FF, broader study, digital leader)*

The Programme's accreditation process documented strong progress across participating provider organisations in meeting digital transformation goals – including HIMSS EMRAM targets – notwithstanding delays resulting from the COVID-19 pandemic.

> *"The big gain is that it's actually pushed us to go further faster (…) it pushed us to actually get to the HIMSS [target], process that probably we would have done a long time ago but just didn't have the impetus (…) to do it." (Site 9, FF, broader study, senior manager)*

Additional outcomes associated with the Programme included setting up and strengthening project management and governance structures for the management of complex HIT change projects within organisations. These enabled rapid and sustained digital transformation over the duration of the Programme and for some provider organisations perhaps also beyond. As part of the Programme, many provider organisations also developed or re-vised and updated their organisation's digital strategy, roadmaps and goals. Finally, the Programme laid foundations for the development and expansion of clinical digital leader-ship roles starting with the CCIO role and expanding to other clinical digital leadership roles including CCIO and CNIO role. In many cases, informatics specialists were at the hospital board's level promoting the strategic prioritisation of digitally-enabled transformation expertise within organisations.

In a small number of cases, organisations encountered unanticipated difficulties and progress was slower than expected. Sometimes this was the result of external factors, e.g. when organisations experienced financial difficulties, which diverted attention away from the Programme; or when organisations encountered problems in implementing the full range of new functionality required which was often linked to the vendors' difficulties with delivering on time. Some organisations also encountered difficulties in relation to finding people with right skillset to implement digital transformation projects.

> *"One of the biggest difficulties has been recruitment. So, it's one thing having the money, it's another thing being able to turn that money into good people. And, we've found that really difficult, so while it has accelerated us, it hasn't accelerated us (…) as fast as we would have liked." (Site C, GDE, in-depth case study, senior manager)*

Three key aspects of the Programme were fundamental to advancing digital transformation and associated outcomes in the provider organisations: (i) earmarked funding and the requirement for matched internal funding, (ii) the prestige and reputational advantages

derived from being selected for a flagship national HIT change programme and (iii) governance requirements. These together ensured a high level of engagement at board and divisional levels and clinical engagement across the organisation with the result that GDE became a programme for digital transformation rather than merely technology adoption. Below, we describe how these three aspects produced digital transformation and associated outcomes in provider organisations. In doing so, we also describe how provider organisation characteristics impacted on the mechanisms and degree to which organisations were able to achieve these ambitious goals.

Earmarked funding stimulated digital transformation locally

Dedicated funding, comprising external funding (allocated from a central national budget) and matched funding from the provider organisation's internal budget, played a key role in accelerating digital transformation of participating provider organisations Funding was used to support and bring forward major upgrades in digital information infrastructures (including renewing core EHR systems) together with a range of smaller-scale digital change projects such as implementation of electronic observations systems or projects to support staff working remotely in the community. Many organisations reported that plans for these changes were already in place prior to the launch of the Programme.

> *"It enabled us to do things, because of the money, it enabled us to do things that we would have done anyway, at twice the speed, (…) but there is something about scale and there is something about speed, which brings a value that is greater than achieving it in twice the time." (Site D, GDE, in-depth case study, GDE programme staff)*

The scope to secure external funding, combined with a requirement for matched funding, also helped to secure local leadership buy-in and support for the Programme and the associated local portfolio of HIT change projects.

> *"[Central NHS money available through the GDE Programme] was enough money to make a case to our finance director and the acting chief executives that we should do it [GDE Programme], because it was money we wouldn't get otherwise, for a thing we wanted to do anyway." (Site G, GDE, in-depth case study, clinical digital leader)*

Protected longer-term funding was especially important in driving digital transformation for smaller provider organisations with correspondingly smaller internal budgets. For the largest organisations, external GDE Programme funding was modest in relation to their overall digital investments. In particular, some of the large provider organisations had substantial development capabilities and large technology budgets that had allowed them, in some cases, to begin planning and implementing comprehensive digital change strategies ahead of the GDE Programme. They had already achieved a certain momentum ahead of entering the Programme. As a result, participating in the Programme strengthened but did not per se transform the digital strategies and capabilities of these organisations in the dramatic way that could be observed in smaller and less digitally mature providers. For those provider organisations, GDE funding allowed them to bring forward their digital

transformation plans. Provider organisations described this support as accelerating the rate of change but not radically changing the direction of their prior digital journey they were able to achieve more as a result of these additional resources.

> *"My reflection on the GDE process is that I don't think we would have done this without it. I think we always wanted to do it and it gave us the opportunity to do what we wanted to do anyway but we would not have been able to employ this people, we would not have been able to pay [vendor] to deliver the extra functionality, we wound not have been able to pay me for two years to provide some clinical input." (Site G, GDE, in-depth case study, clinical digital leader)*

This momentum and ambition for change continued beyond the end of the programme.

> *"So it has focused…just by the injection of money rather than anything else, the money has enabled us to buy products which when you start delivering them, you then can't really stop, so although the £10m isn't enough, it's now made it an issue that we benefit from this if we did a bit more and we spent a bit more." (Site I, GDE, in-depth case study, clinical digital leader)*

Provider organisations perceived that the provision of national support primarily through capital funding, as opposed to revenue funding, impacted on local digital transformation initiatives, as it promoted investment in purchasing hardware and software. The administrative complexity of converting capital funding into revenue streams meant that investing in staff and third-party services to maintain, service, support, upgrade, and optimise systems was somewhat neglected.

Prestige and reputational benefits derived from participating in a flagship national Programme helped to secure organisational buy-in and to negotiate with vendors

Prestige and reputational benefits obtained through taking part in a flagship national HIT change programme and competing for the status of a 'Global Digital Exemplar,' were instrumental in securing leadership buy-in for the portfolio of digital transformation projects in many participating provider organisations. The perceived prestige linked to the Programme also helped to secure wider organisation support for the digital transformation efforts. In many cases, the 'Global Digital Exemplar' badge has been used to communicate the upcoming HIT change projects (e.g. EHR upgrade, or implementation of electronic observations) across the organisation, for example through posters and newsletters.

> *"[The GDE Programme and its agenda] was helpful both from a reputation and to badge it all in a concept of…it gave people a…rallying cry around our direction of travel." (Site 12, FF, broader case study, clinical digital leader)*

The benefits of enhanced national visibility and status from participation in the programme were less evident for those provider organisations with a strong prior national or international profile. Smaller provider organisations with modest local profiles reported that taking part in the Programme allowed them to be more visible and recognised locally and thus also have more impact on local decision making.

"Reputationally, we're considered regionally as digitally mature, and that's quite a battle to fight. Not necessarily with other mental health or community [provider organisations] but certainly with the larger acutes … you kind of have to earn your place. You do have to earn your place around the table and some of the things that we've done in GDE have enabled us, to use a very common expression at the moment, a more sort of level playing field." (Site E, FF, in-depth case study, GDE programme staff)

Provider organisations further noted that the reputational benefits associated with the Programme increased their negotiating power with vendors. Large provider organisations that were recognised nationally and internationally as leading centres were often invited to become reference sites for certain product implementations, and secured allocation of additional resources from vendors. Smaller, less prestigious provider organisations in contrast often found themselves competing over vendor resources with other customers including other provider organisations taking part in the Programme.

"I think if you speak to our finance director… he would say it's the [vendor] relationship that's the most valuable part of the GDE ...being part of the GDE process, he thinks, gives him much more leverage with [Vendor] to actually deliver what they've promised. Cause quite frankly, if they don't deliver it with us, then they won't be able to sell to other organisations, 'cause we will be their site, where everyone will come and see all their solutions together." (Site I, GDE, in-depth case study, GDE programme staff)

Programme governance requirements supported establishment of project management structures, secured executive buy-in and strengthened clinical digital transformation leadership in provider organisations

The contractual obligations laid out in the funding agreement each participating provider organisation signed with the central funding body (including an outline of a portfolio of HIT change projects to be undertaken with timescales, funding milestones, provider organisation's digital strategy and a Statement of Planned Benefits) prompted provider organisations to prepare and then execute a portfolio of HIT change projects in a relatively short period of time. Further, although this was not a formal obligation, there was also an expectation for the provider organisations to set up a local GDE Programme Board (though some organisations chose to set up digitisation programme boards that oversaw all of the HIT change projects taking place in the organisations at the time including but not limited to the GDE Programme ones) to oversee the deployment of the Programme locally. These in turn supported the creation and expansion of project management and governance structures within provider organisations to support the implementation of the HIT change projects outlined in the funding agreement. The requirement to meet the milestones set out in the funding agreement, combined with well depicted digital transformation goals, helped to secure executive support for the portfolio of HIT change projects and helped to make the transformation agenda more salient at the executive level.

"I think one of the main parts that was really effective is the pace-setting element of the GDE. (…) The pace-setting as part of the programme was a massive part of achievements. And I think the reason for that is it really focuses the board. Because you have essentially money attached to a deadline to achieve something, that's extremely motivating. And in [provider organisations] where you have so many competing priorities (…) I thought was very effective actually that we had to hit certain milestones with good quality and that then funding would be achieved. And I think that really helped focus the board. And because of that, we had a really, I think, strong functioning Digital Oversight Committee through the programme and that's one of the things that kept the momentum going." (Site 10, GDE, broader study, clinical digital leader)

Although the funding agreements laid out a timetable of contractual commitments, over time as the Programme progressed in the provider organisations, barriers were encountered and the context, technologies and local priorities changed. Some provider organisations experienced difficulty in meeting the contractual obligations and milestones and highlighted the rigidity of the funding agreements given the dynamism and uncertainties surrounding digital transformation. Although it was possible to renegotiate funding agreements, this process was seen as slow and time-consuming.

"Yes, we can set milestones for six months or twelve months but trying to set a milestone for three years' time when IT changes, the organisation changes so quickly." (Site D, GDE, in-depth case study, non-clinical digital leader)

Another aspect of centrally introduced governance requirements was a mandatory requirement to appoint a CCIO – a senior leadership role within provider organisations combining clinical and digital transformation expertise ahead of the Programme. This requirement was critical in helping provider organisations to build capacity to manage and lead digital transformation projects. The CCIOs also had a major role in securing and enhancing clinical engagement in the digital transformation process and in co-designing of the systems to ensure they would be fit for purpose in the clinical context. Further, it contributed to raising the awareness and priority of the digital transformation agenda within senior leadership. The appointment of a CCIO within the provider organisations further promoted the creation of a number of related senior leadership positions combining clinical and digital expertise such as CNIO, Chief Medicines Information Officer (CMIO) and deputy CCIOs responsible for specific sub-disciplines (e.g. Cardiology, Oncology).

"We wouldn't have had CCIOs if we weren't a GDE really, I think the GDE opportunity coalesced in the IT department which was very IT driven to actually, well, we need to engage clinicians in this, otherwise we won't get this money [from GDE Programme], we've got to show that we've got clinical involvement." (Site I, GDE, in-depth case study, clinical digital leader)

The strengthening of digital informatics capabilities was reinforced by changes in the whole sector including the establishment of the NHS Digital Academy – an NHS training

programme that aimed to develop a new generation of digital leaders to drive digital transformation.

> *"Going through… the Digital Academy has really helped in this kind of difficult phase where you're looking at projects, programmes, organising, whole organisations around it. I mean I'm falling back on some of the stuff we did there quite a bit now actually and I was, I realise how inexperienced we were when we started." (Site E, GDE, in-depth case study, clinical digital leader)*

Finally, as part of the GDE requirements, participating provider organisations were expected to achieve high levels of performance under HIMSS EMRAM. Their ability to meet these ambitious targets within the relatively short timeframes of the GDE Programme was greatly influenced by their choice of vendor. Some (US) vendors that had recently entered the market offered comprehensive 'mega-suites' already well-aligned with the wide range of functionality required to meet the HIMSS EMRAM accreditation criteria. Many GDE providers turned to these solutions in order to meet the ambitious aims of the Programme. Other EHR adopters who stayed with their existing EHR vendor sought to bridge the gap by requesting their vendor to extend their range of functionality or by procuring and integrating modules from other vendors (a strategy that came to be described as BoB). These provider organisations and their vendors thereby embarked on an unpredictable journey that posed challenges for both sides. Some vendors struggled to deliver the new functionalities required within the timeframe of the GDE Programme. In addition, the growth in demand due to the Programme was such that even some large vendors were unable to provide the level of support expected by individual provider organisations.

Conclusions

The GDE Programme has successfully accelerated digital transformation in participating organisations and established the foundations for a digital health learning ecosystem. It appears to have achieved this through relatively modest levels of protected funding, putting in place governance structures, and through harnessing reputational benefits for participating provider organisations. It is now important that learning from this initiative is maximised in efforts to bridge the digital divide across provider organisations.

Chapter 5: Planned spread mechanisms under the GDE Programme between GDEs and FFs

The GDE Programme's attempt to establish a digital health learning ecosystem was accompanied by related national initiatives, including professional training and education. Specific mechanisms to promote inter-organisational knowledge transfer included:

1. **GDE/FF pairings**: Pairing digitally advanced exemplar provider organisations (GDEs) with partner organisations (FFs) who would follow and learn from GDEs throughout the duration of the Programme. The rationale for the pairings varied amongst various stakeholders we consulted, with no official documentation on the issue. Most organisations appeared to choose their own partners. Other pairings were established by external stakeholders. Types of care settings were paired with each other so that mental health organisations were paired with other mental health organisations and acute organisations were paired with other acute organisations.

2. Establishing a series of national **learning networks** to promote knowledge transfer among participating provider organisations and across the wider NHS.

3. **Blueprinting**: Asking all participating provider organisations to produce documents (Blueprints) capturing implementation/adoption/optimisation experiences.

In addition, GDE and FF provider organisations were required to pair up with international partners. Though international links were established, [34] the very differing circumstances of overseas partners in radically different settings reduced the applicability (and thus the direct value) of their experiences and solutions for UK provider organisations. Though international experiences were seen as helpfully broadening general understandings of best practice,[35] the (high) costs of maintaining links and limited learning benefits proved insufficient to warrant sustained intensive bilateral partnerships.

This chapter will focus on exploring knowledge sharing through GDE/FF relationships and through Blueprinting (which overtook Learning Networks). Chapter 6 will provide an integrated overview of these knowledge transfer mechanisms.

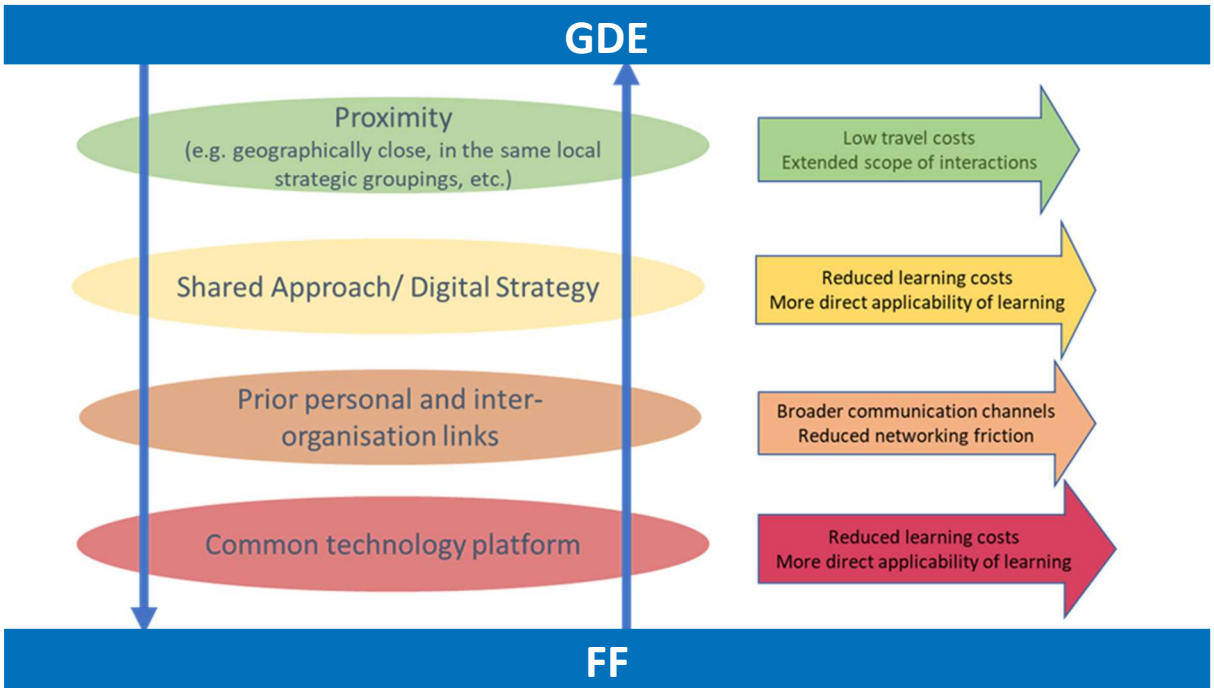
[34] For example, Luton and Dunstable's Global Digital Exemplar programme team visited the Hospital de Cascais in Portugal, one of 3 European hospitals that had by then achieved HIMSS EMRAM Level 7. Luton & Dunstable University Hospital Board of Directors Minutes of Board Meeting 25 July 2018, available at: https://www.bedfordshirehospitals.nhs.uk/documents/board-minutes-25th-july-2018/ last sampled 1 May 2021

[35] In this period, seminar presentations by international players attracted members of multiple NHS organisations members. For example, experiences at Hospital de Cascais were shared more broadly to UK NHS players through seminars organised by the Nuffield Trust https://www.nuffieldtrust.org.uk/person/ana-rafaela-prado and by Digital Health Rewired https://www.digitalhealth.net/2019/03/ex-portugeese-hospital-ceo-gives-international-view-on-digital-maturity

Promoting inter-organisational knowledge sharing through the concept of Fast Follower

Factors promoting informal networking between GDE and FF sites are shown in Figure 3.

Figure 3: Factors promoting informal networking between GDE and FF sites



Enhanced learning and accelerated adoption of technologies

GDE/FF partnerships reduced the cost and increased the pace of digital transformation. Our review provided evidence for this drawing on the experiences of sites. We found that most interviewees believed the formally established GDE/FF relationship had enhanced knowledge exchange and accelerated adoption of technologies. This knowledge transfer was not just about technical matters – it included, for example information governance, training, change strategies, care pathways and advice on clinical engagement.

> *"Certainly, in our experiences with [Fast Follower] is they would say they have learned a lot in terms of the way we use clinical support, the way we do testing…so they learned a lot from our groups" (Site D, GDE, in-depth case study, GDE programme staff)*

Respondents highlighted the time and cost saving resulting from the GDE/FF relationship. Rather than starting from scratch, sites felt able to take on board solutions developed by their partners in the knowledge that these solutions had proved safe and effective in similar organisation.

> *"And we didn't spend weeks and weeks reviewing it, we spent, you know, a two hour session understanding, with the right people in the room, what (GDE) did...And it's taken them five years to develop it and we did it in, you know, in one year." (Site L, FF, in-depth case study, clinical digital leader)*

Though the GDE programme's initial conception and the very terminology of 'Exemplar' and 'Fast Follower" suggests a one-way flow of information from exemplar (GDE) to follower (FF), most respondents pointed to two-way knowledge transfer, with GDEs also learning from their FFs.

> *"So I sometimes, jokingly, call [FF partner] our fast forwarder. Because they, to me, are new eyes on things that we have, and they see things differently, and have suggested places we could improve our solution." (Site 20, GDE, broader study, non-clinical digital leader)*

Some FFs were not happy with the label Fast Follower where they did not see themselves as lagging behind in competence and capability and it therefore did not reflect the actual relationship.

> *"Because we're moving forward, aren't we… I'm not sure I want to follow. And I think we want to be alongside with them. (Site F, GDE, in-depth case study, clinical digital leader of the FF)*

In some cases, the GDE/FF relationship resulted in cycles of improvement where FFs tested a newer version of the system and this in turn had the potential for GDEs to save valuable time when implementing the same upgrade.

> *"[Our FF] went live with a system that was much more developed, and it was two years more up to date… So we were able to share now and look into the content that they had, and we can copy that back in. So it increases and accelerates our ability to keep up to date." (Site 8, GDE, broader study, clinical digital leader)*

In other words, the partnerships had initiated a process of mutual (or at least bilateral) learning between GDE and FF.

Uneven impacts of formal GDE/FF arrangements

There were however circumstances in which these partnerships ran less smoothly. In another case, knowledge was not effectively shared between a GDE and FF adopting the same system as the FF was implementing a newer version of the package and did not feel they had much to learn from their GDE. We also observed a few sites where the formal programme pairing arrangements were proving less effective. These sites expressed concern about how their GDE/FF combinations had been chosen. The pairings had been set up under time pressures resulting from the short timeframes in which the GDE Programme had been developed and launched. Sites generally sought to establish partnerships with organisations they were already collaborating with. However, this sometimes conflicted with the programme strategy, which, for example, encouraged partnerships between sites using the same core platform. In addition, acute hospital providers were only allowed to pair with other acute hospitals, and mental health services with other mental health services. Thus, the CIO of an acute GDE, partnered with an FF using the same platform but two hours' drive away, would have preferred to have a local mental health provider as their FF.

"So we wanted to look at our community mental health [provider organisation] as a Fast Follower, rather than another acute [provider organisation]… So that was our preferred route as a Fast Follower because we could see the benefits of integration and how you could tell a story of an integrated healthcare system. But unfortunately, that didn't fit the model of, you couldn't have a community mental health fast-follower, to an acute [provider organisation] because it didn't fit the GDE model." (Site D, GDE, in-depth case study, non-clinical digital leader)

Where the GDE/FF pairing did not emerge from existing links, there was a need to build relationships with consequent greater uncertainty about outcomes.

"And the truth is, it's not worked anything like as well as [additional FF], has it? ... I think that was partly because we just didn't know the people there at the outset… it just meant that things didn't get done that might have got done otherwise." (Site 13, GDE, broader study, clinical digital leader)

Although the design of the GDE programme conceived the GDE/FF relationship as revolving around the production of and adoption of Blueprints, there was little evidence that these were a significant channel for knowledge transfer between the GDE and FF. One reason was that GDEs were so busy implementing new systems they did not initially have time to write Blueprints, which were produced at a later stage. Knowledge was instead transferred between the GDE and FF through direct contacts: site visits, phone calls and videoconferences and other electronic exchanges, and/or attending each other's committees. These proved to be a more effective vehicle for sharing and support than a formal Blueprint document.

"I haven't seen a Blueprint from [our GDE] for example, [they] don't have a Blueprint for [specific application] yet, as far as I'm aware, I haven't seen one, although we are creating one ourselves." (Site M, FF, in-depth case study, GDE programme staff)

Enablers and barriers to organic knowledge transfer between GDEs and FFs

Knowledge transfer, and in particular the explosion of informal networking, was driven most immediately by the benefits participants derived from exchanging knowledge and experience with their peers. By examining variation in the experience and effectiveness of knowledge exchange between sites, we can identify various enabling and inhibiting factors at play. The uneven contours of informal networking reveal the factors that enhanced the benefits and enhanced the benefits and learning and reduced the coordination costs of knowledge sharing.

Shared technological platform

Where an FF has the same core technology platforms as its GDE (e.g. EHRs and Hospital Electronic Prescribing and Medicines Administration [HEPMA] Systems), learning could be more readily applied and offered greater benefits as sites could readily adopt elements of their solutions (including system configurations and workflows which had often been arduous to produce) without much need to amend them.

"So we are Fast Followers to [named GDE]. Specifically, truly the real fast following with [this site] is about ePrescribing. So the whole HEPMA project. We have worked extremely closely with them. We have more or less cut and pasted all their workflows, all their pharmacy workflows, all their drug administration workflows… we've actually paid for time of their lead project pharmacist. They have attended all our design workshops in the early days…without that involvement, the project would have taken longer…I think the result is safer and more robust than it would have been if we had done it without their help." (Site L, FF, in-depth case study, non-clinical digital lead)

Geography

Many of the GDEs had selected FFs that were in close proximity. This was useful in terms of reducing the time and money costs of travel. It thus also facilitated more intense forms of collaboration. One GDE/FF partnership decided to create a joint procurement team as a result of their successful collaboration. In another provider organisation, the proximity of the GDE site meant a clinician could come over and test their system.

"And then luckily for us we have one of the clinicians working on our site on Tuesdays and Thursdays… So I've given her access to our system, our test systems for her to just go in and test and then see where we need to improve upon, because they've used it for quite some time… So it's like lessons learnt. So she's been really, really helpful." (Site M, FF, in- depth case study, GDE programme staff)

Proximity, also, was associated with other enabling factors related to knowledge transfer, including inter-personal (see below) and institutional linkages. Nearby sites were often within the same STP/ICS – the emerging regional coordination structures, which became increasingly salient in the course of the GDE Programme. These institutional linkages could help in developing a common digital strategy and broader outlook. There were some instances where collaboration was inhibited by specific local factors (e.g. historic competition, performance issues, changes in leadership, mergers).

We also found evidence of successful GDE/FF partnerships at greater distance. Geography was no barrier when the benefits of learning and sharing were perceived to be substantial, with networking often facilitated by other enablers such as prior collaborations, interpersonal relationships, similarity of platform and a shared philosophy of sharing for the benefit of the NHS.

"(Non-clinical digital leader) I don't know that there are advantages. I mean it would be interesting to work with a [provider organisation] that we haven't worked with up till now. Obviously, you haven't got the STP. You haven't got the local structures to make that make sense. But in actual fact we work remotely most of the time from [site]. So the physical nearness is perhaps less important than we would've thought two years ago.

(Senior manager) Rather than the enthusiasm of somebody that actually wants to work with you, which I think is very important." (Site L, FF, in-depth case study, non-clinical digital leader and senior manager)

Peer-to-peer prior relationships

Proximity is also related to the greater likelihood of prior linkages between the individuals and groups in the organisations involved. Some interpersonal relationships of key staff resulted from previous experience of working together or from staff movements between sites. In the case of Site M, the project manager for implementation of the Clinical Data Repository (CDR) had previously worked on the same project for the GDE. At Site F, the CIO already knew staff at the FF site some distance away. Some relationships were based on pre-GDE collaborations. One respondent observed that these kinds of links could encourage greater openness to external ideas.

"I think with the Blueprints, no matter how good they are you've still got a locked door of people who will want to come up with it themselves and you have to change that mind-set there. And I think you do that by getting people moving around." (Site H, GDE, in-depth case study, senior manager)

Conclusions

The GDE/FF pairings have resulted in enhanced inter-organisational knowledge transfer and accelerated technology adoption in participating organisations. They were most effective where they were buttressed by a growth in informal networking that was driven by the mutual benefits of knowledge sharing. Variations between sites in the intensity of informal networking highlighted incentives and barriers at play. Thus, the benefits of knowledge sharing were enhanced where there were common technological platforms and comparable context. Physical proximity and prior linkages reduced, respectively, the travel and coordination costs of networking. In contrast to the Programme's terminology that projected a one-way flow of knowledge from Exemplar to Fast Follower, knowledge transfer was bi-directional, characterised by reciprocal and ongoing exchanges. Sites felt a partnership model would have been more effective without restrictions on the choice of partner.

Using Blueprints to promote inter-organisational knowledge transfer in digital health initiatives

A key mechanism for achieving knowledge sharing was intended to be through the production of Blueprints: the Programme's architects envisaged that GDE sites would "*partner with other hospitals as their Fast Followers (FFs) and develop Blueprints that take the insights and deployment experience of the GDEs and core technical "build" of their system, and work with these FF organisation to implement Blueprints*".[36] Blueprints came to be seen as the key vehicles for conveying the knowledge needed to select and implement 'proven' models of change. Wider uptake of tried and tested solutions within and beyond

[36] Swindells M, Smart W. Progressing the acute global digital exemplar.2017. https://www.england.nhs.uk/blog/progressing-the-acute-global-dig-ital-exemplar/Accessed August 01, 2020.

the GDE Programme was planned to be supported by the establishment of Learning Networks and a digital platform to disseminate Blueprints.[37]

In the context of enduring concerns about the limited success of earlier national programmes to spread good practice across the NHS, issues about the effectiveness of the Blueprinting process have become salient. A 2020 National Audit Office report on *Digital transformation in the NHS* expressed a view that Blueprints "might not be enough to spread good practice… to other provider organisations as intended."[38]

The (changing) conceptualisation of Blueprints in the GDE Programme

The origins of the Blueprint concept within the GDE Programme are not well documented. The term Blueprints does not, for example, appear in the Wachter Review,[39] on which the GDE Programme was based. However, the concept of Blueprints already featured in discussions within the NHS prior to GDE.[40] It had, for example, gained some currency within the NHS under the 2015 NHS England Vanguard Programme, which invited organisations to take *"a lead on the development of new care models which will act as the Blueprints for the NHS moving forward and the inspiration to the rest of the health and care system"*.[41] The term 'Blueprint' appears in the earliest pronouncements about the GDE Programme.[42] An early (March 2017) NHS England announcement highlights the role of Digital Exemplar hospitals:

> *"Not only to become great, but to work with other acute* [provider organisations] *to develop a Blueprint [our emphasis] that can be deployed to other hospitals, reducing the time and cost for further adoption. Our intention is that, in the future, hospitals won't merely choose an IT vendor, they will choose a hospital that they want to partner with and implement the same system, keeping the IT 80% the same and making only the 20% of changes that are absolutely necessary to meet local needs."* (NHS England 2017: p.65)

The engineers' view of Blueprints (the 'cookie-cutter' model)

An authoritative series of blogs in this period by Matthew Swindells (NHS England's National Director: Operations and Information) and Will Smart (CIO Health and Care in England), elaborated on these ideas. They called for standardisation around proven solutions as a way

[37] What are Blueprints and how will NHS trusts benefit? Available from: https://www.england.nhs.uk/expo/wp-content/uploads/sites/18/2018/09/13.30-Leapfrog.-how-Global-Digital-Exemplar-Blueprints-can-accelerate-your-transformation-T2K.pdf (last accessed: 01/08/2020).
[38] Digital Transformation in the NHS. Available from: https://www.nao.org.uk/report/the-use-of-digital-technology-in-the-nhs/ (last accessed: 01/08/2020).
[39] Making IT work: Harnessing the power of health information technology to improve Care in England. Report of National Advisory Group on Health Information Technology in England. Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/550866/Wachter_Review_Accessible.pdf (last accessed: 01/08/2020).
[40] Improvement Guides. Available from: https://improvement.nhs.uk/resources/ (last accessed: 01/08/2020).
[41] Vanguards - developing a blueprint for the future of NHS and care services. Available from: https://www.england.nhs.uk/wp-content/uploads/2015/11/new_care_models.pdf November 2015 (last accessed: 01/08/2020).
[42] We must make IT compelling for clinicians. Available from: https://www.england.nhs.uk/blog/we-must-make-it-compelling-for-clinicians/ 31 October 2017 (last accessed: 01/08/2020).

of reducing the time and cost of current procurement methods based on *"point by point evaluation of systems"* by individual provider organisations, suggesting that this would deliver *"discounted costs"* from vendors: *"If the GDE Programme is successful and offers a range of proven partnerships and solutions, why would any hospital pick an unproven system?"*.[43] Swindells suggested that, with what he describes as a *"cookie-cutter model"* of Blueprints *"nobody will run procurements to buy IT systems again".* Instead, provider organisations *"will run an evaluation"* to select from existing proven Blueprints.[44]

This conception was supported by some senior programme managers who had joined NHS England with an industrial background in the automotive and aerospace sectors, who anticipated opportunities to achieve the kinds of standardisation of processes that have been achieved in global manufacturing organisations. A few specific sites would develop, test and optimise models for digital change that would then be rolled out to hundreds of sites. This view of standardised procurement revolves round the original meaning of the term Blueprint, which arises in the construction and engineering industries in reference to a method for accurately copying technical drawings by making contact prints on light sensitive paper.[45]

Swindells' idea of eliminating the need for provider organisations to run competitive procurement exercises raised complex difficulties under competition law. There are more fundamental questions about whether this cookie-cutter model, derived from manufacturing standardised products, would succeed with health service digitisation.[46] In particular, the Wachter Review had argued that to implement Health IT you cannot *"simply follow a recipe or a checklist"*; instead this kind of *"adaptive change"* requires *"substantial and long-lasting engagement between those implementing the changes and the individuals tasked with making them work"* (front-line users: whether healthcare professionals or patients).

Blueprint as a networking tool: a live document that allows people to seek further information

A strikingly different conception of Blueprints, more in line with the concept of adaptive change, was subsequently articulated by the Blueprinting and Learning Network Steering Group, established in the summer of 2017. GDE Programme leaders brought external consultants and then leading GDE sites into this Group to develop the concept of Blueprinting and pilot their production over a five-month period (December 2017 – April 2018).[47] A set of *Frequently Asked Questions* produced by the Group notes that previous

[43] Matthew Swindells and Will Smart, 'Future Development in Global Digital Exemplars' Blog (Digital). Available from: https://www.england.nhs.uk/blog/future-development-in-global-digital-exemplars/ (last accessed: 01/08/2020).
[44] GDEs should remove need for procurements, says Swindells. Available from: https://www.digitalhealth.net/2017/07/gdes-will-change-procurement-models-swindells/ (last accessed: 01/08/2020).
[45] The History of Blueprints. Available from: https://blog.plangrid.com/2016/04/the-history-of-blueprints/ (last accessed: 01/08/2020).
[46] Hanseth O, Bygstad B. Flexible generification: ICT standardization strategies and service innovation in health care. European Journal of Information Systems. 2015 Nov 1;24(6):645-63.
[47] Global Digital Exemplars Blueprinting update and next steps. Available from: https://www.ehealthweek.himss-

"one size fits all" Blueprints (citing the NPfIT which assumed that all organisations would follow a uniform approach) had limited impact, and argues instead that *"it is important to highlight the different approaches to implementation that work in a local context"*.[48] The Blueprinting Framework that was eventually developed by this group offers a sophisticated model of how Blueprints may become a vehicle for knowledge transfer – as *"live documents that drive people wanting to benefit from GDE experiences to seek further information"*.[49] It highlights that Blueprints *"can be viewed through a range of lenses", in part due to the differing requirements of 'different audiences"* (hospital boards, CIOs, implementation and clinical teams). As well as being applied at *"varying levels"*, Blueprints may have *"different levels of abstraction"*.[50] Boards, for example, might look for technology agnostic Blueprints, while technology implementation teams would find value in technology specific Blueprints.

A subsequent presentation to the Health and Care Innovation Expo 2018 explicitly contrasts this evolving conception with the engineering view of Blueprint as standardisation. Thomas and Charnley's presentation mapped out a sophisticated account of Blueprints as an enabler of learning. Thus, Blueprints would be "*story-like – a compelling narrative of actions and events..."* that could *"instruct without dictating [and] accommodate the adaptive component of change"*.

Today Blueprints are promoted by NHS England as *"a structured collection of knowledge assets and associated methodology for using them…." [encompassing] "organisational leadership and culture, technical guidance, clinical and staff engagement as well as the people and processes required to deliver the benefits of technology"*.[51] [52] The Blueprinting platform now includes videos and webinars as means of communication.

There was thus a remarkable shift in how Blueprints were conceived, from their initial conception as a vehicle for capturing and transferring knowledge needed for implementing tested digitisation models, to seeing them as a means for sharing *deployment experience* and as a *networking tool*. Although senior policymakers had espoused a 'cookie-cutter' view of Blueprints (originating in manufacturing engineering) as a means of standardised procurement, this gave way to the strikingly different conception of Blueprinting emerging from the provider organisations producing and using Blueprints.

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uk.org/sites/ehealthweek/files/sponsors/presentations/GDE_1/paul_charnley_-_blueprinting.pdf (last accessed: 01/08/2020).

[48] Global Digital Exemplars – Blueprinting: Frequently Asked Questions (FAQs) (internal GDE document, version 1.0 no date; circulated December 2017)

[49] Global Digital Exemplars: Blueprinting update and next steps, presentation for e-Health Week. Available from: https://www.ehealthweek.himss-uk.org/sites/ehealthweek/files/sponsors/presentations/GDE_1/paul_charnley_-_blueprinting.pdf (last accessed: 01/08/2020).

[50] Health Catalyst (2017) Presentation for NHS England Blueprinting Workshop January 2018 (confidential draft).

[51] Global Digital Exemplar Blueprints. Available from: https://www.england.nhs.uk/digitaltechnology/connecteddigitalsystems/exemplars/gde-blueprints/ (last accessed: 06/05/2021).

[52] Global Digital Exemplars – Blueprinting: Frequently Asked Questions (FAQs) (internal GDE document, version 1.0 no date; circulated December 2017)

This points to significant process of policy learning in the course of the GDE Programme involving policymakers and provider organisations. However, as we see in the next section, this change created difficulties in relation to the implementation of the Blueprinting concept. There are policy dilemmas here: i) about how policy can be adaptive without creating confusion amongst its intended audiences – which may require greater investments in communication and engagement – and ii) about timescales – that the evolved policy may arrive too late to be implemented within short-term change programmes.

Three key themes emerged from our analysis: 1) From Blueprints to Blueprinting: the evolving conceptualisation of Blueprints over time; 2) The production of Blueprints; and 3) Use of Blueprints including unanticipated use as a networking tool. These are next explored in more detail.

From Blueprints to Blueprinting: the evolving conceptualisation of Blueprints over time

The new conception highlighted that Blueprints *"can be viewed through a range of lenses"*, in part due to the differing requirements of 'different audiences' (hospital boards, CIOs, implementation and clinical teams). Boards, for example, might look for technology-agnostic Blueprints, while technology implementation teams would find value in technology-specific Blueprints.[53] Thus Blueprints would be *"story-like – a compelling narrative of actions and events..."* that could *"instruct without dictating [and] accommodate the adaptive component of change"*.[54] This pointed to significant process of policy learning in the course of the GDE Programme involving policymakers and provider organisations.

However, these competing conceptions and changes over time in the model of how Blueprints would convey learning created difficulties for the provider organisations charged with implementing the Blueprinting concept. Site A's Digital Lead flagged a key uncertainty about the intended role of the Blueprint, noting that *"right at the very beginning it wasn't clear"* whether the intention was that sites would produce a *"high level piece"* with generally applicable lessons on how to achieve a digital change or a more detailed prescriptive guidance on *"how you do it"* for implementing that change within a particular technology platform. Many sites pointed out that their initial implementation experiences would be rooted in their particular organisational and technological context. As a result, the lessons drawn in their Blueprints were liable to be technology- and organisation-specific.

This would increase their relevance/value for similar sites but limit their transferability. Thus Site C's Information Management and Technology (IM&T) flagged that they could produce specific guidance that would be *"immediately available"* for other sites working with the same platform, as it *"doesn't have to be redone from scratch and I think that has huge value"*. Likewise, Site A's digital hospital lead noted that for another site with the same

[53] What are Blueprints and how will NHS trusts benefit? Available from: https://www.england.nhs.uk/expo/wp-content/uploads/sites/18/2018/09/13.30-Leapfrog.-how-Global-Digital-Exemplar-Blueprints-can-accelerate-your-transformation-T2K.pdf (last accessed: 01/08/2020).
[54] Health Catalyst (2017) Presentation for NHS England Blueprinting Workshop January 2018 (confidential draft).

version of their platform *"I could send them the actual configuration that they could import"*. While technology-specific Blueprints might have great relevance to organisations with similar technology and processes, these might not be widely applicable or readily transferable to other sites. Site 20 noted that six of the GDE sites had adopted Cerner Millennium, which had created scope among this cohort to exchange very detailed platform-specific configurations. Site L (also a Cerner site) had been able to draw on workflows developed by another provider organisation including sharing code through the Cerner platform: *"Taking the code that they've developed and using it in our [provider organisation]."* In turn, Site L had been approached by other Cerner sites who were able to adopt their Blueprint (for a specific function) – but noted that these lessons would be irrelevant for non-Cerner sites.

The CIO in Site F felt that *"the Blueprint has to be contextual… unique to every care setting* [in terms of systems and how my environment works] *so to some extent it's very difficult to take a Blueprint out and drop it somewhere"*. For example, *"a process I'd done on* [specific application] *that would only be really, really applicable to some other [provider organisation] on* [specific application]*"*.

The production of Blueprints

There was widespread support across the GDE for the idea of Blueprints – at least in principle – driven by a shared commitment to the collective desire for the success of the NHS and a consequent concern to support and share expertise and experience with those organisations that were not part of the GDE Programme. *"I think Blueprints are a great idea… I'm very supportive of the Blueprint principle"* (Site A, CCIO), *"a great concept"* (Site M, senior project lead); *"the concept of Blueprinting is really positive"* (Site B, digital programme manager); *"a tangible output out of GDE to support those sites that aren't on GDE"* (Site B, programme manager).

This near unanimous enthusiasm for the principle of Blueprints was tempered, however, by equally prevalent doubts about whether the costs – in terms of the time and effort of organisation members producing them – would be justified in relation to their benefits in terms of how widely used and how useful Blueprints would be.

At the start of the Programme, when GDE sites were preoccupied with procuring and implementing new digital solutions, the production of Blueprints was often set aside for later. Site I project manager noted that *"we've been too busy doing it… to actually Blueprint it."* At this site, production of Blueprints only occurred after completion of their GDE projects.

Many sites also emphasised the large amount of work required to create a Blueprint and associated documentation. Site I's digital change manager told us *"I didn't really realise how big of a job it was going to be. And like trying to juggle that, as well as your day-to-day activity, that has been a challenge."* At Site B, the chief medical information officer felt "*Blueprinting has taken a massive chunk of time"*, while the Clinical Transformation lead

noted that writing the Blueprinting document *"was taking over my life. It's a huge amount of effort and work. … the only way I could do it was I stayed late after work"*. Notwithstanding these costs, the CCIO at Site I drew our attention to an unanticipated benefit of producing the Blueprint which had forced them *"to reflect on what you do. And, I'm sure there are a huge number of lessons that we've surfaced, having read the draft Blueprint that will be really beneficial for other people."* And this had also benefitted them: *"we're sort of now retro-fitting some of our lessons, but forcing us to think about them, forces us to continue to go back and improve it"*. Given the time pressure and work required *"we probably wouldn't have bothered, if we didn't have to* [analyst emphasis] *write a Blueprint."*

The majority of sites were at the time of interviews not convinced about the utility of Blueprints and their value as a vehicle for knowledge transfer. Thus, Site F's CIO judged that Blueprints were only *"useful to a very limited extent"*. Site C's IM&T lead expressed concern that *"Blueprinting stuff is a waste of time, [be]cause, essentially, people are spending quite a lot of time writing stuff up, and it'll sit in a library and the people who need to use it, won't use it."* As a result, the investment may not be warranted: *"I'm not sure how much they're actually used so, I think, there's quite a lot of money and time going into things that are probably not sensible"* (Site C, IM&T). Similar concerns were expressed by Site I's project manager about the effort invested in producing *"a 20,000 to 30,000 word document, that I don't know who's going to read."*

Site B's IM&T lead noted that the jury is still out *"about how useful they are"*. More work and better understanding would be needed to create Blueprints that would be widely adopted at "scale and pace" (CIO at Site L).

Use of Blueprints including unanticipated use as a networking tool

The vast majority of sites (27 of 36 covered in case studies) did not report using Blueprints as a vehicle for acquiring the knowledge needed to implement change. Two sites (10, 22) indicated that they were planning to use others' Blueprints in the future. In the third round of data collection, three sites indicated that they had used a Blueprint from elsewhere. Many other sites reported that they had reviewed the Blueprints but not adopted them. Several observed that the Blueprints had arrived too late for them to adopt and were not aligned with the digital transformation journey they had by then developed.

Others found Blueprints from other sites useful. FF sites B and AG 23 had followed the approaches that their GDE had adopted and subsequently Blueprinted (an observation that implies that the Blueprint itself was not the vehicle for their learning). They had not adopted Blueprints from other sites. Site AG 3 identified four specific Blueprints they had learnt from, which helped them accelerate change and avoid mistakes.

> *"I have read a few and I found them … actually quite useful. So I sort of changed my mind on them… I've reviewed quite a number. I found [named Blueprint] very helpful… some of them include costs, which is useful, to give us a steer on how much investment we might be needed before we start embarking upon them".*
> *(Site M, FF, in-depth case study, non-clinical digital leader)*

However, it is important to keep in mind that use is not the same as adoption. For instance, Site AG 14 decided against adopting a particular change after reading a Blueprint that was honest and candid about the difficulties and costs entailed.

Although there was little evidence that Blueprints were working in the way originally planned – as a vehicle for delivering the knowledge needed to implement a change – they were proving helpful in other ways. Provider organisations used them not only as an initial introduction to a particular area of change, but, also, and more significantly, as a way of contacting the people involved. Thus, their main value was perceived to be as a networking tool.

As Site M, GDE project manager noted: *"part of it is that you've got contact details and … you undertake to make yourself available to other organisations... So, it's a sort of networking tool".*

The Head of Hospital at Site A suggested that Blueprints were "*just the distillation of often the conversations that we're having with lots of hospitals anyway*". They could never "*be a truly one stop shop"* for other sites which, due to differing circumstances, would have different issues to raise. "*I view the Blueprints as a really good starting point… but then there will always be some sort of follow up conversation".* The CNIO at Site A also observed that *"the Blueprint is there just to start the conversation"* noting that seeing things was more useful for understanding than *"reading it on a piece of paper"*. Several sites (Sites (AG 3, 9, 17, 18) shared this view that visits and interactive conversations were more valuable in transferring these kinds of complex knowledge than a piece of paper, particularly in communicating important cultural factors. Site visits were particularly effective because they provided an opportunity to address the differing circumstance of sites and other factors that might readily be overlooked.

Many other respondents observed that it was these contacts and visits that brought the greatest benefit. At Site D, the CNIO observed *"the most benefit you get is that contact with other people"*, while the CIO flagged benefit for them and others when provider organisations *"come and visit us and we talk … and share"*. This was in part because the Blueprint could only convey a limited amount of information. An allied health professional at Site C felt that Blueprints were not detailed enough from a user perspective*: "I'm not convinced there is enough detail to really drill down"* but noted that this was not a problem however: *"as long as they've got contact details… most people in this space are very willing to share and collaborate"*. A similar perspective from a Blueprint producer came from the assistant director of programme delivery at FF Site L who noted that *"There is a limit to how much technical stuff you can put on a Blueprint"*. Instead, sites will *"get in touch with us and maybe come over and have a look at it"*.

Conclusions

Blueprints have facilitated knowledge transfer among GDE and FF organisations and beyond. However, we found limited evidence that Blueprints were being adopted and used in the way initially envisaged (as a vehicle for the wholesale transfer of the knowledge needed to successfully implement a particular innovation). Our respondents drew attention to ways in which Blueprints were being used and proving useful in other ways. They acted as repositories for codified knowledge but were most successful where their role in formal knowledge transfer led on to, and was supplemented by, informal knowledge sharing and linking together stakeholders interested in a particular implementation.

Documents capturing implementation experience (such as Blueprints) may offer helpful introductions to a field and generic high-level guidance but cannot provide all the knowledge needed for implementing digital change in another site. This is due to the (different) particular technological and organisational circumstances, as the information they contain may quickly become dated they need refreshing and careful curation as live repositories. We found that would-be adopters therefore found Blueprints useful not primarily as a knowledge repository but crucially as a networking tool – as a means to identify and contact colleagues elsewhere who had implemented a change in their own organisations. Through direct interactions, complex implementation experience could be transferred to different settings and 'translated' to address local contingencies. Formal knowledge transfer mechanisms thus enabled and in turn were strongly supported by crucial informal knowledge sharing activities – and in this way contributed to the development of a digital health learning ecosystem.

Chapter 6: Inter-organisational knowledge sharing to establish digital health learning ecosystems

Many aspects of digital transformation have been studied.[55] [56] [57] However inter-organisational knowledge sharing is a key feature of recent initiatives to promote concerted change across multiple organisations by establishing a learning ecosystem.[58] [59] Understanding inter-organisational knowledge transfer may help to mitigate risks by avoiding repetition of mistakes and thereby save money and minimise potential threats to patient safety and quality of care. Concerted adoption might also reduce inefficiencies of fragmented one-off implementations by encouraging learning across communities of adopters and increase their influence over system development.

We use the term *learning ecosystem* to refer to inter-organisational sharing of technology, knowledge, and know-how to achieve digital transformation (i.e. to change technologies and organisations). We differentiate this from the notion of *learning health systems*, which focuses on optimising the use of clinical and operational data to advance and apply medical research (i.e. to advance the clinical cycle/improve care processes).[60] Learning ecosystem highlights that knowledge and experience of technology adoption and implementation is particularly valuable for members of other organisations contemplating similar digitally enabled transformation (and also for vendors and policymakers).[61]

Though there have been local examples of attempts to promote digital health related knowledge exchange, these are often not systematically evaluated and are poorly theorised.[62] [63] In contrast, in the commercial sector, a large body of literature explores

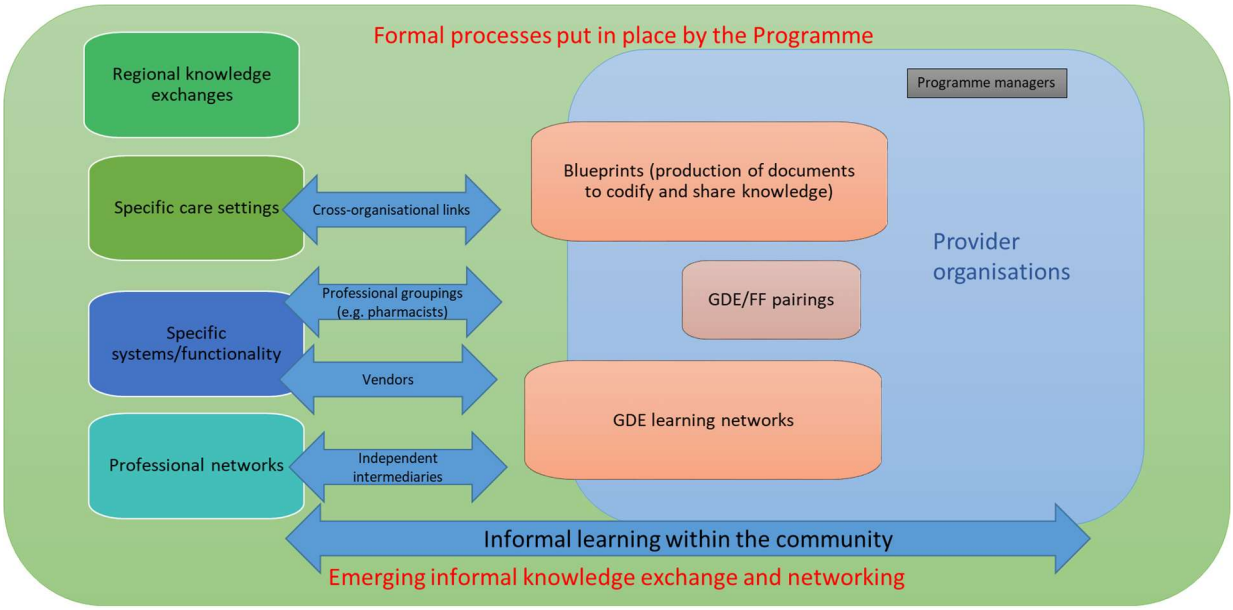
[55] Latest round of technology funding announced. Available from: https://www.england.nhs.uk/2015/03/tech-fund-announced/ (last accessed: 06/05/2020).
[56] Cresswell KM, Bates DW, Sheikh A. Ten key considerations for the successful optimization of large-scale health information technology. Journal of the American Medical Informatics Association. 2017 Jan 1;24(1):182-7.
[57] Cresswell KM, Bates DW, Sheikh A. Ten key considerations for the successful implementation and adoption of large-scale health information technology. Journal of the American Medical Informatics Association. 2013 Jun 1;20(e1):e9-13.
[58] Secundo G, Toma A, Schiuma G, Passiante G. Knowledge transfer in open innovation. Business Process Management Journal. 2019 Feb 4.
[59] Hamer S. Developing an innovation ecosystem: A framework for accelerating knowledge transfer. Journal of Management & Marketing in Healthcare. 2010 Dec 1;3(4):248-55.
[60] Lave J, Wenger E. Situated learning: Legitimate peripheral participation. Cambridge university press; 1991 Sep 27.
[61] Lundvall BA. Product innovation and user-producer interaction. The Learning Economy and the Economics of Hope. 1985;19.
[62] New service helps Ontario hospitals with technology. Available from: https://www.canhealth.com/2017/12/20/new-service-helps-ontario-hospitals-with-technology/ (last accessed: 06/05/2020).
[63] Rogers H, Silvester K, Copeland J. NHS Modernisation Agency's way to improve health care. Bmj. 2004 Feb 19;328(7437):463.

knowledge transfer between technology vendors and users.[64] [65] [66] [67] This work highlights how various intermediaries play a key role by bridging gaps, translating, and facilitating information flows between different stakeholder groups.[68] [69] In addition to formal organisational links (e.g. vendor-hosted user groups), informal networking, driven by the benefits of knowledge transfer, can be particularly important in communicating "sticky" information (information that is hard to acquire and intimately linked to context of use).[70] Some papers discuss user-to-user sharing of knowledge, but this focuses mainly on consumer products or open source applications.[71] [72]

Figure 4 illustrates the emerging formal and informal learning and knowledge exchange processes, knowledge exchange forms, and key intermediaries in the Programme. We use the term "formal" to describe knowledge exchange processes resulting directly from planned programme activities, including those emerging from GDE/FF relationships, Blueprinting documents, and programme learning networks. We use the term "informal" to describe emerging knowledge exchange processes whether as an unanticipated, indirect consequence of these activities or as unrelated activities.

[64] Brady T, Tierney M, Williams R. The commodification of industry applications software. Industrial and Corporate Change. 1992 Jan 1;1(3):489-514.
[65] Koch C. ERP Software packages: Between mass-production communities and intra-organizational political processes. In Technological change and organizational action 2003 Sep 2 (pp. 70-90). Routledge.
[66] Mozaffar H. Entangled Biographies: A Multi-Biographical Approach in Study of User Communities Around Information Infrastructures. In ECRM 2018 17th European Conference on Research Methods in Business and Management 2018 Jul 1 (p. 287). Academic Conferences and publishing limited.
[67] Mozaffar H. User communities as multi-functional spaces: innovation, collective voice, demand articulation, peer informing and professional identity (and more). In The new production of users 2016 Apr 20 (pp. 219-246). Routledge.
[68] Stewart J, Hyysalo S. Intermediaries, users and social learning in technological innovation. International Journal of Innovation Management. 2008 Sep;12(03):295-325.
[69] Bougrain F, Haudeville B. Innovation, collaboration and SMEs internal research capacities. Research policy. 2002 Jul 1;31(5):735-47.
[70] Von Hippel E. Economics of product development by users: The impact of "sticky" local information. Management science. 1998 May;44(5):629-44.
[71] Von Hippel E. Democratizing innovation: the evolving phenomenon of user innovation. International Journal of Innovation Science. 2009 Mar;1(1):29-40.
[72] Johnson M, Mozaffar H, Campagnolo GM, Hyysalo S, Pollock N, Williams R. The managed prosumer: evolving knowledge strategies in the design of information infrastructures. Information, Communication & Society. 2014 Aug 9;17(7):795-813.

Figure 4: Formal and informal learning and knowledge exchange processes in the GDE Programme



Overall, our work suggests that GDE initiatives, coupled with the broader impetus generated by the Programme, have promoted a burgeoning learning culture across digitally engaged provider organisations and GDE/FF pairs, with increased sharing of knowledge and experience. Virtually all the provider organisations described involvement in networking activities, sharing knowledge/experience and learning from others. We also observed some evidence of the emergence of a learning ethos in the NHS reinforced by these processes.

"We're starting to share what we're doing, in a demonstrable way, and start to see it, and it was quite powerful." (Site 14, GDE, broader study, non-clinical digital leader)

"[Provider organisation] had spent about a year building paediatric meds. And they said here, you can have it. So that's a year's work, that's non-trivial. They just simply gave it to us. Now would that have happened two years ago? Three years ago?... So there are people sharing things of real value, real cost, real-time… which is excellent. So are we creating new knowledge by that, I'm not sure. Are we sharing and optimising that knowledge? Very definitely." (Site L, FF, in-depth case study, non-clinical digital leader)

Evolving formal processes to promote a national digital health learning ecosystem

Programme managers implemented several linked formal initiatives to facilitate knowledge transfer within tight timeframes. Formal mechanisms encouraged and were also strongly supported by the burgeoning of informal networking and sharing of knowledge and experience. These developments led to changes in the strategic focus of the Programme. In particular, the strategy associated with the production and distribution of Blueprints evolved to become a key component of the learning ecosystem. The Blueprinting process

changed as the user community (provider organisations) became actively engaged in developing the mechanisms for their production, distribution and use. Blueprints were initially conceived as repositories of the extensive information needed for rapid procurement and implementation of validated technologies that could then be widely disseminated. However, as stated above, provider organisations found them useful in unanticipated ways – as an initial introduction to a topic and as a way to identify and make contact with people involved in these implementations – leading to email exchanges, phone calls and site visits. Thus, Blueprinting changed from an activity of capturing digital transformation knowledge in artefacts to a means of facilitating informal networking.

> *"[Blueprinting]'s supposed to be not just about taking and adopting, it's to open up conversations." (Site 8, GDE, broader study, non-clinical digital leader)*

The evolving Blueprinting concept also saw a relaunched online platform, radically reconceptualising Blueprints as *"a structured collection of knowledge assets and associated methodology for using them"* [39].

Particularly successful were occupational groupings that aligned their professional interest with enhancing practice through digital transformation. For example, pharmacists were actively involved in knowledge networks around hospital electronic prescribing and medicines administration (HEPMA).

> *"…all the GDE groups that work on prescribing, we're having monthly phone calls and meetings" (Site H, GDE, in-depth case study, senior manager)*

The uneven outcomes of the GDE/FF pairings also highlighted the importance of informal networking. We found that adoption of a common core system (such as for EHRs and HEPMA), prior relationships, geographical proximity, and regional alignment were in most instances beneficial for knowledge sharing and networking.

> *"Clinically, I think it's fantastic, and organisationally and operationally with [GDE], because you've got the same system and we're taking a lot of their content that they're developing and then we copy it." (Site B, FF, in-depth case study, clinical digital leader)*

However, knowledge sharing was inhibited in some instances by existing perceived competition for prestige and resources between provider organisations. In particular, some FF organisations were unhappy to be designated as "followers", especially where they felt they possessed or would soon attain greater capability than their GDE.

> *"I don't call this Fast Follower I like the word partner…I think that some of the work that we're doing we're leading rather than following our GDE." (Site B, FF, in-depth case study, non-clinical digital leader)*

We further observed that national activities in many instances helped to initiate and sustain informal networking. Informal networking, in most cases, maximised the effectiveness of formal inter-organisational knowledge transfer processes and ensured their sustainability.

> *"Nothing is really very formal any more, they will pick up the phone and phone [other GDE] and ask how they are doing it. So, it's those informal relationships that I think are really beneficial." (Site B, FF, in-depth case study, GDE programme staff)*

Although informal processes constituted a large and effective part of knowledge transfer and networking, these varied significantly among participating provider organisations. Analysing these differences provided insights into the facilitators and barriers. As well as sharing a common technology platform (see below), participants mentioned having a similar organisational ethos and culture, similar (or the same) patient populations, regional strategic alignment, and geographical proximity as facilitators.

> *"We're a similar size [organisation] with a similar footprint of patients with similar economic and geographical pressures, so that's really helpful." (Site C, GDE, in-depth case study, clinical digital leader)*

Similarities reduced the learning costs and increased the relevance/benefits of knowledge exchange. The common challenges facing specific care settings were also facilitators for informal inter-organisational networking and knowledge transfer. We, for instance, observed productive knowledge exchanges amongst mental health providers. They perceived that they shared specific needs and purposes (that might be overlooked by larger acute hospitals) and began to organise informal collaboration.

Common technological functionality was a key facilitator as organisations with the same vendor often faced similar challenges and sharing of lessons could contribute to avoiding repeating mistakes. There was also scope to transfer detailed elements of systems configuration – removing the need to replicate onerous coding work and speeding up implementation.

> *"That has been happening…the knowledge sharing, especially about those organisations with similar systems, oh, you've just done that, so we'll go and look at it, you've done that, we'll take this." (Site G, GDE, in-depth case study, senior manager)*

The reputational benefits of GDE Programme membership was an important motivator for knowledge sharing. Conversely, one organisation was concerned about reputational risk if their partner performed poorly.

"I think people are worried about reputational damage. So, if the [provider organisation] that you were partnered with would never ever get to a position where you were, is that a failure on the mentoring a [provider organisation], or is it a failure with the [provider organisation] trying to catch up?" (Site A, GDE, in-depth case study, non-clinical digital leader)

Provider organisations are in some respects competing for status and resources. For example some GDEs were seeking recognition as the most digitally mature provider organisation in the country. Although under some circumstances, organisational status conflicts had inhibited knowledge sharing (e.g. where there was a history of local competition between neighbouring organisations) these were exceptions to a broader pattern whereby a culture of sharing prevailed.

The GDE Programme encouraged links between users and with vendors including the development of user groups around the major system vendors. In some instances, organisations also reported increased leverage over system vendors and joint procurement.

"Working with other GDEs has… given us a bigger voice to talk to suppliers, it's given us an opportunity to introduce new people into the market, and then share that experience with others." (Site F, GDE, in-depth case study, non-clinical digital leader)

Mediators facilitating knowledge transfer across the wider health system

Some stakeholders acted as knowledge exchange mediators, extracting and collating lessons from particular implementations for wider application. Here a range of inter-organisational networks facilitated knowledge exchanges between provider organisations. These included system vendors who coordinated networking among national organisations with the same system (e.g. through user groups, pilot site visits, connecting key individuals to work together across organisations) and promoted connections with international organisations with the same system.

"[Place in the US] was one we met through [vendor], because they're a [vendor] client, and [name], who's their Chief Clinical Information Officer, came here, and again we've kept in touch with them." (Site 19, GDE, broader study, non-clinical digital leader)

Professional networks also played an important role. These allowed members with a common interest to get together, and to exchange ideas, challenges and lessons learnt in a neutral space.

We moreover observed the development of specialist digital transformation managerial communities that facilitated informal networking. An example here included the formation of an informal national network of Chief Clinical Information Officers and a range of online

and face-to-face networking activities organised by an independent community of digital health professionals.[73]

> *"There's an outfit called Digital Health Networks… and they run a series of forums…it's an online community that's growing all the time, and is exchanging ideas very productively." (Site C, GDE, in-depth case study, clinical digital leader)*

Another example was the NHS Digital Academy, a national programme to develop digital health leadership capability in the NHS.[74] 50 participants from 29 different GDE provider organisations studied at the NHS Digital Academy during the time of our data collection.

> *"The Digital Academy have really shown that it's phenomenally important…We've had loads of conversations, over dinner and things…about what they're doing, what we're doing…and, actually, that's been really beneficial because otherwise we probably wouldn't have found time to have those conversations." (Site C, GDE, in-depth case study, non-clinical digital leader)*

Relative costs and efforts associated with knowledge transfer

The mutual benefits of shared learning and an ethos of public health benefit facilitated emerging small-scale exchanges. The biggest barrier to knowledge transfer cited in our sample were competing demands on participants' time, particularly given the priorities for health professionals to provide day-to-day care.

> *"It's [knowledge transfer] one of those things that you need to make time for and we're all really busy in our day-to-day roles..." (Site D, GDE, in-depth case study, clinical digital leader)*

Knowledge sharing activities were particularly burdensome for organisations (mainly GDEs) that were perceived as national leaders and therefore had many requests from a range of other organisations to share knowledge. Those seeking to establish themselves as national leaders expressed concern that moving forward as a group of organisations could slow down processes such as procurement and thereby hold back their development.

> *"That's just the difficulty of moving together as a group of organisations, even though we do work very well as a unit. It's those sorts of things where there are more complications in terms of procurement and contracting and so on and so forth." (Site F, GDE, in-depth case study, non-clinical digital leader)*

Knowledge sharing through informal networking is demanding of people's time and offers fewer obvious opportunities for economies of scale, than, for example, circulating

[73] Digital Health Networks. Available from: https://www.digitalhealth.net/join-the-digital-health-networks/ (last accessed: 06/05/2020).
[74] NHS Digital Academy. Available from: https://www.england.nhs.uk/digitaltechnology/nhs-digital-academy/ (last accessed: 06/05/2020).

documents. There were some concerns that the cost of networking would threaten the sustainability of sharing activities.

Individuals and organisations benefitted from learning by receiving information/learning. They could also experience reputational benefits that could improve organisational status and strengthen individual expert careers. Networking and knowledge transfer were enhanced where the costs of learning were minimised and the benefits maximised. However, issues emerged where there was asymmetry between knowledge providing and knowledge receiving for organisations making this informal mutuality difficult to sustain. This was, for example, an issue where provider organisations engaged with large numbers of adopters and where knowledge transfer required a lot of resources.

Nationally organised activities somewhat mitigated barriers, by reducing the cost of knowledge transfer to provider organisations. Different kinds of national intervention played a catalytic role. Critical factors here included stimulating discussion topics/shaping agendas, setting up webinars and knowledge transfer work, and curating artefacts for sharing.

> *"We've had the capacity to go out and talk to other organisations across the UK which we've done… and the project team have the capacity and the ability to do that. We would never have been able to do that pre-GDE." (Site E, GDE, in-depth case study, GDE programme staff)*

Conclusions

Our exploration of inter-organisational knowledge transfer in the GDE Programme shows that the Programme has made a major contribution to the current upsurge in knowledge transfer across the NHS. The combination of its formal learning mechanisms and processes to initiate a national digital health learning ecosystem promoted systemic learning, but was most successful where supported by informal networks. Formal knowledge transfer mechanisms did not necessarily work in the ways planned. They evolved over time and prompted a dramatic growth in informal learning among organisations and specialist communities.

Inter-organisational knowledge transfer has been promoted by formal structures initiated through the GDE Programme. However, informal processes which play a key role in knowledge transfer are highly contingent and cannot readily be promoted and sustained by conventional top-down planning structures. National mechanisms to stimulate knowledge sharing therefore need to be flexible to align with emerging, changing needs, sustained through informal networking driven by mutual benefits of knowledge exchange. Benefits are most immediate and networking most readily sustained where there is strong convergence between group members in their organisational and technological setting and goals. Recent

concerted efforts to deploy digital solutions in the face of the COVID-19 pandemic reinforce this point.[75]

The Programme has laid the foundations for a digital health learning ecosystem. However interpersonal knowledge transfer (e.g. through networking and visits) is labour- and resource-intensive and may be difficult to scale and sustain. Knowledge transfer through circulating documents like Blueprints alone, whilst potentially scalable and low-cost, is, on its own, unlikely to be effective. This situation calls for evolving strategic and policy frameworks, shaped by a mixture of top-down and bottom-up input, with a trusting relationship between those that facilitate knowledge exchanges and those involved in actively sharing and using that knowledge. Recent developments of the Blueprinting policy include facilitators going out to local and regional groups. This could be the focus of promoting knowledge transfer through both formal and informal networking

Our findings align with findings of other initiatives, including the HDR UK Better Care Programme,[76] the evaluation of the NHS Care Record Service,[77] and the evaluation of the Vanguard Programme.[78] Parallels here include the importance of informal networking; the need for leader flexibility to align with emerging, changing needs; the need for evolving strategic and policy frameworks; and the role of programme facilitators identifying synergies across various contexts.

[75] Lenert L, McSwain BY. Balancing health privacy, health information exchange and research in the context of the COVID-19 pandemic. Journal of the American Medical Informatics Association. 2020 Mar 31.
[76] HDR UK Better Care Programme. Available from: https://www.hdruk.ac.uk/using-health-data/better-care/ (last accessed: 13/05/21).
[77] The Long and Winding Road… An Independent Evaluation of the Implementation and Adoption of the National Health Service Care Records Service (NHS CRS) in Secondary Care in England Final report for NHS Connecting for Health Evaluation Programme. Available from: http://www.chs.med.ed.ac.uk/grantdocs/526%20-%20Final%20report%20v31st%20Mar%20FINAL.pdf (last accessed: 14/05/21).
[78] National evaluation of the Vanguard new care models programme. Available from: https://www.research.manchester.ac.uk/portal/en/projects/national-evaluation-of-the-vanguard-new-care-models-programme(1444648f-0543-4162-ac50-83e05845738c).html (last accessed: 14/05/21).

Chapter 7: The consequences of COVID-19 on digitisation and the impact of digitisation on tackling COVID-19

The impact of COVID-19 on the GDE Programme

Overall, we observed that GDE projects were paused during the initial COVID-19 crisis, unless they were directly relevant.

> *"Then things ground to a – well, I say things ground to a halt, they did and they didn't. Certainly from our perspective with COVID, it was very quickly evident that a number of our GDE solutions could provide some support." (Site E, GDE, in-depth case study, non-clinical digital leader)*

> *"And so, speaking as a programme manager, COVID was both difficult but it also brought some new opportunities to accelerate some of the things that otherwise would have had a longer delivery time on them. And I think even where some programmes were suspended I think at most those projects were suspended for about three months before we restarted them." (Site 4, FF, broader study, GDE programme manager)*

In particular, complex technological change developments requiring diverse inputs were put on hold during the COVID-19 crisis (e.g. EHR upgrades, HEPMA implementations).

> *"It's a real shame that we couldn't start digitising the medical record before COVID hit. Because I think if we'd have started, and we're due to start digitisation process in February now, and if COVID had occurred a year later I think we would have just continued with the digitisation process. And that would have really, really helped with COVID. 'Cause we wouldn't have had notes being trundled around in the same volume as we do. But as it was, we just couldn't start digitising in the middle of that because the whole hospital was turned upside down." (Site 4, FF, broader study, non-clinical digital leader)*

In other instances, we observed re-prioritisation of projects with certain projects being recast to be more directly relevant to challenges associated with COVID-19.

> *"So, what we've done is we repurposed the LHCRE platform for the first wave of COVID, and what we're able to do is for every single provider in [local region], and there are over 2,500 of them, we send them electronic communications every day. Those electronic communications are via the LHCRE platform and it's basically an eForms engine and it gathers data on everything from PPE…. our LHCRE journey and our GDE journey have met in this way." (Site H, GDE, in-depth case study, GDE programme staff)*

Discrete technologies, especially those used for remote communication/consultation were adopted rapidly. For example, Attend Anywhere was centrally procured and given to provider organisations for free until March 2021. We also observed rapid exploitation of

existing data and information infrastructures where they already existed e.g. to reorganise health care to separate COVID-19 and non-COVID-19 care (e.g. using EHR and HEPMA tools), and rapid bottom-up development of messages standards to share data needed (e.g. to manage COVID-19 status).

COVID-19 overcame prior institutional inertia, which had impeded adoption of digital solutions (e.g. there have been calls over several decades for remote consultation but little progress hitherto).

Most sites took a pragmatic approach finding "good enough" solutions in short timeframes, and implementing solutions with limited functionality in beta development stage to address COVID-19 (e.g. digital NHS passport). There is now a need to consider the benefits and trade-offs of face-to-face and remote methods in order to maximise benefits and reduce costs going forward.

The role of digital maturity in tackling COVID-19

Most GDE sites felt that they were in a better place to tackle COVID-19 related challenges because of their digital maturity than non-GDE sites. They stated that this was partly due to the investment associated with the GDE Programme and established information infrastructures that acted as a basis for deploying specific functionality.

> *"And I think, we were already a number of steps on this process with the GDE programme, and I think that's really, really helped us. Because if we'd started from ground zero, like a number of [provider organisations] have tried to, it must've been remarkably tricky. We also already had quite a lot of the structure in place, quite a lot of the background sort of business intelligence, and things, available, to be able to bolt on, really very rapidly, the resources that the clinicians need." (Site B, FF, in-depth case study, clinical digital leader)*

> *"And I think we've had enough experience now of having an electronic record to know what difference that's made to our ability to cope with COVID. And I think we can contrast that with other experiences around the region and, more widely, about hospitals that didn't have that capacity." (Site E, GDE, in-depth case study, clinical digital leader)*

Here, the digital maturity promoted through the Programme was viewed as an enabler to act quickly, rapidly deploy, and at scale.

> *"So, no administrative staff wanted to actually handle paper. So, we were fishing it from another angle. Well, actually, can we get rid of it? Do we really need it in this day and age? The one thing that it's taught us, and, again, this links to GDE but it's more about maturity, the more digitally mature organisations were, the easier and better they were able to cope and react." (Site J, FF, in-depth case study, non-clinical digital leader)*

A “fluid and dynamic” infrastructure and staff capable of configuring their own systems was viewed as a facilitator as this enabled acting quickly to emerging challenges.

> *“[Vendor] really gave just that flexibility in that we do 90 per cent of the configuration in-house. So, if we want to change something in the system our analysts and our builders do it…it came down to using our own staff to enable substantial EPR capabilities of changing everything we did, moving folks off site, doing virtual visits, all of that capacity was done, setting up new tasks, setting up new offsite locations for COVID testing, all of that configuration came down from our configuration teams.” (Site A, GDE, in-depth case study, non-clinical digital leader)*

The sophistication of systems depended on the level of digital maturity in sites (e.g. advanced dashboards were not possible in sites without a clinical data repository) and the strategic maturity which allowed organisations to make decisions quickly. Strategic maturity was conceptualised through established digital leadership and digital change processes already in place, familiarity of the workforce with using digital resources to undertake their daily work, and executive leadership support.

> *“So, [GDE] doesn’t use the [vendor] ITU (Intensive Care Unit) system, and it took really quite a long time to be able to rollout and support ITU beds in areas that weren’t normally ITU. At (acute hospital, part of the same provider organisation) it happened over the weekend, led by a consultant who incidentally had COVID at the time and was quite unwell, and was able to manage all of this remotely. So, by having a system that’s designed in the way it is, which was put in through the GDE programme, enabled us to extend from tens of beds to being able to support 100 or more really very rapidly because we had the processes and the procedures that we’d put in through the GDE programme, not just the technology but the way of managing.” (Site 5, GDE, broader study, non-clinical digital leader)*

> *“They could not see any oxygen levels or anything like that. That had to be manually checked. And going back to A’s point, that’s additional staffing because then someone’s got to go in and check that. And when you’ve got two large hospitals and you can really see the difference in how quickly they can get that information – one had it real time the minute that it came on the screen, and the other one had to go in and manually check all patient records – that’s a big difference.” (Site 12, GDE, broader study, non-clinical digital leader)*

> *“It has awoken the board to the potential and I think once again reflecting on COVID, it came along just at the right time if anything like that could come along at the right time. The kind of conversations we can have with the board now about digital are different to the ones we would have had because of what we’ve been able to do.” (Site 18, GDE, broader study, non-clinical digital leader)*

Unanticipated benefits of COVID-19

We observed a number of unanticipated benefits of the COVID-19 crisis. Firstly, it allowed a new digital vision and we observed changes in staff attitudes towards digitisation. This in turn facilitated staff engagement with digitally-enabled transformation activities.

> *"We had some consultants who were old-school consultants who were not really keen on the technology, coming to us and seeing them carry out monitors and laptops was quite amusing, but they really, you know, and then seeing them on Teams was just brilliant. So I think it's been a real…for me, digital enhancement is probably a real big benefit from COVID. People have had to adopt the technology rapidly and they've seen it can work, so I think that's been a real benefit" (Site B, FF, in-depth case study, non-clinical digital leader)*

Secondly, we saw increasing and more efficient collaboration with vendors, particularly in organisations that already had established good working relationships with their vendors. However, if relationships with vendors were problematic, COVID-19 exacerbated issues. We also observed some resource and capacity issues to respond quickly amongst smaller vendors.

> *"So, I think we were drawing on knowledge from a few different sites that had the same system portfolio as us, and now we've got a hybrid of that…I think we're probably more heavily focused on the [vendor] side of things because that has massively come to the fore with COVID. I think we would really have struggled to cope with COVID in the organisation had we not put (system) in there, and I don't think any of us would have plotted the trajectory of implementation change and new modules coming on to the extent that it did. It was just expedited by COVID and massively well-received." (Site 21, FF, broader study, non-clinical digital leader)*

> *"Nearly all vendors wanted and offered to go above and beyond and do that for nothing and not looking for payment." (Site 8, GDE, broader study, non-clinical digital leader)*

We noted greater attendance at all-team meetings (i.e. teams that are traditionally spread across the provider organisations can easily get together using digital tools), reconsideration of the necessity of face-to-face contacts, substantial increases in cross-divisional collaboration and collaboration with external partners, and in some cases better integration with other care settings (e.g. care homes).

> *"We could also share COVID test statuses with our shared care records platform. So the GPs, ourselves and acute care, whenever we had completed a COVID test for a patient, we would report via an alerting system in our EPR which fed into the Health Information…the HIE, Health Information Exchange" (Site E, GDE, in-depth case study, non-clinical digital leader)*

We found an increase in quantity and quality of people applying for IT jobs in the healthcare sector. This was due to the rise in profile of digital work in the healthcare sector, which is now seen as sustainable as compared to vulnerable jobs in other sectors.

In addition, networks established throughout the GDE Programme helped sites to collaborate and share resources in challenging COVID-19 times.

> *"So, we've done some work recently with other providers, so that we now, because our data storage facility was coming to end of life. So we've actually entered in a shared agreement with other [*provider organisations*], to work together to produce a joint, more robust data share storage solution." (Site B, FF, in-depth case study, clinical digital leader)*

It remains to be seen, if these effects will be sustained post-COVID-19. However these reduced barriers provide an opportunity that could be leveraged for agile and speedy delivery of further digital transformation across the NHS.

Unanticipated consequences of digitisation during COVID-19

We saw some unanticipated negative consequences of digitisation during the COVID-19 pandemic. These included an escalation of meetings with mental and physical health consequences (stress, back problems).

> *"There was another phenomenon that we've got, it's called 'Teams backside'. You know, you sit in on a Teams meeting that long, your backside is sore." (Site J, FF, in-depth case study, non-clinical digital leader)*

Physical infrastructure challenges included: increasing bandwidth to cope with extra data traffic, purchasing of mobile devices and laptops for staff, and purchasing of extra licenses for an increasing user base for remote working.

We observed increasing digital inequalities amongst patients and staff (e.g. increase in did-not-attends, staff not having the right equipment needed to allow them to attend digital meetings), and some expressed concerns around potential vulnerability to cybersecurity and privacy risks and uncontrolled releases due to fast deployment of systems. In addition, the integration of new technology may not have received sufficient attention due to the increasing speed of implementation. The lack of integration with existing IT infrastructures was perceived to slow down work practices (e.g. scheduling appointments had to be done through two different systems in some instances).

Provider organisations welcomed offers of free access to products, although some expressed concern that the market might become flooded with sub-quality digital products. Some vendors were regarded as "unethical" as they were perceived to view the pandemic as "a cash cow opportunity" charging the NHS for overpriced and sub-quality products.

Chapter 8: The evolving hospital EHR market during the GDE Programme

Historical context and the current state of the EHR market in NHS England

Central procurement under NHS England's NPfIT favoured a select few vendors of complex enterprise systems in hospitals. As a result, many players, especially smaller vendors, failed to sustain their business or left the market – a situation which had been improved, but had not been remedied by the time the GDE Programme began in 2016 – leading to deliberations on how to promote the diversity of supply. Out of 51 provider organisations participating in the GDE Programme, only three (one GDE and two FFs) relied mainly on in-house systems. In others, the legacy of NPfIT was still apparent in the provider organisations' choices of EHRs, most notably RiO and Cerner Millennium.

Historically, the NPfIT managed EHR roll-out for the NHS through the Care Record Service (CRS), which covered primary, secondary care and mental health services. England was divided into regional clusters with their own local affiliation of NPfIT, which decided their own systems for roll-out. In the mental health sector, the RiO solution was successfully implemented in London and subsequently implemented in the South region after it agreed to change vendors. The North region, however, procured the RiO solution outside of the NPfIT after its vendors' chosen solution, Lorenzo, was rejected by provider organisations. By 2011, 62 RiO systems were provided across England via the NPfIT, excluding those additional systems that were procured outside the national programme.[79] It was reported that the majority of provider organisations involved in the NPfIT chose to stay with RiO after the national Programme was dismantled.[80] In the acute sector, Cerner Millennium was deployed at approximately 20 provider organisations in London and the South of England.[81] As with RiO, the majority of provider organisations adopting Cerner chose to stay with it after NPfIT ended.[82]

Amongst provider organisations participating in the GDE Programme, RiO was found in 13 organisations (seven GDEs and six FFs), whilst eight used Cerner (five GDEs and three FFs). Five provider organisations adopted MEDITECH and a further five adopted System C. Other systems on the market were found in fewer than three provider organisations per system.

[79] Are electronic patient record information needs of mental health staff being met by the National Programme for IT? Available from: https://dagda.shef.ac.uk/dispub/dissertations/2011-12/External/BUTTERFIELDDeniseDissertation.pdf (last accessed: 06/05/2021).

[80] Final score: NPfIT in mental health and community services. Available from: https://www.digitalhealth.net/2015/11/final-score-npfit-in-mental-health-and-community-services/ (last accessed: 06/05/2021).

[81] FinIT: the end of NPfIT in London and the South. Available from: https://www.digitalhealth.net/2015/11/finit-the-end-of-npfit-in-london-and-the-south/ (last accessed: 06/05/2021).

[82] Cerner trusts stick with system. Available from: https://www.digitalhealth.net/2015/06/cerner-trusts-stick-with-system/ (last accessed: 06/05/2021).

"The NHS are in part an architect of this situation. So, NPfIT essentially wiped a load of suppliers out of the market by setting up… the various regions. But no, because it's a global market [for] most suppliers. [Vendor] [is] a good example. The UK is a tiny market for them. The NHS in its entirety would probably be of serious interest, but a few [provider organisations] are neither here than there, to be quite honest. By its very nature, the digital supply chain is global. As soon as small organisations become successful, they're bought out by the larger, successful organisations. So, the NHS is a relatively small player." (Site C, GDE, in-depth case study, GDE programme staff)

The NPfIT constituted a part of the national strategy toward increasing data integration between (and within) various specialist systems with the more general patient administration systems and deploying them at point of care within hospital contexts. Nevertheless, the spiralling costs and complexity of implementation had cast doubt on the NPfIT, which was eventually dismantled in September 2011.[83] At the end of the NPfIT, provider organisations faced three choices regarding the future of their EHR systems: (1) continuing with systems implemented during NPfIT, (2) developing systems in-house, or (3) procuring a new system from the EHR market. For the majority of provider organisations, developing systems in-house was no longer a viable option due to the growing levels of skills and resources needed to maintain/develop them and sustain interoperability with other systems. With limited opportunity to recoup these increasing development/maintenance costs through onwards sales, there was also a risk of these systems becoming obsolete. Consequently, most provider organisations relied on vendors to develop and maintain their EHR systems.

"[A provider organisation – which still builds its own system] made a really big mistake in a way, because they were ahead of their field in the National Programme because they opted out and wrote their own. But nobody writes their own these days. So, they got to the stage [where] they needed a big team of people to keep it maintained and to keep it developed. They almost had to throw it out and start again. They were looking for a partner with a third-party company to try and onward sell. But who'd buy it? Because it was quite old by then, even though it was an innovation in its own right when it first started. So, it would take a brave man to start to write their own. The days of writing your own software are way gone. So, you have to decide on how to encourage new joiners really." (Site L, FF, in-depth case study, non-clinical digital leader)

Types of EHR vendors and factors influencing procurement decisions

Market pressures have pushed vendors into four situations, which we categorise as four groups: (1) mega-suite vendors: major vendors which are capable of providing a full EHR; (2) aspiring mega-suite vendors: vendors which have not yet been able to provide full functionalities of a EHR, but are striving to expand their portfolio of applications through co-

[83] Justinia T. The UK's National Programme for IT: Why was it dismantled?. Health services management research. 2017 Feb;30(1):2-9.

development with provider organisations; (3) adopter-led BoB vendors are traditional vendors, which develop solutions based upon provider organisations' requests and delegate interoperability responsibilities to adopter sites, and (4) vendor-driven BoB vendors are new entrants into the EHR market, whose visions include building platform-based infrastructures utilising agile development processes.

> *"You can view Best-of-Breed as dumb. You can view tier two of the next generation EPR as intelligent and you view the top tier which is a full EPR as your utopia, it's got the intelligence and it's got all the data in… So, [for a full EHR] you've probably got something that's very good at everything, but not excellent at some things, which you might need. I personally think that being tier two is the best place to be because you keep your flexibility." (Site M, FF, in-depth case study, GDE programme staff)*

Although these categories are useful for analytical purposes, they have not been officially recognised by vendors and adopters. Furthermore, the demarcation between the categories are not clear-cut. Mega-suite vendors, for instance, do not possess the capacity to cater for every need of provider organisations. As a result, mega-suite adopters are also in crucial respects BoB sites, as their solutions must operate alongside and be integrated with hundreds of other systems. In other words, even the most comprehensive EHR system still needs to be woven into the working information infrastructure (i.e. "pervasive enabling resources [e.g. organisational, technical, and data resources] in network form",[84] whose planning, development and maintenance is "an ongoing effort where technology is 'cultivated' rather than built"[85]) of provider organisations.

Each type of vendor (and associated types of solution) comes with its own advantages and disadvantages (see Table 3). Consequently, provider organisations face increasing difficulty in making procurement decisions.

[84] Bowker GC, Baker K, Millerand F, Ribes D. Toward information infrastructure studies: Ways of knowing in a networked environment. In International handbook of internet research 2009 (pp. 97-117). Springer, Dordrecht.

[85] Grisot M, Hanseth O, Thorseng AA. Innovation of, in, on infrastructures: articulating the role of architecture in information infrastructure evolution. Journal of the Association for Information Systems. 2014;15(4):2.

Table 3: The advantages and disadvantages of three types of systems

	Adopter-led BoB	Vendor-led BoB	Aspiring mega-suite	Mega-suite
Upfront costs	Low	Low	High	Extremely high
Interoperability issues	Interoperability is difficult to achieve due to the fact that non-standard interfacing require bespoke interfaces to be written.	Platform-based interoperability is easier to achieve and maintain because it is based on standardised interfaces.	Interoperability between systems is achieved through the expanding of solution offerings from the same vendor. When interfacing with systems from different vendors, this model faces the same hurdles as the adopter-led BoB approach.	A well-integrated system, which can utilise APIs to help achieve interoperability with other specialist and legacy systems. Easier to achieve and maintain.
Data storage	Locally	Locally	Centrally or locally	Centrally
Types of vendors	Small and Medium-sized Enterprises (SMEs) and some larger companies	SMEs	Established companies	Multinational corporations
Scale and sustainability	Do not benefit from large user community. Vendors might go out of business.	Do not benefit from large user community. Vendors are start-ups or newly established companies, which might also go out of business.	While adopters of discrete component technologies, such as HEPMA, have potentially large user base, adopters of core EHR components do not benefit from large user community (yet). Vendors are established and thus, they are less likely to go out of business as compared to start-ups.	Benefit from large user community. Vendors are likely to stay in the market for an extended period of time.
Vendor leverage	Vendors are more responsive to requests, but they might lack necessary resources to deliver projects.	Vendors are more responsive to requests. The agile approach allows vendors to be more adaptive to the changing needs of provider organisations.	Vendors are likely to be more responsive to requests, as long as provider organisations help co-develop functionalities, which are added to vendors' portfolios of applications	Vendors might not be as responsive to provider organisations' requests.
Ability to meet GDE Digital Maturity targets – HIMSS EMRAM	Adopter-led BoB vendors struggle to achieve high level of HIMSS EMRAM during timeframes of the GDE Programme due to the fragmented nature and the lack of a unified view of data.	BoB vendors have longer term potential to deliver HIMSS EMRAM, but they are not currently able to achieve this.	Aspiring mega-suite vendors have medium- to long-term potential to deliver HIMSS EMRAM, dependent on the level of maturity and comprehensiveness of their systems.	Already well-aligned with HIMSS EMRAM, and thus making it easier for provider organisations to achieve high level of HIMSS EMRAM certification during timeframes of the GDE Programme

The literature on procurement of enterprise solutions in the private sector shows that selection is an arduous, yet possible, process.[86] The procurement team seeks to "frame" their decision through a series of "comparative measures", which gradually give a shape to assessments of various solutions on offer, instead of relying on the highly negotiable and contested properties of those systems. Previous studies also reveal that adopters tend to stay with incumbent vendors due to the value of understanding the strength (and appreciating the limitations) of existing vendors, and the scope to exploit already-accumulated expertise and experience in dealing with the existing systems. [87] [88] These insights also apply, to a certain extent, to the adoption of hospital EHRs in England.

"If they [the vendor] fall into [the category of] the big multinational conglomerate, then it's "here's our products, you'll pay what we tell you, yeah". If they fall into the SME [small and medium enterprises], they will do anything you want to, but it's gonna take quite some time, and we do need the money upfront. That's pretty much the two unpalatable places you can land. […] We don't really want to switch our EPR. There isn't a [provider organisation] on the planet that really wants to do that, you know. So, there's a kind of mutual benefit of staying together." (Site E, GDE, in-depth case study, non-clinical digital lead)

Reasons for provider organisations choosing to stay with incumbent vendors include advantages associated with existing relationships, as well as exploiting local expertise and experience in handling already-familiar systems.

"It's like throwing the baby out with the bathwater, starting all over again, it was like working with the company, working with [mega-suite vendor] to improve what we had and making it work for us rather than starting afresh with somebody else." (Site L, FF, in-depth case study, clinical digital leader)

"We were out of the national Programme, we do have a small, but very experienced team in terms of basically cheating and modifying the back end of [vendor] and actually developing it and we've developed a whole load of things that, you know, from scratch here and there's all sorts." (Site L, FF, in-depth case study, clinical digital leader)

Furthermore, the costs and risks of migrating to a new system with potentially incompatible data structures was regarded as a barrier to moving between systems.

[86] Pollock N, Williams R. Technology choice and its performance: Towards a sociology of software package procurement. Information and Organization. 2007 Jan 1;17(3):131-61.

[87] Pollock, N. and Williams, R. (2008) Software and Organisations: The biography of the enterprise-wide system or how SAP conquered the world. London: Routledge.

[88] Howcroft D, Light BA. The social shaping of packaged software selection. Journal of the Association for Information Systems. 2010;11(3).

"I think the first key step with suppliers is really holding them to account for delivery for interoperability of data and openness of data. I think we can't be in a situation where [provider organisations] are afraid to move away from clinical suppliers because of the data migrations. […] The single biggest hurdle to people moving between systems is the potential consequence of data migration and it getting wrong." (Site D, GDE, in-depth case study, clinical digital leader working with aspiring mega-suite vendors)

Provider organisations that decided to change vendors or put their EHRs out to tender for the first time, had to balance a number of incommensurable factors during the procurement process. The most immediate factor was associated with the affordability of the new solution. While the total cost of ownership for all types of systems was hard to determine, the high upfront acquisition and implementation cost of mega-suite solutions [89] deterred many organisations.

"I think, at the time, I very much thought [mega-suite system] was the right solution but on reflection, I think it would have been too much change for the organisation and too much cost for it to absorb in one hit. My view is it probably would have been just financially crippling for the organisation." (Site D, GDE, in-depth case study, clinical digital leader working with aspiring mega-suite vendor)

Second, functionality and usability of the proposed EHRs were usually assessed during the procurement process. Since mega-suite vendors offered new clinical functionalities that were sought after by clinicians, provider organisations were often pressed by their own clinical staff to adopt mega-suite solutions. In a context in which clinicians were intensively using EHRs in care delivery, their preferences tended to have great impact on influencing the provider organisations' choice of the final solution, provided that the organisation could afford the solution (refer to Case study 2 in the section below)

"But principally, actually, the reason why [system name] was chosen was because every single clinical and operational team, when we looked at all of the possibilities, they said that is the system that we think we would genuinely use." (Site A, GDE, in-depth case study, clinical digital leader, working with mega-suite vendor)

Third, provider organisations might have their own visions/preferences for how their systems and digital strategies might evolve in the long-term, and hence, procurement decisions were often made as a reflection of those projections. While some provider organisations regarded the mega-suite model as "a disaster" due to the fact that it helps concentrate the market power into a handful of select vendors, others envisioned the move toward full-fledged EHRs as "inevitable" due to the recent shift of emphasis toward integrated care and international benchmarks, such as HIMSS EMRAM.

[89] It was reported that mega-suite vendors' asking prices for a 10-year contract in early 2010s for a particular provider organisation ranged between £20 million to £60 million. There were (and still are) great difficulties in estimating these costs due to the lack of data transparency and systematic approach to calculating those figures across the NHS England.

"I think the idea of the mega-suite is just a disaster, really. I think [system name] locked down approach, I don't think it allows you to innovate around the edges." (Site H, GDE, in-depth case study, Clinical digital leader, working with aspiring mega-suite vendor)

"It seems inevitable that we'll move to an all-encompassing EPR system. I think the Best-of-Breed is great in theory, but the difficulties of integration are not insignificant. I think that a lot of the things we've heard about some of the feedback we got back from HIMSS and some of the requirements of HIMSS, feel like they're making a case for EPR for a single solution." (Site M, FF, in-depth case study, clinical digital leader, working with vendor-driven BoB)

While most interviewees commented on the need for a large and competitive vendor market, some flagged the benefits of a relatively oligopolistic market in delivering scale economies and learning economies. In particular, some provider organisations expressed a view that there was a limited number of vendors in the UK that were capable of developing healthcare information systems for hospitals. As a result, there were good arguments for deploying the limited capability in a few vendors, rather than spreading them very thinly across the market.

"I don't mind so much the monopoly because from our point of view, although it costs us quite a lot of money to deal with [a mega-suite solution], we've got a solution that really works for us. We've got a whole plethora of people out there that use the same product. We've got the chance to put some pressure from our end, user end, onto the [mega-suite vendor], but I would have thought that there's more that the central NHS could do to put pressure on vendors." (Site L, FF, in-depth case study, non-clinical digital leader, working with a mega-suite vendor)

However, the majority of provider organisations that we observed during our evaluation advocated for a market built around open-platform models and interoperability standards. Not only was this position in alignment with the NHS England's policy,[90] but it also reflected a major concern amongst provider organisations over challenges of integrating EHR with a myriad of ancillary systems present in their information infrastructures – a common problem which occurred in both BoB and mega-suite adopters' sites.

"But by being able to configure our own EPR, alright, well we see value in that, by being able to own the data that is put into the EPR, there's clearly huge value in that, by being able to bring in a supporting ecosystem linked to hopefully an open platform to sit alongside [vendor] and I think that allows us to really go towards a more bi-modal approach. EPR is going to be our mode one, our slow, steady bedrock but all the cool, sexy stuff that we want to do around the sites, okay, well use an open platform to allow you to do that." (Site H, GDE, in-depth case study, clinical digital leader, working with aspiring mega-suite vendor)

[90] Next steps on the NHS Five Year Forward View. Available from: https://www.england.nhs.uk/wp-content/uploads/2017/03/NEXT-STEPS-ON-THE-NHS-FIVE-YEAR-FORWARD-VIEW.pdf (last accessed: 06/05/2021).

Procurement processes

We observed a notable lack of expertise and experience in conducting procurement at local level. Provider organisations had restricted access to information and knowledge relating to major infrastructure procurement as these major upgrades were infrequent (occurring at most perhaps once every 10 years). In addition, there was a lack of forward looking and planning for longer term developments since provider organisations were largely absorbed in their day-to-day operation, and hence focused on tackling short-term problems. This mind-set was further strengthened by the nature of information system development, in which vendors developed new functionalities and made their new offerings available in an incremental manner. There was also a dearth of strategic roadmaps for information technology development in the healthcare sector in England – a problem which had been addressed to a certain extent by the adoption of international standards, such as the HIMSS EMRAM.

"I think it's difficult because the knowledge we have in a process is probably very one dimensional and you know what you want but you only know what you want based on how you work at the moment, and then the faff around the whole selection and really how you properly evaluate and decide what makes you choose a system. People aren't perhaps so well practiced at that, or those people who have done it are very rigid in more of an old style of "these are the ways you go about procurement". You risk always making deciding factors, actually things that are almost less of an important factor when you are selecting a system." (Site D, GDE, in-depth case study, clinical digital leader)

The procurement problem also manifested itself in the power imbalance between vendors and provider organisations. Provider organisations had great difficulty in articulating their needs as what opportunities they might take up tended to appear in relation to vendors' offerings. As a result, it was not possible for provider organisations to develop an understanding of their needs without working closely with vendors. This practice, however, was regarded as conflicting with competition law which required an arm-length relationship between vendors and adopters[91].

"The procurement process is quite constrained and everyone's petrified of challenge. We had someone visit the other day and they are in the procurement process, and it's almost like the primary thing is not to get challenged on the decision we make rather than make sure they get the right solution. And so, they were so concerned over making sure that they had conversations with suppliers in the room, rather than having conversations without the suppliers so they could get to the truth as to whether it really is the right solution… They kind of almost could risk reaching outcomes that aren't in the best interest of all the patients that we serve." (Site D, GDE, in-depth case study, clinical digital leader)

[91] Competition law allows vendors, which do not win the contract, to challenge the provider organisation's decisions on winning solutions. If vendors could prove that they had been treated unfairly during the procurement process, the provider organisation has to start the whole process all over again. Therefore, provider organisations were seen as doing everything they could to avoid being challenged by vendors.

There was also an information gap between vendors and provider organisations with regard to the EHR market, particularly around the procurement process. While vendors were well-informed about the costs of their own products and of their competitors' offerings, provider organisations had limited access to such information before procurement. There was no reliable third-party source on which provider organisations could rely to compare and validate various solutions on the EHR market. This situation was in stark contrast to the commercial enterprise software market, where industry analysts (most prominently Gartner) were observed to play a pivotal role in sorting vendors, guiding adopters, and shaping the digital future of certain technologies/ product markets.[92] [93] Owing to the lack of such key players in the EHR market, provider organisations had to rely solely on the finite amount of information which became available during the procurement process.

"It has been a comparatively asymmetric relationship, as in supplier has got a great deal more information, particularly around procurement and I think that would certainly fit with our practical experience, as much as it's been narrated on, in the literature." (Site D, GDE, in-depth case study, clinical digital leader and non-clinical digital leader)

This problem was aggravated by the fact that provider organisations felt inhibited from exchanging information about the procurement costs of their EHR systems. This was an unintended consequence of the 2013 health service reforms, which meant that provider organisations were in effect competing organisations. It placed a constraint on concerted actions amongst provider organisations. Vendors sought to retain confidentiality around contracts on the grounds of commercial confidence. In this context provider organisations were defensive about sharing this information. Another factor was provider organisations' fear of being "exposed to be the person who's paying the most" and thus, opening themselves up to criticism.

"Because people don't want to be the person who's paying the most or exposed to be the person who's paying the most. It's wrapped up in things like oh, but we've put a nondisclosure agreement in the contract… But actually what you want to know is all the nuances [of costs of ownership]… You just don't get that balance. There isn't that obvious honesty in the room. And the flip side of that is where you get suppliers trying to price based on what they think they can get the market to pay rather than on what you think the return on investment is for your starting point." (Site E, GDE, in-depth case study, non-clinical digital leader)

In discussing procurement choice, suggestions were frequently made by digital leaders participating in our in-depth study that, although software acquisition and licensing costs might be lower for BoB solutions, the total costs of ownership were higher than mega-suites if the ongoing costs of establishing and maintaining interoperability (costs which were bundled up in the mega-suite license fees) were taken into account. However, authoritative data about the total costs of ownership (TCO) of different supply strategies are not currently

[92] Pollock N, Williams R. Who decides the shape of product markets? The knowledge institutions that name and categorise new technologies. Information and Organization. 2011 Dec 1;21(4):194-217.

[93] Pollock N, Williams R. How industry analysts shape the digital future. Oxford University Press; 2016 Jan 14.

available. This partly results from a structural problem. Individual provider organisations lacked the resources and incentive to comprehensively capture all costs associated with the procurement, implementation, and maintenance of their systems over an extended timeframe. Even if such data were collected, they could not be used in a straightforward manner to compare different systems in different locales for several reasons. First, the different software functions procured in various different versions and different sizes of provider organisations mean that it is not straightforward to make direct comparisons. Second, these costs are incurred in very different ways. These include a) up-front software purchases, b) ongoing license fees and service contracts, c) the growing practice of charging for software based on the numbers of users, d) costs for provider organisations of employing of technical staff for maintenance and interoperability with third-party systems. TCO could as a result be calculated in very different ways. Even where organisations feel able to share costs data (despite the constraints discussed above), there is no unified data collection framework across organisations and no simple established way to capture TCO in a comparable manner. Consequently, it is extremely difficult to perform direct comparison between organisations. As a result, provider organisations had to make procurement decisions based on partial understandings of TCO, which had been formed under conditions of imperfect information. Central NHS players had a more complex appreciation of cost structures, informed by their informal knowledge of contracts signed by provider organisations. However, they were constrained in collecting and sharing such information in a systematic manner and thus not able to effectively tackle this problem.

Vendor delivery capacity

We also observed some problems with vendor delivery capacity. Some provider organisations complained that promises which had been made by vendors during the procurement process were often exaggerated, and few materialised in the specified timeframe. These difficulties were compounded by the nature of software as highly complex non-material goods, whose properties cannot be straightforwardly assessed by simple inspection, and hence, it was difficult for provider organisations to appraise vendors' claims.[94] [95]

> *"Everyone says they can do everything. And if they say they can't do it, they tell you it's in the roadmap for the next year, but the reality is it just doesn't materialise." (Site D, GDE, in-depth case study, clinical digital leader)*

Once contracts had been signed, many vendors struggled to fulfil the promised functionality in the agreed timeframes. Provider organisations attributed such failure to vendors' lack of skills, capacity, and resource commitment. Furthermore, provider organisations castigated some vendors for having non-responsive, outdated development models. In contrast to the agile development models now current in the IT sector, vendors were perceived as using the outdated, yet prevalent, waterfall model,[96] which was characterised by the breaking down

[94] Williamson OE. Markets and hierarchies: some elementary considerations. The American economic review. 1973 May 1;63(2):316-25.

[95] Pollock N, Williams R. How industry analysts shape the digital future. Oxford University Press; 2016 Jan 14.

[96] Laplante PA, Neill CJ. The Demise of the Waterfall Model Is Imminent, and Other Urban Myths: Rumors of the demise of the Waterfall Life-cycle Model are greatly exaggerated. Queue. 2004 Feb 1;1(10):10-5.

of project activities into linear sequential phases. The project's progress was expected to flow largely in one direction, i.e. "downward" like a waterfall, and each phase was dependent upon the outcomes of the previous one. This resulted in slow and inflexible vendors' responses to user requirements/ upgrade requests. In consequence, delay occurred at one stage during the development process risked creating a "knock-on-effect" that hampered the digital transformation of provider organisations as a whole.

"Interviewee 1: We are completely hampered by [our vendor's capability in delivering a product]. So, the broad aspects are a lack of skills and capability… The second one is that they've got a very enterprise driven approach, that one thing has to be done before they do the next thing, so it's almost a very linear development cycle […], which doesn't really start to incorporate mobile workflow or other things that you may need to build out, to incorporate somebody adding a piece of information out of a particular point. […]

Interviewee 2: Yes, it's a very slow progress, which then has a knock-on effect, because delays to this piece of functionality then means they can't start work on the next, and it just has a domino effect really." (Site D, GDE, in-depth case study, clinical and non-clinical digital leaders)

Most provider organisations considered the late delivery of projects, and vendor management in general, a difficult issue stating that there were few measures they could utilise to leverage and move vendors forward.

"There are lots of organisations are in the same place as us, where the suppliers are holding them back from where they need to get to and yes, seem to be stuck in a similar position, that there is no support to help them move the supplier forwards. So, I think … actually supplier management is a big issue." (Site D, GDE, in-depth case study, clinical and non-clinical digital leaders)

"Because otherwise, the suppliers, once you've signed the contract so they're all-singing, all-dancing, whatever, you're completely stuffed, because you get what they let you have rather than what you need." (Site M, FF, in-depth case study, senior manager)

Attempts had been made by central NHS bodies to address the issue of vendor management. The GDE Programme was initially set up as an initiative to coordinate procurement processes. It was intended that GDE sites would provide successful demonstrations of technologies, which could then be used as Blueprints for other sites to adopt without the need to go through procurement. There were however legal impediments to such standardised procurement as well as unhappiness amongst provider organisations, particularly following NPfIT, with centrally directed procurement:

"The whole GDE thing, if you roll it back to its initial starting point, looked, from the outside, and I've got no inside knowledge, but from the outside, it looked like a programme to buy [mega-suite system]." (Industry stakeholder).

In addition, NHS England and NHSX established a specific category within the Health Systems Support Framework (HSSF) in August 2019 to help provider organisations, STPs and ICSs to get best value for money via procurement through the framework.[97] NHS England hoped that HSSF could become a "one-stop-shop", which local and regional NHS organisations could procure from. Those vendors on the "pre-approved" list of HSSF were required to meet a number of criteria, especially interoperability standards, before responding to tenders. A part of HSSF was used to help accredit GDE vendors based on the Definition of Done.[98]

Nevertheless, the impact of the GDE Programme and HSSF on managing vendors and the procurement processes was limited. NHS England could not use the GDE Programme and HSSF to restrict vendors that were not on the list from accessing the market due to competition laws and legal challenges. In addition, providers can procure outwith the Framework if they wish. The case in point was Epic – a premier vendor in the EHR market – which did not submit to HSSF initially, but there had been no barrier to prevent the vendor from entering and subsequently increasing its user base in England.

"Because, you know, if I look at the GDEs, and the selection process for the GDEs, it didn't really judge the supplier, it judged the [provider organisations] on what the [provider organisations] were doing. And so, there was some confusion. I think, where it ended up is where it had to end up, really, that there was a legal framework, the HSSF. Now, I find it interesting – going off topic a little bit – that there was a HSSF framework in order to find suppliers who could sell into the UK market, and yet, Epic weren't on that list. And I very much doubt that anyone has the appetite to prevent [provider organisations] choosing Epic… the NHS clearly finds it difficult to restrict market access to a subset in these situations." (Industry stakeholder)

In addition, the HSSF was initially criticised by the industry for being "too narrow and too focussed on certain types of suppliers", which risked locking provider organisations into "inflexible and steadfastly expensive" solutions.[99] Since its initial announcement, efforts have been made to enhance the presence of SMEs and specialist vendors on the HSSF. NHS England and Improvement also promised to update HSSF regularly to "to ensure it stays current and includes the latest innovative products, services and suppliers".[100]

[97] About the Health Systems Support Framework. Available from: https://www.england.nhs.uk/hssf/background/ (last accessed: 06/05/2021).

[98] List of accredited EPR suppliers published by NHSE and NHSX. Available from: https://www.digitalhealth.net/2019/08/accredited-epr-suppliers-published-by-nhse-and-nhsx/ (last accessed: 06/05/2021).

[99] Narrow HSSF 'risks locking buyers into inflexible and expensive solutions'. Digital Health. Available from: https://www.digitalhealth.net/2019/10/narrow-hssf-risks-locking-buyers-into-inflexible-and-expensive-solutions/ (last accessed: 06/05/2021).

[100] NHS England re-opens HSSF to LHCR and population health suppliers. Available from: https://www.digitalhealth.net/2019/11/nhs-england-re-opens-hssf-to-lhcr-and-population-health-suppliers/ (last accessed: 06/05/2021).

To switch or not to switch vendors: Tales of Three Case Studies

Although choosing to stay with their existing vendors was the default approach for provider organisations, there were still cases where provider organisations made strategic decisions to start anew and implement their systems from scratch. Below, we discuss three case studies: two of these decided strategically to switch vendors, while the other chose to stay with their incumbent vendor. These case studies are used to illustrate some of the difficulties, which provider organisations faced as part of their re-procurement process. They highlight the complex sets of concerns and pressures surrounding the procurement process (Box 5, 6 and 7).

Box 5: Case study 1 of re-implementation

Case study 1

Site A decided to move away from their in-house and end-of-the-line systems[101] to procure a full EHR system in the early 2010s. Procurement was a long and arduous process, which took almost three years to be completed from the beginning of the procurement process to the date when the system went live. Site A's approach to implementing their EHR system was perceived (by themselves and other provider organisations) to be risky and expensive.

> *"So, if you've got an [system's name in Site A] and you've already spent 200 million on it, and you've crashed your hospital once, and you've learnt all sorts of things around what to do, having ten million quid to do GDE is a bit like putting a new wing mirror on everything, it's not really fundamentally changing much." (Site A, GDE, in-depth case study, clinical digital leader)*

The big-bang implementation of the system brought disruptive changes to both organisational and technical infrastructures of the provider organisation at the same time. The first year was described as "rocky", "disorientating", and staff were expected to go through "trial by fire".

> *"We also did internal restructuring at the same time as our [system's name] implementation, so we moved from seven clinical divisions to five. And so people's line management and roles all changed as part of the implementation. […] That disorientation takes folks time, and I think, yes, we also ripped out paper processes and put in an integrated system, and we took out your old kit and put in new kit, and so we did infrastructure, restructuring clinically and that all at the same time. The first year I would expect to be rocky. I would absolutely expect folks to kind of trial by fire through it. It was very disorientating." (Site A, GDE, in-depth case study, GDE programme staff)*

Nevertheless, it was argued that the big-bang approach was more suitable for provider organisations, whose activities were usually not confined to any one ward or department, and thus, the benefits of big-bang implementation were said to outweigh its risks and difficulties.

[101] End-of-the-line systems refer to those that have been developed long time ago and they are no longer received support or update from developers.

"My argument would be that, whilst lots of hospitals have made progress in all sorts of ways over the last five, ten years, I don't believe that any hospital has made as much progress in the same timescale that we have in the same way. So yes, you might consider it a risk, but yes, the benefits have made that risk worthwhile." (Site A, GDE, in-depth case study, clinical digital leader)

Site A reached HIMSS EMRAM 7 six years after their mega-suite system went live.

Box 6: Case study 2 of re-implementation

Case study 2

Coming out of the NPfIT, Site D was disappointed with their existing vendors, and their staff were reported to be "fed up using the… system [because] they found it really, really clunky" (Site D – GDE Programme Manager). Site D decided to go through a full procurement process, at the end of which a mega-suite vendor was chosen as the most preferred bidder by the clinical staff. However, Site D could not afford the mega-suite system, and as a result, they were forced to choose the runner up instead. The chosen vendors - Vendor M (an aspiring mega-suite vendor) - was not able to provide a full-fledged EHR, and thus, Site D had to embrace the BoB approach to implement their EHR systems.

"And I think for [Vendor M], they promote themselves as being open source, which makes them different to some of the bigger players out there… If there's something that is obvious, that is a bespoke clinical system that is specialised in a certain area, [Vendor M] really don't have anything that they can challenge that with. And certainly, the way in which contracts are set up, we've then contracted through [Vendor M], so they've acted as a third party for us." (Site D, GDE, in-depth case study, GDE programme staff)

Site D had to go through a difficult and strenuous process to replace the old EHR system with the new one, beginning with "firefighting" issues arising from the Patient Administration System (PAS) replacement, followed by bringing in various specialist vendors to cater for the provider organisation's clinical needs.

"So prior to GDE we'd put in [system's name] in September 2015, I would say we had probably about a six month stabilisation period where it was really firefighting the issues that arise from a PAS replacement, and then we started to focus on a strategy which was almost a modular approach to digitising the clinical record working in partnership, which was planned to be delivered in partnership with [Vendor M] with some specialist elements being delivered by [another vendor] at the time, and then there was a view that we would need to bring in some other specialist suppliers later on in the journey, for things like electronic prescribing." (Site D, GDE, in-depth case study, clinical digital leader)

As a result of re-procurement, Site D found themselves in a difficult position, where they had to work within a very tight timeframe to avoid any set back that would result in "significant delays" and hefty penalties in terms of re-licensing costs.

> *"Because we made the choice to change our supplier, if for whatever reason, we suffered significant delays, then there's penalties, and then they would have charged x amount of money for us to still stay with them for an additional month or an additional two, and of course we didn't want to find ourselves into that position. So, we had to be really, really tight, not only as ourselves, working to our set time frames, but also holding [Vendor M] to account for working with us, with those timeframes." (Site D, GDE, in-depth case study, GDE programme staff)*

To make the situation even more perilous, Site D was caught up in Vendor M's scheme to expand its portfolio to become a mega-suite vendor. Such a venture was later proved to be too difficult, and too demanding in terms of resources and capability for both Site D and Vendor M to achieve.

> *"I think the intra-operable route is the right route that we are going down in the Best-of-Breed solution. We probably, where we got it slightly wrong was we should have, where originally we thought we'll do everything with [vendor] and we'll build from the ground, actually, we should have asked [supplier's name] to focus on the PAS, we should have looked at some bespoke system elements with them, but continued to build on very much the Best-of-Breed mode, whereas we almost bought into trying to help them build an EPR which is just such a difficult undertaking and will take far more time and money than either party have really got at that point." (Site D, GDE, in-depth case study, clinical digital leader)*

Overall, Site D's decision to go through re-procurement did not help them accelerate the digital transformation process. Instead, it created more problems, which eventually compelled Site D to spend great time and resources on: (1) firefighting problems arising from replacing the old EHR system; (2) establishing new relationships and experimenting with a wide variety of vendors; and (3) helping their core vendor to expand their portfolio of applications. Consequently, the success of Site D's re-procurement was still considered moderate compared to the great effort and resources they had spent on the Programme.

These two case studies illustrate the time- and resource-consuming process of switching vendors at two different provider organisations with different outcomes. While one was successful in achieving high level of digital maturity a few years after implementing their EHR, the other faced a great number of problems and delays during their implementation. One key difference between the two cases were that Case 1 implemented a tried-and-tested mega-suite solution with a clear roadmap toward HIMSS EMRAM, while Case 2 spent a significant amount of time and resources on experimenting and co-developing new systems with vendors, with a less clear roadmap toward a fully integrated EHR solution. In addition, Case 1 had a much higher budget to invest in the deployment and associated hardware. Consequently, in the short- to medium-term, Case 1 is more likely to achieve better

outcomes in terms of digital maturity. Despite the differences in outcomes, both provider organisations had to go through lengthy and expensive procurement processes, as well as disruptive and arduous periods of implementation. These observations underline why the majority of provider organisations choose to stay with their existing vendors, instead of taking a leap of faith with new vendors. Nonetheless, re-procurement has the potential to help provider organisations accelerate, or even leapfrog, their digital transformation process provided that the organisation sufficiently prepares to accommodate disruptive changes, and has a clear long-term strategy to guide the implementation and optimisation.

Box 7: Case study 3 of re-implementation

Case study 3

Similar to Site D, Site L also took part in the NPfIT and implemented the same mega-suite solution in early 2000s. Although Site L also experienced "a lot of problems in the past" with the mega-suite solution, they took an opposite direction to Site D by continuing to work with their incumbent vendor. It was argued that (1) it was better to improve the relationship that Site L already had with the existing vendor, rather than starting anew; and (2) there was no other viable option on the market at the time.

"You've come so far, you've got a product. Why… it's like throwing the baby out with the bathwater, starting all over again… Working with [mega-suite vendor] to improve what we had and making it work for us rather than starting afresh with somebody else. And the way the UK market is, there aren't that many other suppliers… So really, in the UK, [our vendor] is one of the big players. And the more they go about, the more people use it, the better the product becomes and the richer it is full of UK content if you like." (Site L, FF, in-depth case study, clinical digital leader)

The mega-suite solution was responsible for the majority of Site L's clinical and non-clinical functionalities. Nonetheless, there were still around 200 to 300 individual systems running in parallel to the mega-suite solution. A great number of them were audit systems (some were self-built Access databases) containing patients' information or performing other useful purposes. These systems were thus still in operation and were not completely replaced by the mega-suite solution. As a result, reducing the total number of legacy systems by incorporating or replacing them by new functionalities provided by the mega-suite solution was the top priority of the provider organisation's long-term digital strategy.

"We tend to quote a number between about two hundred and eight and three hundred individual systems… And we talk about our top twenty and our top forty systems, and all the top twenty and top forty are applications. Once you start getting outside of that you are starting to talk about audit systems or, you know, self- built Access databases or those sort of things – but they still contain, some of them, patient information or they still do something useful, otherwise they wouldn't be being used… But yes, you know; it's quite a lot of systems but, you know, we are cutting down the number." (Site L, FF, in-depth case study, non-clinical digital leader)

Another key issue in the digital transformation of Site L was to ensure the interoperability between their mega-suite solution and the rest of their information infrastructures consisting of hundreds of other systems. Site L admitted that it was still challenging to establish connections between their mega-suite solution and specialist systems, through what they called "fat integration" (consisting of different types of data moving between two systems), as opposed to "thin integration" (i.e. a simple demographic look up of patient's data). Establishing fat integration was far from smooth and perfect, which resulted in low data quality and potential threat to patient's safety.

> *"The echo machines connected to the cardiology system, the cardiology system to [the mega-suite solution]. And appointments were put separately in the cardiology system and appointments were put separately in EPR. And if you were lucky, they were the same. But obviously they weren't some of the time… And it was just…data quality nightmare. Potentially unsafe. So, having that fat pipe again, all the data through, all the data back… So that sort of integration will be a challenge for most [mega-suite solution] customers." (Site L, FF, in-depth case study, non-clinical digital leader)*

In order to tackle these challenges in the long term, Site L employed two strategies: (1) to keep everything within the mega-suite solution, unless a third-party system was proven to be the only choice or to provide significantly greater benefits than the mega-suite solution; and (2) using thin integration whenever it was possible to do so. In this way, Site L was able to keep their information infrastructures functional, while gradually switching third-party components with systems provided by the mega-suite solution.

> *"So, I mean, going forward, our strategic direction is that everything should be in [proprietary mega-suite solution] unless we can make a good case for the fact that [mega-suite vendor] doesn't deliver a solution for your particular thing... So there would always be some specialty systems, Best-of-Breed systems, well, certainly for the next decade, where [the mega-suite solution] can't fill the gap. So, we need a mechanism to be able to do that. And in some areas, like in ophthalmology, it may be that they are completely on a different system and all we need to do is just receive, you know, almost free flowing PDFs, just so that everybody knows what's going on. But there's no requirement for fancy complex messaging and reporting, and stuff, because they can do all their reporting off the third-party system." (Site L, FF, in-depth case study, clinical digital leader)*

As a fast follower, Site L was paired with a GDE which implemented the same mega-suite solution. It was reported that the two organisations had a very good relationship both prior to and during the GDE Programme (e.g. junior doctors moved between the two organisations on rotation; both sites collaborated on implementing HEPMA system before the GDE Programme). Therefore, the GDE-FF pairing played a crucial role in Site L's decision to stay with its incumbent vendor. It was also revealed that such an arrangement fitted "logically" into Site L's long-term plan. By having a clear roadmap, as well as building on the well-established foundation of their mega-suite solution, Site L was able to make steady progress toward achieving high level of digital maturity and HIMSS EMRAM standard.

> *"We have a five-year digital hospital strategy as a [provider organisation]. This fast follower programme was the first two years of it. So, we now have the next two-year programme internally. And we're just completing the business case approval process for that… So, that is a programme put together in very much the same way as we put the Programme together for the fast follower. And that has the next logical pieces of the digital hospital, which will get us to HIMSS six anyway. So, it fits together logically. We haven't radically changed what we would have done anyway because of HIMSS six. It flows naturally." (Site L, FF, in-depth case study, GDE programme staff)*
>
> In 2018-2019, Site L was assessed at HIMSS EMRAM Level 5, and thus fulfilling their required target of digital maturity as a fast follower in the GDE Programme.

Case 3 illustrates a digital transformation journey of a provider organisation which chose to stay with their incumbent vendor. It was apparent that the organisation did not go through a disruptive and arduous period of switching systems and implementing a new solution from scratch as compared to their counterparts in the previous two case studies. Interestingly, despite implementing one of the most well-established mega-suite solutions on the market, Site L still had to run hundreds of legacy and specialist systems in parallel. Interoperability therefore became one of the biggest challenges that Site L had to overcome to achieve higher levels of digital maturity. Nevertheless, by choosing to stay and co-develop with their existing vendor, as well as having a clear roadmap, Site L was able to make gradual, yet steady, progress toward becoming a digitally mature healthcare provider organisation.

Interoperability challenges: Barriers to achieve digitally-enabled transformation

As illustrated above, even the most advanced mega-suite solutions on the market still need to work with hundreds of other legacy and specialist systems in order to cater for the needs of provider organisations. Therefore, interoperability is still one of the greatest challenges that provider organisations face in their digital transformation journey. This section is thus dedicated to discussing barriers to interoperability as the first step toward addressing this key issue.

First, provider organisations start off with very different arrays of installed software, reflecting different historical procurement choices. They are moreover at different stages in their digital transformation journey. They differ in the maturity of their technical infrastructures, the digital literacy of their workforce, and the commitment to digital transformation at board level. The larger the digital maturity gap is between provider organisations, the more difficult it is to make them interoperable with one another.

"But when you've got neighbours that either have paper, are going to buy Epic or have got home-brewed systems, how we're meant to interoperate safe reference-based data when we can't semantically interoperate. [It] is very difficult… We're a digital island in an analogue sea and those bits that aren't analogue are, how can I put it, they talk a foreign language? Yeah, they can't interpret safely what we can give them… You could try and use [free-form text] but it's not safe or you could say [you] can't use it. Or you may not even get an option to get an interface to [the system], or they may charge you the earth, right?" (Site H, GDE, in-depth case study, non-clinical digital leader and GDE programme staff)

Second, different systems are developed around different data models and standards, which might not allow them to interoperate technically or semantically. We found that some provider organisations still used parallel digital and paper-based systems.[102] Even with digital systems, some provider organisations still stored data in a wide variety of ways, ranging from state-of-the-art proprietary database management systems, to simple discrete programmes such as Microsoft Access, and spreadsheet files that they managed manually. As a result, interoperability between systems was not always technically or semantically possible.

Third, costs for interoperability between different systems were seen to be prohibitively high for some organisations. It is expensive especially for small vendors to develop and maintain interfaces. Individual adopters often have to pay for gateways between new solution and their existing systems. There was a concern that this effort was being duplicated across a number of provider organisations who were in effect being asked to pay many times for the same work.

Moreover, provider organisations feared that vendors had little incentive to adopt open standards and resisted opening up their systems for third-party interoperation due to fear of losing control of their products and diminishing their unique selling points (USP).

"If the suppliers don't want to give us an API, don't want to play nice with us, then again, we're stuffed." (Site F, GDE, in-depth case study, non-clinical digital leader)

"The interoperability of [SNOMED] to being vendor applications, though, was a bigger story, because vendors want to be unique, they wanted to have a USP that they could sell, and the last thing they wanted to do [was to make everything interoperable]." (Site A, GDE, in-depth case study, GDE programme staff)

Provider organisations also reported a lack of vendor commitment to collaborate with one another to make their systems interoperable.

[102] Having paper-based element was considered necessary as a transitional stage for some provider organisations in their digital transformation journey when they started from a low level of digital maturity.

"I think closed looping particularly, we got lost between two suppliers who were very poor in managing the interface… And by the end of that project, we realised that, you know, that wasn't going to happen, that they'd never had that conversation to understand the complexity of their configuration between the two systems would require actually a very complex interface being built in the integration engine. And they've both sort of thrown their spec over the wall to say, well, you need to sort it. It became our problem at the end of the day and it wasn't at the very beginning. And I think sort of quite often when they had a requirement to build functionality it, we'd end up rebuilding it ourselves." (Site H, GDE, in-depth case study, non-clinical digital leader)

Interoperability was further inhibited by the existing fragmentation in NHS structures including specialties and care settings.

"And when the original contract for the NHS was put together it was trying to bring in the whole of the health economy into one organisation. And GPs aren't really part of the NHS… Dentists are outside it... So you do have that not set up correctly in the first place, or not set up optimally in the first place… And because of that then the only way you can really manage that is to become insular, is to start looking at your organisation as if it is just your organisation and trying not to deal with anything that happens outside of that." (Site L, FF, in-depth case study, GDE programme staff)

Intended and unintended consequences of the GDE Programme on vendor management

The GDE Programme has given provider organisations greater leverage and helped them better manage their relationships with vendors. In particular, the Programme signals an increase in investments for digital systems for a sustained period of time, which helped attract more vendors to the market.

"GDE meant that over a small number of years, three years, we were investing a very significant amount in our digital agenda. So, [vendor]'s interest in us was clearly greater because it was an opportunity." (Site 5, FF, broader study, senior manager)

Furthermore, the Programme helped increase provider organisations' position (e.g. through the increase of number of provider organisations implementing the same system), and hence, gave them more leverage over the vendors.

"Actually, there was an element of the GDE status helped with vendor management. So, particularly because [vendor] had quite a few [more provider organisations as their customers], and they were in the spotlight. It collectively gave us leverage over them to make certain that they delivered." (Site 19, GDE, broader study, GDE programme staff)

The perceived prestige of the GDE Programme also played a role in holding vendors accountable, as well as incentivising them to deliver projects at greater pace.

"We're also getting a level of product delivered at a certain pace that we wouldn't have been able to do before… It's [because of] money, and I think it's [because of] leverage over the supplier, because before they could promise quite a lot, and not deliver it. Now, they're still promising quite a lot, and delivering slowly, but they've got much more pressure on them to deliver." (Site I, GDE, in-depth case study, clinical digital lead)

Nonetheless, we also observed some unintended consequences with regard to vendor management. The synchronous procurements across the health service created by the GDE Programme led to a sharp rise in demand for people with a certain level of skills and experience making it hard to fill new posts, especially where GDEs and FFs were located in a small geographical area. This meant that provider organisations had to compete for recruitment[103], and led to delays in positions being filled impacting on implementation timelines.

"One thing I've always maintained is that I think having a lot of GDEs within a specific geographical area is a bit of a double-edged sword. It's great because you can go and visit them, […] but conversely, we've found real problems recruiting because everyone within the local area has been sucked up on GDE projects." (Site B, FF, in-depth case study, clinical digital lead)

"I would say that the potential for that [the GDE Programme] has been marred by difficulties in recruitment. Yes, when we originally got it...got the statues [of GDE] and the money was on the table we had great aspiration and we couldn't recruit half of what we needed really." (Site C, GDE, in-depth case study, senior manager)

Similarly, it was evident that some vendors were not able to cope with the drastic rise in demands on their resources from provider organisations after securing a great number of new contracts through the GDE Programme. Where vendors secured many new awards in a closely linked timeframe, their attempts to increase capacity saw a shortage of people with appropriate skills and experience in the labour market.

"So, recruitment has been a problem. [Major Vendor]'s capacity is also, you know, problematic. [Major Vendor] have got the largest number of GDEs in the country. They find it difficult to recruit, they find it difficult to retain staff and get the right quality and level of staff. And it's a fairly buoyant market for specialists in EPR type stuff. And, I'm sure, [if] you go around the country, you'll find exactly the same mantra, you know, virtually everywhere" (Site C, GDE, in-depth case study, GDE programme staff)

[103] Apart from internal competition for recruitment within the NHS, the problem of staff shortage was exacerbated due to the fact that people with skills and experience were highly sought after by the private sector. NHS pay policies limited the scope for provider organisations to attract suitable candidates for vacant posts through competitive salaries, particularly in and around London.

Lessons learned on vendor management

The GDE Programme provides a number of valuable lessons on managing relationships between provider organisations and vendors. The Programme supported the development of EHR user groups and facilitated procurement partnerships through the GDE-FF connections (i.e. 16 out of 23 pairs of GDE-FF shared the same core platform). Closer provider organisation – vendor relationships seemed to work well under certain circumstances. For instance, when there were mutual benefits for both organisations (e.g. reputational gain, especially through the GDE Programme, competitive advantage, etc.), both parties were committed to delivering the project.

> *"We've delivered a lot that they've needed us for, so it is a true partnership. I get asked to speak at their conferences and talk about what we've done and how we've done it, so others can learn. I've used the phrase, we are their show home, you know, so they need to keep the walls painted and the grass cut, all that sort of stuff." (Site J, FF, in-depth case study, non-clinical digital leaders)*

Strategic alignments and shared roadmaps further facilitated effective collaboration.

> *"Adoption of [mega-suite solution] was something that was a major game changer for us. The systems that we had before were gloriously out of date, I mean, it was very much a very low-level digital system. Adoption of [system's name] was an important part on our journey to EMRAM, and it was an important part of getting rid of those elements of losing notes." (Site A, GDE, in-depth case study, senior manager)*

When there was a misalignment in strategies, the relationship suffered.

> *"We know they had the (name) product and it had viewing capability and they wanted to deliver an electronic observation but, where it causes problems was it was quite light on detail and light on commitment. So yeah, we took forward electronic observations with them and they made really good progress on that… But it ultimately broke down when we were 18 months into the journey with them, it became apparent that really, there was a misalignment in actually where they wanted to go versus where we wanted to go." (Site D, GDE, in-depth case study, clinical digital leader)*

The relationship also worked well when vendors and provider organisations considered themselves as long-term partners and invested in developing this partnership.

> *"I think they [vendor] were pleased to have us as a customer. I think the relationship that we've had with them has been very positive. I'd like to think that we've helped to support them in terms of their wider aspirations within the UK and Europe, but then equally, they've helped us to progress and achieve some of the benefits that we've done. It is about a relationship with a company and a partnership, as opposed to I'm just buying this system from you. It's not that transactional sort of relationship." (Site A, GDE, in-depth case study, clinical digital leader)*

The relationship suffered when vendors were perceived to lack sufficient skills, expertise and resources to address the needs of provider organisations.

> *"Yes, so it's a bit of a supplier issue, both in terms of the skills capability, resource and their mind-set and their mind-set about whether they are actually truly able to do this or not, are probably the biggest challenges, which we've had very open and honest discussions at all the appropriate governance levels, which have now been put in place, to make sure that you can manage this on a formal level, it's just not corridor conversations." (Site D, GDE, in-depth case study, clinical and non-clinical digital leaders)*

Recommendations on policies for market management

Considering the lessons that we have learned through the GDE Programme, we propose the following recommendations for future policies on market management.

(1) Develop a thorough national strategy for market management, which considers long-term investment into the market (i.e. to attract new comers and increase the competition), while setting interoperability standards and priorities to help nudge the market toward a more agile, platform-based approach to EHR. In order for the NHS to save money while gaining the greatest benefit from such an investment, we recommend supporting the optimal (arguably limited) number of vendors which possess the capability and commitment to the EHR market in the long run.

(2) The value of long-term mapping lies in the fact that it helps signal opportunities and overall direction to a wide variety of vendors, while also providing them with sufficient leeway to adapt and change. Requiring provider organisations to deliver particular functional requirements in a limited timeframe, on the other hand, favours established vendors with tried and tested products (for example Cerner, Epic and other mega-suite vendors) at the expense of smaller and newer players and unintentionally provides a disincentive to the search for more innovative solutions.

(3) Facilitate and support collaborations between provider organisations within existing user groups.

(4) Support joint procurement initiatives. Strategies here must learn from successful joint procurement experiences for example in the mental health sector and also draw crucially important lessons from previous failed joint procurements, for example of EHRs[104] or EPMA[105] during NPfIT.

(5) Develop initiatives to fund and manage integration work centrally. This could help provider organisations and vendors avoid doing (and paying for) the same integration work time and time again across multiple sites.

(6) Though this is not specifically the responsibility of the GDE programme, tackle the surprising failure to systematically collect, collate and share information about Total Costs of Ownership of different procurement strategies.

[104] Cresswell K, Morrison Z, Crowe S, Robertson A, Sheikh A. Anything but engaged: user involvement in the context of a national electronic health record implementation. Informatics in Primary Care. 2011 Jul 1;19(4).
[105] Lee L, Williams R, Sheikh A. How does joint procurement affect the design, customisation and usability of a hospital ePrescribing system?. Health informatics journal. 2016 Dec;22(4):828-38.

Chapter 9: The GDE Programme legacy and implications for policy

Overall, the GDE Programme has been strikingly successful in achieving its key strategic goal of advancing digital transformation in the NHS. It has accelerated digitisation in selected provider organisations to serve as exemplars of successful change and share their knowledge with other provider organisations; and created the foundations for a learning ecosystem to promote digital transformation across the NHS in England. Taking part in the Programme allowed provider organisations to accelerate/achieve a range of digital capabilities. In turn it has also enabled GDE provider organisations to cope with the COVID-19 pandemic in a more rapid and effective way than they would have been able to otherwise.

This chapter seeks to understand the context of these successes in more detail and explore changes over time, in order to draw out lessons for future initiatives and policy making. We have started to work on mapping lessons from a range of digital transformation programmes in healthcare (see Box 6).

Box 6: Lessons from previous evaluations[106]

- **Relationship with central bodies**
    - Policy change impedes digitisation
    - Delays/changes to milestone payments, increase in requests to change projects

[106] National Audit Office, Digital Transformation in the NHS, 15 May 2020 https://www.nao.org.uk/wp-content/uploads/2019/05/Digital-transformation-in-the-NHS.pdf
Making IT work: Harnessing the Power of Health Information Technology to Improve Care in England: Report of the National Advisory Group on Health Information Technology in England: Chair Robert Wachter https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/550866/Wachter_Review_Accessible.pdf
The Long and Winding Road: An Independent Evaluation of the Implementation and Adoption of the National Health Service Care Records Service (NHS CRS) in Secondary Care in England. Kathrin Cresswell, Maryam Ali, Anthony Avery, Nicholas Barber, Tony Cornford, Sarah Crowe, Bernard Fernando, Ann Jacklin, Yogini Jani, Ela Klecun, Valentina Lichtner, Kate Marsden, Zoe Morrison, James Paton, Dimitra Petrakaki, Robin Prescott, Casey Quinn, Ann Robertson, Amirhossein Takian, Katerina Voutsina, Justin Waring and Aziz Sheikh (2011) http://www.cphs.mvm.ed.ac.uk/grantdocs/526%20%20Final%20report%20v31st%20Mar%20FINAL.pdf
Independent Review of NHS and Social Care IT, commissioned by Stephen O'Brien MP, Chaired by Dr Glyn Hayes, August 2009
https://ntouk.files.wordpress.com/2020/11/nhs-and-social-care-it-review-2009.pdf
National Evaluation of the Vanguard new care models programme. March 2019
Citation for published version (APA): Checkland, K., Coleman, A., Billings, J., Macinnes, J., Mikelyte, R., Laverty, L., & Allen, P. (2019). National evaluation of the Vanguard new care models programme: Interim report: understanding the national support programme. Citing this paper Please note that where the full-text provided on Manchester Research Explorer is the Author Accepted Manuscript or Proof version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version. https://www.research.manchester.ac.uk/portal/files/103375904/Interim_report_of_the_NCM_external_evaluation_final_v1.pdf
Local Health and Care Record Programme: National Evaluation Final Report, NHSX
Technology Funds Programmes – Lessons Learned
Technology Funds Programme Closure Report 2017
Lessons Learnt Report: Technology Funds incorporating Integrated Digital Care Funds and Nursing Technology Funds

  - Autonomy to achieve end goals results in varied plans but promotes learning
  - Core standards to avoid divergence did not arrive in time
  - Choice and interoperability require national standards for functionality and accreditation of systems

- **Vendors**
  - Commercial interests mean lack of shared learning
  - Local provider organisations require choice in vendors
  - Potential tension between increasing number of vendors and interoperability
  - Reduced funding resulted in reduced functionality
  - More robust assessment of vendor may mitigate issues with deployment

- **Benefits realisation**
  - Unrealistic assumptions about achieving cost savings or return on investment
  - Steep learning curve in benefits management
  - Introduction of new templates part way through had negative impact on relationships with organisations

- **Evaluation**
  - Evaluations should be systematic and on-going
  - Little evidence that lessons have been captured systematically
  - Evaluations should be formative and summative considering cost, benefits and impact on clinicians
  - Evaluation is moving towards encompassing the complex environment in which technology is introduced

- **Funding/costs**
  - Estimate of funds for digitisation based on limited data
  - Tight timeframes for receiving and spending money
  - Centralised procurement and implementation created diseconomies of scale
  - NHSX does not know the whole life cost of enterprise system, BoB or self-build, nor the cost of inefficiencies of legacy systems

- **Interoperability**
  - National strategy should ensure systems benefit organisations and users before connection on a larger scale
  - National standards for functionality and national accreditation required to provide provider organisations with choice and interoperability
  - NHSX does not have timeframe for achieving interoperability. This risks making interoperability harder in the future

- **Vision and strategy**
  - Focus attention on ‘adoption’ –accommodation between staff and technology.

- Waiting for utopia of Detailed Care Record prevented development of other IT services that benefit patients
- It would be reasonable to expect all provider organisations to have high digital maturity by 2023. No funds after this date and compliance with quality and safety standards.

- **Staff/clinical involvement and engagement**
  - Lack of clinical functionality and usability issues interfered with patient care
  - Clinical and social care engagement difficult
  - Clinical involvement in design improved applications

Shifting policy landscape

As digitally-enabled transformation of services involves a significant change, only incremental moves can be made towards achieving this. As a result, the GDE Programme was only part of a wider transformation of care, which included other initiatives such as shared care records, which have flagged the potential of radical new information architectures (although there is a lack of clarity on to how achieve them).

"As a consequence of the GDE, we were asked to lead the STP Digital work, so we've led all the co design across the system, we've now got an executive lead from the CCG join that group as well. So, the system, effectively, recognised the work we've done in GDE and asked us to drive it for the system, which is great". (Site F, GDE, in-depth case study, senior manager)

The Programme was situated within a complex and constantly changing policy landscape, where re-organisation and changes in leadership shifted agendas and trajectories in ways that increased programme management challenges. These features were perceived as a given by most stakeholders, who felt obliged to develop strategies to adapt to landscape change.

"We've had challenges with the Programme because we still don't know what the accreditation is. In theory we finished.... We still don't have clear guidance on the interoperability standards that we are being held accountable for delivering. So, we've accredited three times against different interoperability standards. I believe the website itself from the NHS says do not build against these, these are Beta, you should not under any circumstances build against this specification. And yet we've been asked three times by the Programme to deliver against that specification." (Site A, GDE, in-depth case study, non-clinical digital leader)

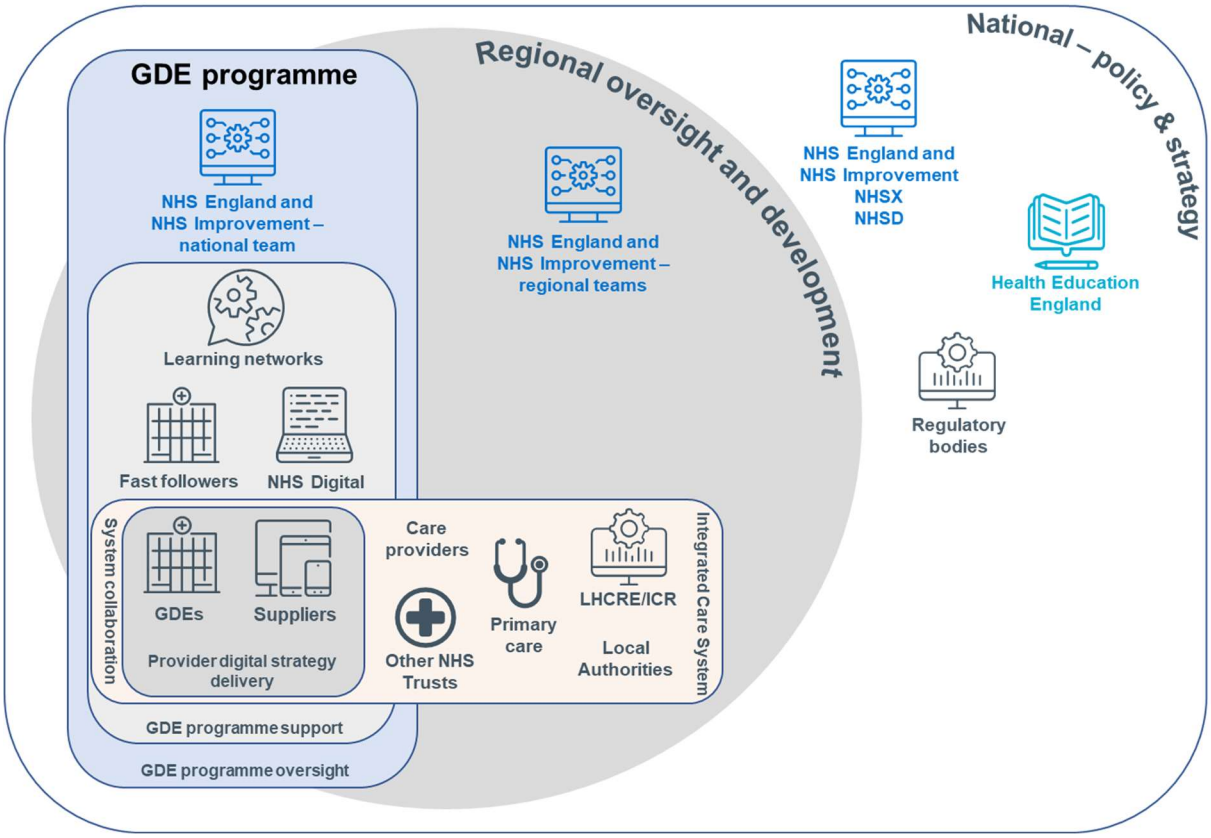
"But I think, yeah, from how the centre works sometimes it's a bit - what's the word for it, a bit foggy to decipher how it all works. (…) For instance, there was no information around recommendations of when payment milestones should be within the project, it was always, oh, that's completely up to you. They needed to be...in my opinion, there should have been a bit more structure from the centre around what the profiling should look like, what they expect upfront. A good example would be for every single payment milestone we've had a new funding

assurance template to fill out, they've never been the same, every single payment milestone there's a new template because there's new people in post who want new information or they want to put in new processes. So if there was one output of the GDE Programme there should be some sort of standardised funding assurance model." (Site E, GDE, in-depth case study, non-clinical digital leader)

This was further complicated by the existing mixture of statutory and non-statutory bodies at different national, regional, and local levels; and the complexity of NHS strategic governance structures (Figure 5).

"It's a multiagency programme and by their very nature there's always a little ambiguity in the governance, but our governance seems to have drifted in change with the changing responsibilities of different bodies during the lifetime of the Programme. And that's not unusual but it has been particularly disruptive I think on this programme. Even changes at the top of the shop, changes of Secretary of State has an impact on our programme, because the ultimate goal or importance that the Programme is given, changes with that change of direction." (Engagement lead)

Figure 5: Stakeholder map of strategic governance structures in the GDE Programme



The need for a sustainability strategy to promote the GDE Programme legacy

Sustainability of existing achievements

At the end of our work, all sites wanted to continue on their digitisation journey and build on the digital capabilities and capacity achieved through the Programme, following completion of the Programme.

> *"The clinical transformation team is key and is something that we would not want to lose, it's something that I'm very passionate about... all of that work with clinical staff alongside, you know, IM&T programme staff, project staff, is invaluable. So, we did have a business change manager who did a lot of that, was brought in specifically for GDE, but I've had that role in previous organisations before GDEs existed, and again I've had that working really closely along with a programme manager with a team of clinical staff. So for [Site B], I will certainly be keeping that model in place, that's important for me." (Site B, FF, in-depth case study, non-clinical digital leader)*

New clinical digital leadership posts are unlikely to be rolled back (some are expanding), as clinical digital leadership in the Programme has been seen as a success. We found evidence that GDE boards were in some instances converted into more general digitisation boards.

> *"So, I think it's changed the nature and structure of digital leadership in the organisation, so there's greater depth and breadth in clinical engagement, and those posts persist, so we've been able to transition the CCIO, CNIO funding into Business As Usual, so that is maintained. Some of the posts that we've lost we were able to resource an uptick in number of digital resources, so PMs, EPR developers, integration leads and so on. That has been harder to sustain and subject to, you know, we're having to do that through separate business cases, and so on, if we want to increase numbers there." (Site H, GDE, in-depth case study, clinical digital leader)*

At the time of writing, there was no central future vision/strategy associated with GDE sites. It was unclear whether and to what extent investment and digital change governance structures (which have been established through the Programme) in exemplar sites could be sustained once the financial resources provided through the Programme would no longer be available.

> *"So what I'm worried about is the continuity of those projects. We should continue with the same momentum. It's a bit different because we contract people to work on these, so it's a bit unsure of where we are going, et cetera. So, some concrete communication on the kind of transition period will be useful." (Site F, GDE, in-depth case study, clinical digital leader)*

Accreditation

GDEs wanted their efforts/role as national digital leaders to be acknowledged. The 'GDE Accreditation' process was refined in early 2020 (based on the Definition of Done) – when the Programme was nearing the end.

> *"I think it's important that they do get acknowledged because they've done all this work, they've reached these levels and then we had a change in…well a change in leadership, a change in approach and, you know, we can't just forget that they were GDEs and they've done this work. There needs to be some acknowledgement of the difference it's made to them and to the patient." (Engagement lead)*

The accreditation process came as a surprise to some provider organisations, who reported that they thought they were GDEs from the start. There was also some uncertainty as to what to expect from the process and around criteria for assessment.

Spread and dissemination of learning across the NHS

The GDE Programme has shown that competitive allocation of funding is a powerful motivator (promoting commitment associated with status). However, this tends to favour already well-resourced provider organisations and those with a clear vision of digital transformation (thereby accentuating unevenness and the digital divide between provider organisations).

> *"I can imagine doing GDE in [place] is very different to doing it here for instance, if you're in Cambridge you've already got a Lamborghini and you've got everything digital… Having ten million quid to do GDE for [provider] is a bit like putting a new wing mirror on everything, it's not really fundamentally changing much. Whereas for us we had a very basic level of IT infrastructure which had delivered on time and on budget over the period of history that we could measure, but didn't have much digital maturity. So, we've had to put in huge amounts of technical stuff to get us to anything like the starting point that an awful lot of other GDEs were at."(Site I, GDE, in-depth case study, non-clinical digital leader)*

There were thus challenges for sites that had not benefitted from prior investments in terms of physical infrastructure, digital capability and skills. Digital Aspirants were not only set to receive lower funding but were also less likely to derive prestige from their status, inhibiting progress.

> *"Investment can drive rapid change, and I think you can see a greater bang for your buck, with a large sum, rather than a tiny drip, drip, drip to everyone. And again, that's possibly a problem with Digital Aspirants, that 'Is it enough money to do anything meaningful with?'" (Site H, GDE, in-depth case study, clinical digital leader)*

Lessons had been learnt in the course of the GDE Programme about how to mobilise a learning ecosystem. This has illustrated the difficulties in top-down planning of networking activities, and the unpredictable uptake. Although a significant amount of sharing was going on, in part prompted by the GDE Programme, there is now a need to develop a supporting framework to promote the spread of knowledge and experience beyond GDEs and Digital Aspirants to wider providers. On one hand, it is crucial to incentivise digitally mature provider organisations, such as GDEs and FFs, to play a role as national digital leads and engage with less digitally mature sites to share hard-earned lessons and help catalyse digital maturity of hospitals throughout NHS England. On the other hand, it is equally important to help less digitally mature provider organisations develop their minimum viable infrastructure and digital capability via funding and other incentives from the centre to increase the chance of successful implementation of the lessons learnt.

"What we've asked multiple times for NHS Digital to produce is for the GDEs what sites are delivering what and can we have contacts. Almost, like, a directory of the GDE programme…. because then when we're looking at any of the projects, you could think, actually there's a GDE site that have done it but we've not got that. All we get is through (name of engagement lead) his knowledge of other sites that he can help put us in contact with, but again, he's only, I don't know, three or four GDE sites that he looks after…in terms of blueprinting, I think there's much more value in that type of interaction than a 40-page document that we have to produce." (Site D, GDE, in-depth case study, non-clinical digital leader)

Any framework going forward needs to take into account that national structures can put the framework for supporting learning into place, but that knowledge transfer needs to be owned and driven by sites themselves (with informal networks being most effective but hard to coordinate nationally). Developments are likely to be hampered by differences in digital maturity and infrastructures, workforces' capability and readiness to embrace technology, and new governing structures. This may impact on the capability of less mature provider organisations to learn and implement lessons. Future initiatives should therefore place emphasis on investment in digital infrastructures as well as digital programmes that often take for granted the infrastructures needed to run these technologies.

"And I guess the other thing that I would advise [provider organisations] not to start on this journey is if they haven't got the money to actually do it, and to get the infrastructure right before you start doing an EPR, then you really shouldn't start because you will end up not achieving the patient safety aims of the whole project. So if you haven't got a proper IT network and Wi-Fi and enough computers and single sign-on and somewhere to put your EPR in terms of servers and a robust system, you shouldn't give £30 million to an EPR provider. You sort out the simple but boring stuff first, then you do it, but you have to have enough money to see it through and make it happen. And that's not just buying equipment, you have to have the staff within your organisation to do the delivery, because you will not get what you need simply by paying money to an external provider." (Site G, GDE, in-depth case study, clinical digital leader)

Sustaining Programme management expertise

Changes in national leadership and national management teams throughout the Programme threatens to disperse momentum and waste valuable skills and experience. Some of this expertise was generic e.g. project management – which means that individuals were likely to move (e.g. to private sector with higher wages). The expertise acquired by provider organisations and national bodies in implementing these programmes involves particular combinations of knowledge of NHS context and change management. This experience-based capability, gradually acquired and refined in particular contexts is a very valuable resource that may be lost to the health service.

> *"We've lost staff to a multitude of organisations, absolutely, because we spent years configuring a system. They now have this very specific expertise of how do you go about a big bang, huge amount of change, organisation. And I think the other piece is, in order to truly be skilled at configuring the [name of] system, it takes time, and so just going out and getting certification is kind of like getting your training wheels. But actually, it takes another 12 months or so before folks really get upskilled enough to be valuable, and so given that we were the only ones in the NHS with that upskill when the other [*provider organisations*] were starting to join, all of a sudden people who could relocate had a pretty big opportunity to do it again and take maybe a higher-banded job or other pieces to exploit their expertise." (Site A, GDE, in-depth case study, non-clinical digital leader and clinical digital leader)*

Many also held the view that management/IT consultants in the NHS brought limited value and *"they tell you what you already know".* Nevertheless, many provider organisations also brought in support from health service consultancies to assist them with meeting skills/experience gaps.

> *"We've really struggled getting good technical resources into the organisation. It's always difficult to attract people at the rates of pay we have. You know, when we've got Microsoft half an hour down the road that pays engineers a hell of a lot more money than we do. So those are very difficult to do and you need some technical specialists to help you out." (Site 4, FF, broader study, non-clinical digital leader)*

During the Programme, specialised national support has been provided for project management and accountability, market management, networking and knowledge flows. There is now a question of how this will be provided going forward, although market management is likely to become a more generalised function within NHS Digital. Some of this depends on collating national level experience in areas such as strategic vision, setting standards, and vendor engagement. There are now questions of how this scarce digital transformation expertise will be sustained with the currently proposed shift towards increasing regional leadership.

"I'm really worried about how NHSX might consider what the next phase is. If they are thinking about, we can affect some of this largescale change through something like the GDE programme. The reality is that there is no structure for, right, the vendors, this is what we want you to do, these are the bare minimum things that, to play on this level, you have to be able to deliver these components, or this functionality, or be able to have this minimum structure that people can play into, before you even get into what is the description of the APIs that might be necessary for technology or indeed what role technology might play in the future. The NHS is too reactive, at the moment, and needs to have this long term view in terms of what a wrap up around health and social care might look like." (Site A, GDE, in-depth case study, non-clinical digital leader)

Programme design needs to address trade-offs between activities most effectively supported at local/regional level (e.g. partnerships facilitated by proximity to provider organisations and existing inter-institutional relationships) as well as the value of centralised (e.g. nation-wide) provision to increase strength/sustainability of specialised expertise (e.g. in vendor engagement procurement, architecting and harmonisation/standards). Consideration is needed regarding where to locate and how to organise capabilities between regional and national structures (which in some areas may call for a matrix structure).

"I'm still really struggling to find the core purpose of NHSX, and maybe this could be one of their core purposes. The danger is, because there are too many providers now in a saturated market all trying to sell the same thing … The reward sits with the providers because they're going to get an order from a [provider organisation], whether their product stacks up or not, the risk sits with the [provider organisation]. The danger, therefore, is we can slip dangerously back into duopolies because you'll go with [provider organisation] and scale rather than innovation." (Site C, GDE, in-depth case study, senior manager, clinical and non-clinical digital leaders)

Retaining and re-using digital transformation and programme management expertise is important to enable strengthening/sustaining and wider utilisation of valuable expensively acquired experience-based learning. This is inhibited by the inflexibility of the NHS labour market and roles and careers. It may be supported by informal and formal mechanisms such as buddying, secondments, consultancy, and service contracts. There is however, a risk of dispersal of expertise and of hard-earned lessons getting lost. Particularly where project management and benefits realisation expertise was bought in on temporary service contracts and was lost to the NHS when the Programme ended.

*"Would the NHS, should they say, well you've done that, you've got this expertise, we're going to second you to this [*provider organisation*] for a month or two months to go and sit down and show them how you do your process map, show them how you implement this – there you are, you get your drug catalogue… I think reading a document and actually going to doing the do and guiding someone through it is very, very different, and I think one of the dangers of GDE only funding a limited number of [*provider organisations*] is that you are just going to get very, very concentrated expertise and how is this going to ripple out to the wider NHS." (Site B, FF, in-depth case study, clinical digital leader)*

There is also currently a lack of clarity of how the expertise of engagement leads and programme managers can best be maximised, retained, redeployed and exploited.

*"In terms of the people, like me [an engagement lead], who have got that oversight, I don't know, we'll move onto a different programme, hopefully it'll be a similar programme and that way you can exploit that knowledge and the expertise about how you work with different [*provider organisations*], how you get them to work together, how you get them to move, you know… But that will depend on the type of role that NHSX and NHS England want… If the decision is that, no, we just want people to monitor the progress of the Digital Aspirants, but not get involved and not go and challenge and not say, well have you really delivered that? Then that's not something I would want to do myself." (Engagement Lead)*

"I suppose things that have helped is NHS Digital lead engagement. It helped that she knew everybody (…) because she has worked in this area for years, so she has worked in this region for years. So, she has worked, she knows [our CIO] from ages ago. (…) You can tell that in the meetings because they all talk like they don't quite know each other, but they do blatantly, have known each other for years. Which isn't a bad thing, you know, it's been helpful, because they haven't got to unpick each other's mind sets or what they are thinking, so that's definitely been helpful. I think, you know, people knowing that they can't pull the wool over each other's eyes with things has been helpful. (…) So, if it was somebody that didn't know Mental Health or didn't know [local healthcare system], it would have been a lot easier to go oh yes, yes, we've done this, or we are doing this and it's new. And it's not, it's old hat and we are just re-hashing it." (Site E, GDE, in-depth case study, non-clinical digital leader)

There is a need for a long and thin funding stream to maintain momentum and reinforce the legacy of the GDE Programme (including both financial and non-financial incentives around reputations and careers that serve to create a trading zone for digital transformation expertise). Resources and incentives need to support this and the regions may be able to facilitate these developments.

"Even though we're at the end of the first GDE Programme, most of the projects are still in its early infancy…So what I'm worried about is the continuity of those projects. We should continue with the same momentum… So, some concrete communication on the kind of transition period will be useful." (Site F, GDE, in-depth case study, clinical digital leader)

There are, however, labour market constrains (digital transformation expertise is still scarce) and a great potential value from secondments across organisations (potential of champion and fellowship schemes).

NHS organisations with lower digital maturity must embark upon a longer digital transformation journey. Their limited prior technical and change management capabilities may be compounded by difficulties in mapping out their long-term plan (which may not simply replicate the journey of their more mature peers). Knowledge transfer needs to include a strategic vision of what emerging maturity is looking like.

Lessons for running digital transformation programmes emerging from the GDE Programme

There are multiple factors and tensions that need to be negotiated with a set of trade-offs that must be managed at different levels. There is a risk of overcompensating on the basis of previous experience e.g. doing the polar opposite of what has been done previously. We can see this kind of policy pendulum in the shift between centralisation and local autonomy in procurement. There is also a need to ensure that initiatives build on one another, whilst taking account of the constantly changing political landscape. We summarise these in Table 4.

Table 4: Lessons for running digital transformation programmes emerging from the GDE Programme

Reconciling national, regional and local priorities and functions	There is a need for strategic national goals whilst allowing local ownership and flexibility to tailor efforts to local needs. There is an ongoing discussion on which functions should be done regionally and which centrally as there are trade-offs with each approach that need to be considered. Some specialist functions may best be undertaken centrally (e.g. oversight of markets), whilst some kinds of specialism may best be maintained by a system wide division of labour (e.g. procurement) but could be done through a matrix of regionally located stakeholders. Other kinds of functions that require knowledge of local organisations and population demographics may best be done locally (e.g. population health).
Digital transformation requires a long-term vision and support	In the GDE Programme, the long-term stable national vision was not clearly articulated from the start. It was unclear what defined a "successful" GDE and what would happen when GDE status is achieved.
Funding for innovation and exploitation of digital systems	Innovation and exploitation of digital systems were often treated as the same although they have different dynamics/timeframes and require different kinds of support/funding.
Digital transformation requires an understanding of the existing policy and organisational landscape (a birds eye perspective)	Clear understanding of the policy landscape and existing incentives and risks/costs and how these impact on different stakeholder groups is important when implementing digital change initiatives. Digitally enabled transformation requires the digital to be applied to where the wider change is needed/problem to be solved, hence clear understanding is needed so that the change initiatives/programme can make use of the incentives and manage the risks.
Ensuring consistent senior leadership support	More could be done to involve stakeholders with subject matter expertise to inform policy (e.g. implementers, academics, end-users). There was also an issue with policy makers needing short accounts of complex problems, and the use of external consultants that did not always have required expertise and do not always bring value. Changes in leadership can result in failure to develop policy incrementally as incomers seek to develop novel policies rather than refine old ones. This is one instance of a more general problem of 'policy churn' arising from the emphasis in UK policy circles on creating novel policies rather than extending and improving existing ones. The result is a succession of programmes – which need to be differentiated one from another; a failure to build on earlier programmes; can lead to 'project fatigue' amongst enactors. The challenge is to have long term policy learning. Changes in the vision were associated with changes in regime (e.g. Hunt to Hancock, NHSE/D to X). A key tension therefore relates to how strategic alignment can be maintained as the policy and strategic

	landscape shifts. This needs to be done proactively when planning change programmes. There was some confusion around roles amongst NHSE/D/X, and a perceived disconnect between regions, provider organisations and the centre.
Alignment with other existing change programmes and digital transformation initiatives	As one initiative ends and another one starts. There is currently limited transfer of learning/knowledge between these. There is a key question of how to transfer accumulated knowledge and experience from one programme to another. Retaining and redeploying knowledge embedded in key individuals/intermediaries and networks/relationships is important. It is critical to think beforehand on how people can move from one national initiative to the next and having a clear plan for supporting people "crossing the bridge" (although not everyone will need or want to cross that bridge). Both within NHS governance structures and also provider organisations. A long thin funding scheme to support people through this transitional stage might help. Alignment with the growing importance of integrated care systems and developing regional shared services is crucial.
Digital transformation requires long-term funding and flexibility	Annualised budgets complicate long-term strategy. Funding is often only available for a year or so and it is not clear if there will be more money next year not that budgets are planned on a yearly basis. There is an urgent need to address the problems of revenue funding. All digital projects have revenue implications in terms of both depreciation of the system purchased and in maintaining it. Many provider organisations find capital funding constraining with the increasing salience of licencing and per user charges (software as a service model). Changes in policy and priorities, and associated shifts in direction, were disruptive to those on the ground. A balance needs to be achieved between developing new initiatives and continuing earlier ones. National programme managers are acutely aware of this, but see these features as part of the political landscape that are not amenable to change, and therefore develop strategies/workarounds to manage and mitigate these instabilities.
There is a need to re-assess balancing benefits and risks	Information governance presents barriers to information sharing (difficulty of getting data flow to respond to existing challenges), but current policies fail to find an appropriate balance between benefits and risks around information sharing (failure to assess the cost of not sharing).
Addressing the digital divide	The GDE Programme has created beacons of excellence, but there is now a policy focus on levelling up digital maturity across organisations. There may be scope in twinning organisations in a more structured way going forward building on the success of GDE/FF partnerships (importance of regional and common platform pairings)

Lessons for managing digital transformation Programmes

Benefits measurement approaches

As discussed in Chapter 4, benefits realisation became a dividing issue. From a Programme management perspective there was a perceived need for accountability to show that money was well spent to Treasury, to demonstrate both return on investment for future business cases and due diligence in spending/milestones. However, benefits realisation may have different timeframes to short-term programmes.

Existing evaluation methods, largely based on evaluating outcomes of simple changes (discrete automation with early and visible impacts on the conduct of a finite, local set of tasks/jobs) are unlikely to capture the outcomes of complex changes arising in particular with information integration. Such changes are often difficult to achieve, resulting in protracted implementation processes, with outcomes not visible until a range of secondary innovations (organisational, service innovation and optimisation) have been affected, and they are mediated by multiple critical intervening variables (implementation strategy, capacity, engagement, culture). Outcomes emerge slowly and cannot be reliably attributed to particular inputs. This is particularly an issue with digital transformation which builds upon physical infrastructure, change management capability, work and information practices, capabilities and more general workforce digital literacy of previous waves of change. As a result, inputs and outputs cannot readily be linked by traditional research methods.

There is also a need to recognise that there are different levels of benefits and disbenefits depending on where they sit within the system. These need to be accounted for recognising that benefits sit within a wider health and care system. Diffuse benefits are hard to detect and may not readily be attributable to particular digital changes (especially when considering major infrastructure changes which enable multiple organisational innovations - e.g. from dashboards/secondary use of data depend on subsequent optimisation activities). If disbenefits are discovered, then this has to be addressed (either through forcing, incentives or through devising ways of transitioning).

The development of benefits realisation methodologies and tools in the course of the Programme affected how they were perceived within some provider organisations. A different perception might arise had the tools and skills in their use been available to plan change from the outset and were developed to satisfy local as well a national reporting requirements. Benefits realisation processes are costly and may be resented if their purposes are not evident and not seen as contributing to the goals of organisational members involved (e.g. if data is not used locally other than for diligence) or if benefits realisation costs to the organisation are disproportionate to their benefits. Ideally, benefits measurement should not be onerous and should align with the organisational reporting methods. The Digital Aspirants have a lower level of benefits reporting, but this may risk low levels of accountability and lack of ability to demonstrate return on investment.

We below outline some hygiene factors for effective acceptance of benefits reporting:

- Co-produce benefits realisation methods with provider organisations
- Clarify reasons for data collection
- Harmonise reporting tools and timeframes
- Use tools to plan future changes rather than apply them retrospectively
- Don't shift goalposts
- Share benefits as part of the learning ecosystem
- Promote recording of unanticipated benefits
- Recognise that quantifying benefits, especially within short timelines, for making the case for technology is difficult and that cost savings are hard to attribute
- Value qualitative evidence of benefits

Establishing a sustainable programme management toolkit

We observed a tension between harmonising/standardising methods and setting clear stable objectives at the outset versus the need for flexibility in implementation to alter timescales and shift priorities in light of experience.

Initially reporting requirements were seen as onerous. The principles of monitoring structures, however, were perceived by some to add structure that was seen as helpful in achieving digital transformation. It is therefore important to differentiate between the Programme giving structure and the monitoring procedures/tools. Tools must be usable and there is a trade-off between user satisfaction and granularity of the data.

There may be several ways in which monitoring mechanisms may be made more relevant to local organisations, including:

- Imposing national measures is unlikely to work, national frameworks can be used to make sense of local data and provide a toolkit
- Tailoring in line with track records: e.g. a bit more hands-off for those with a track record of successful delivery.
- Increased flexibility of timescales of achieving milestones if organisations, working in an agile way, want to do this earlier
- Increasing visibility of aggregated figures and devise ways in which these can feed into service delivery (ideally through co-design of benefits frameworks)
- Simplifying and synchronising reporting structures between different parts of the system
- As benefits are locally contingent, local organisations may be best placed to determine and capture these. There is also a need to involve users in design of benefits approaches to promote adherence and local relevance.
- Policy makers need to discuss with provider organisations aspects of a Programme that could be done at national level, e.g. Information Governance with GPs, to avoid every provider organisation spending large amounts of time re-inventing the wheel and creating an inefficient patchwork of Information Governance systems.

Digital maturity was a key feature at the beginning of the Programme but it has somehow lost focus over time. HIMSS was perceived as helpful in some respects as it gave sites focus and impetus, but there are different pathways towards achieving digital maturity depending on local organisational need that need to be articulated. HIMSS EMRAM does not take these into account and focuses on individual organisations, as opposed to digital maturity across an integrated health and care ecosystem. Nevertheless, HIMSS provided an established way to measure digital maturity. However, there is a need for using agreed measurements consistently and over time as otherwise there is a risk of losing focus. Going forward, there may be a need to make it part of performance and regulatory frameworks in order to motivate organisations (e.g. CQC).

Sustaining the learning ecosystem

The GDE Programme has succeeded in establishing a learning ecosystem (together with other developments such as the Digital Academy and the Digital Health Networks). There has been insufficient attention to how to ensure this momentum and roles are sustained- i.e. how to establish a self-sustaining ecosystem. This will require constant efforts throughout the digital transformation journey, recognising that digital transformation will never end. It is complicated by policy processes that favour discrete programmes as it is often seen as more politically advantageous to launch a new programme than sustain an old one. This creates problems for the cumulative development of long-term change programmes. There may be opportunities for the NHS to gain additional advantages through aligning this learning ecosystem with collaboration mechanisms supporting the transformation to ICSs, recognising the critical way in which digital transformation can enable the delivery of integrated care and supporting system maturity.

Sustaining knowledge and learning in complex organisational and fluctuating policy environments is difficult. Organisational memory now needs to be promoted. Collective memory is likely to endure through the development of clinical informatics as a credible profession rather than through organisational/political structures. The body of expertise now being established through professional cohorts needs to expand in order to impact effectively frontline practice.

Establishing learning networks (building on Blueprinting and Digital Health Networks) is crucial but difficult to plan as it depends on growth/sustaining of informal networks. As the Blueprinting platform expands to include videos, webinars and local and regional events, this could be the focus for national facilitation of the digital learning ecosystem. There is a need to create frameworks that can encourage and sustain successful networks and allow unsuccessful ones to wither (e.g. where groups invest time and energy to sustaining networks organically). In addition, asymmetric networking/knowledge trading needs to be supported where not sustained by mutual learning benefits.

Learning in the course of the Programme

The GDE Programme has demonstrated learning from previous large-scale transformation programmes:

- It has achieved a degree of balance between national guidance and local involvement in decision making/ownership, and
- Leveraged funding gates to promote accountability.

Programme leadership and operational management were highly reflective. They had productive exchanges with the evaluation team and were open to incorporate emerging lessons.

We also observed evidence of learning in the course of the Programme (e.g. in relation to Blueprints where strategy evolved to make the resources more accessible and usable through new search functions and formats such as “Blueprints on a page”).

Chapter 10: Conclusion, discussion and recommendations for policy and further research

From technology implementation to digital transformation

GDE stood in contrast to many earlier technology adoption programmes as it was conceived as a digital transformation programme rather than merely a technology procurement programme. It successfully promoted digital transformation in participating sites. Several aspects of the GDE programme design appear to have been influential in achieving this:

- Funding including matched funding requirement
- Programme governance relationships – in particular appointment of CIOs and including digital transformation expertise on Boards of provider organisations
- GDE/FF status and reputational benefits

These ensured engagement of all levels of organisational stakeholders in the digital transformation agenda, including senior leadership and clinical engagement. Senior ownership of the Programme and engagement at all levels also facilitated learning and transformation.

The GDE Programme was supported by initiatives in the wider environment in which the role of digital transformation expertise became more widely recognised facilitated by parallel developments, e.g. the NHS Digital Academy. Some aspects of the Programme were also accelerated by the common pressing need for digital solutions posed by the COVID-19 pandemic.

GDE was a learning programme

The GDE Programme learnt from earlier programmes. It followed several years after the NPfIT, in which centrally procured systems did not achieve optimal or anticipated local ownership and adoption thus limiting the value for money achieved. Learning from this and subsequent initiatives such as the Safer Hospitals Safer Wards, Nursing Technology Fund and the Integrated Digital Care Fund, the GDE Programme was a national initiative designed to optimise local ownership and accountability by allowing provider organisations flexibility on routes to achieve digital maturity. It did so through a structured framework of accountability (e.g. funding gates, progress monitoring and targets) to achieve digitally enabled transformation of services rather than merely to fund technology adoption.

The Programme was launched and implemented under tight timescales and many elements needed to be put into place in the course of the Programme. Learning in the course of the Programme was therefore essential in order to cope with emerging challenges e.g. around the role of Blueprints. This had unintended and some undesired consequences in some aspects, especially surrounding programme management, where targets and tools were put into place and revised as the Programme proceeded. Flexibility is a critical requirement in managing digital transformation programmes. However there is also a need for cumulative development of programme management tools. In addition, the long timeframes of digital transformation stand in contrast to annualised budgets and the relatively short policy cycles and short periods of tenure of senior leadership.

Since the NPfIT, there has been much willingness to learn and collaborate closely with evaluators, which is encouraging and now needs to be sustained/maintained.

Building a learning ecosystem

National programme managers rapidly designed and launched an interlocking set of innovative formal knowledge transfer mechanisms in an attempt to initiate a national digital health learning ecosystem. These did not necessarily work in the manner and to the degree anticipated but nevertheless did achieve an impact in supporting the development of a learning ecosystem. Formal learning mechanisms and processes were most successful where supported by informal networks. GDE Programme managers revised their methods of intervention in the light of these experiences. There were important processes of policy learning (e.g. around monitoring and Blueprinting). As the GDE Programme comes to an end, there is a risk that these lessons (and the associated programme management tools and capabilities) will be lost.

The GDE Programme has made a major contribution to the recent upsurge in knowledge transfer across the NHS. Formal knowledge transfer mechanisms have prompted and in turn been powerfully reinforced by a dramatic growth in informal learning among organisations. These seem to have provided the foundations for the emergence of a digital health learning ecosystem in the context of a supportive broader environment, which also included the establishment of the NHS Digital Academy, the strengthening of digital transformation roles and the increasing salience of online sectoral and professional networks.

There is growing interest in the formation of inter-organisational learning ecosystems in healthcare, but whilst the critical ingredients/components are known, they cannot be readily achieved through conventional top-down planning structures. Support instead needs to be deployed in a flexible way that enables participants to co-design the mechanisms. National mechanisms to stimulate knowledge sharing need to be flexible to align them with emerging, changing needs and may be sustained through informal networking, driven by the mutual benefits of knowledge exchange and a culture of sharing. Benefits are most immediate and greatest where there is strong convergence between group members in their organisational and technological setting and goals such that the costs of learning are minimised and the benefits of learning/relevance of knowledge is maximised. Recent concerted efforts to deploy digital solutions in the face of the COVID-19 pandemic reinforce this point.

Most importantly, a digital health learning ecosystem needs time to be established and lessons learned need to be retained. This calls for evolving strategic and policy frameworks that are shaped by a mixture of top-down and bottom-up input, and trusting relationship between those that facilitate knowledge exchanges and those involved in actively sharing and using that knowledge. Central to this will be the drive to improve patient care and health outcomes.

Strengths and limitations of the evaluation

We have conducted a national formative evaluation of a first-of-type digitally-enabled national transformation programme and collected a large qualitative dataset from a range of settings and data sources. We achieved this by analysing change processes and mechanisms of knowledge transfer in detailed studies of selected provider organisations, whilst testing these emerging findings in a wider range of settings and placing them within the national context of the Programme. In doing so, we gained rich insights into how knowledge transfer takes place in an evolving inter-organisational learning ecosystem.

Conducting a combination of broad and in-depth case studies allowed us to balance breadth and depth through conducting both detailed embedded case studies and "lighter touch" studies in a larger and more varied sample of provider organisations. A further strength was the formative nature of this work, where the research team played an active role in shaping the strategy and ongoing implementation of the GDE Programme. However, a limitation is that the qualitative methods used for formative evaluation are unlikely to provide detailed substantive information about the impact/eventual outcomes of the Programme (which may be difficult to disentangle from the impact of other initiatives). It was also difficult to disentangle the impact of the GDE Programme from other transformation initiatives running concomitantly.

The GDE Programme involved major Health Information Infrastructure upgrades, typically through upgrading core EHRs. This meant that the Programme was geared towards systemic change, e.g. through secondary uses of information. However, sites are still exploiting and optimising EHR infrastructures and it is still too soon for the full range of outcomes to be visible. These long timeframes present challenge to summative evaluations. In addition, our work has focused on national and local managers. Although they often, helpfully, had clinical backgrounds and responsibilities, they may not have reflected the wider clinical population. We therefore obtained limited insights into the latter's perspective, which may have unearthed further complexities and unintended consequences associated with the Programme processes and outcomes.

However, as this work is based on one national qualitative case study, the findings need to be interpreted with caution. As our work took place in a public managed health system, associated values/motivations may affect generalisability to private providers. This will be particularly important, considering that our findings highlight the central role of informal networking. We have captured perceptions of the importance of informal channels but had limited opportunity to examine the spread and operation of networking amongst those at the coalface of providing care. In addition, our fieldwork examined knowledge transfer in organisations participating in the GDE Programme, but not organisations outside the Programme. There is also an overall difficulty of capturing informal knowledge exchanges, and a risk that attempts to monitor these will overlook important informal knowledge transfer processes.

COVID-19 presented a significant challenge during the final stages of data collection, as provider organisations struggled to find time for interviews. In addition, the focus of organisations shifted from general digitally-enabled transformation efforts towards systems that could help address issues faced through the pandemic.

Recommendations

The progress achieved and lessons learned from the GDE Programme need to be carried forward to inform the development of the broader NHS ecosystem:

1. **Risk of loss of national organisational memory**: To ensure that the learning achieved under the GDE Programme is taken forward, it is important to build long-term organisational memory around large-scale digitally enabled transformation initiatives. This includes consideration of how to retain, sustain and best utilise the capabilities and experiences that have been accumulated within national and local organisations during the Programme. Clear national recognition of what the sites have achieved in the Programme is needed, accompanied by an outline of how the NHS will draw on this learning to inform future programmes.

2. **Addressing the digital divide**: Lessons learned from the GDE Programme should inform the development of the broader NHS learning ecosystem and ongoing initiatives to address the existing digital divide across organisations. Although some experiences may not easily transfer to organisations with lower digital maturity, others will.

3. **Early involvement of participating provider organisations and cumulative development of programme management tools:** Programme management tools need to be iteratively refined and streamlined, with stakeholder input, to simplify and reduce the burden associated with a multiplicity of programme management and reporting tools. A shared understanding of and capability in planning and using these tools is essential as an intrinsic aspect of digitally enabled transformation. Benefits realisation tools need to be developed jointly across user groups and applied from the outset to plan changes. The learning that widespread engagement delivers transformation therefore also applies to the co-development of appropriately rigorous programme governance arrangements.

4. **Retain and develop transformation expertise**: Developing, retaining and re-using digitally enabled transformation and programme management expertise is important to enable strengthening/sustaining and wider utilisation of valuable, expensively acquired, experience-based learning. There is an opportunity here to look at the role GDE/FF staff can play in wider networking/buddying to support other organisations to mature and/or link to the Digital Academy and a growing digital alumni network.

5. **Consider institutional design**: Current proposals to shift programme management roles to regions will bring benefits from greater proximity between managers and providers, but may risk dispersing valuable national capacity. There is also a risk that regional actors will not have sufficient intensity of engagement needed to establish

specialist expertise. Institutional design needs to consider trade-offs between central and local deployment. Some specialist functions may best be undertaken centrally (e.g. oversight of markets); some expertise may best be maintained by a system-wide division of labour (e.g. procurement) but could be deployed through a matrix of regionally located stakeholders coordinated through ICSs and Integrated Care Partnerships (ICPs).

6. **Establish a visible national function to support market management:** The GDE Programme has contributed to establishing a national function to manage the market. Managing the market is a long-term project impinging on all digital programmes. This function now needs to be made visible at local level through expansion and formalisation taking into account long-term investment into the market (i.e. to attract newcomers and increase competition), while setting interoperability standards and priorities to help nudge the market toward a more agile, platform-based approach to EHR. It also needs to facilitate and support collaborations between provider organisations within existing user groups.

7. **Develop long-term vision, strategic support and consistent senior leadership to sustain digital transformation**: Vision and senior leadership support is required both in provider organisations with senior digital transformation leadership represented at board level, and nationally, to ensure local organisations can follow a stable overall vision of digital health system transformation. The extension of the NHS Digital Academy is likely to accelerate this. Strategic decision makers need to consider how to ensure the momentum established by the GDE Programme and related initiatives can be sustained i.e. how to establish a self-sustaining ecosystem. There is a need for a long and thin funding stream to establish infrastructures (particularly in less digitally mature organisations), maintain momentum and reinforce the legacy of the GDE Programme. Resources and incentives are needed to support this and the regions may be able to facilitate these developments.

8. **Ensure digital becomes mainstream, operationally and in terms of health and care strategy and policy.** This includes:
    a. **Alignment with other existing change programmes and digitally enabled transformation initiatives:** This includes digital transformation funding streams but also skills development and networking activities;
    b. **Including digital capability in regulatory and assurance structures:** e.g. assessing and monitoring digital maturity of organisations and local health economies needs to become the norm;
    c. **Digital capabilities in institutional operating environments:** top level governance support, new digital transformation/skills capabilities, informatics expertise, and clinical engagement.

    There are real advantages for pace and scale of progress from ensuring that digital transformation priorities align with wider organisation and system priorities, allowing organisations to align different funding streams and change programmes to optimise impact around a clear shared vision.

9. **Maximise the value of formative evaluations**: Traditional summative evaluation methods, based upon discrete changes, do not effectively capture and guide complex digitally enabled transformation developments. This is because digital transformation involves complex and extended chains of interaction around infrastructural changes that exceed reporting timeframes and create attribution problems. Formative evaluation approaches exploring processual outcomes (such as this one) feeding back emergent changes and helping to mitigate risks are key going forward.

Contribution of authors

RW and KC led the study and oversaw data collection, analysis and write-up. WL and SE oversaw data collection in broader case-study sites. HN, MK, and SH were responsible for data collection in in-depth case study sites and also coded the data. All authors met regularly to discuss emerging findings and analyse the data. All authors critically commented on various versions of this report.

Appendices and supporting material

Dissemination activities

We have presented at the following workshops and conferences based on this work:

- NHS Innovation Expo, September 2019.
- Best-of-Breed event, Southampton, October 2019.
- All GDE network event, London, November 2019.
- Digital Health Summer School, December 2019.
- GDE Insights Webinar for HTN Digital Health Week, January 2020.
- 4Words 2020 - Le parole dell'innovazione in sanità presentation, title: reconceptualising the digital maturity of health systems, Rome, January 2020.
- Digital Health Summer School presentation, title: reconceptualising the digital maturity of health systems, London, March 2020.
- Healthcare Efficiency Through Technology (HETT), panel discussion on Blueprinting, June 2020.
- Presentation to the Blueprinting Steering Group, July 2020.
- Presentation to the Scottish Digital Health and Care Network, July 2020.
- Webinar 'International Workshop on Health IT maturity models', September 2020
- GIANT 2020 speaker panel - The theory behind spreading and scaling ideas and innovations: the human behaviours the system can learn from, November 2020.
- Presentation at “International Workshop on Health IT Maturity Models Challenges and international experiences”, a satellite session to GMDS & CENIBS 2020 (65th Annual Meeting of the German Association for Medical Informatics, Biometry and Epidemiology (GMDS), Meeting of the Central European Network (CEN: German Region, Austro-Swiss Region and Polish Region), title: current findings on requirements and experiences measuring digital maturity: results of a Delphi study, September 2020.
- Guest lecture at the University of Oxford, 20-21 MSc in Technological Innovation and Digital Health, title: formative evaluation of health technology innovations - Independent Evaluation of the Global Digital Exemplar (GDE) Programme, April 2021.
- Digital Academy Residential presentation, title: formative evaluation of health technology innovations - Independent Evaluation of the Global Digital Exemplar (GDE) Programme, April 2021.
- ROSE Graduiertenkolleg "Lernendes Gesundheitssystem" (Germany), title: formative evaluation of health technology innovations - independent evaluation of the Global Digital Exemplar (GDE) Programme, May 2021.

- Digital Health Networks Summer School presentation, title: applying the key lessons and experience from the GDE Programme to future NHS digitisation programmes, July 2021.

We led the following workshops:

- With Scandinavian partners from the University of Oslo on the 29th January 2019 in Edinburgh
- TechUK workshop with vendors on the 8th May 2019 in London

Original research papers based on this work are:

- Cresswell K, Sheikh A, Franklin BD, Krasuska M, Hinder S, Lane W, Mozaffar H, Mason K, Eason S, Potts HW, Williams R. Theoretical and methodological considerations in evaluating large-scale health information technology change programmes. BMC Health Services Research 2020 Dec;20(1):1-6.
- Cresswell K, Williams R, Sheikh A. Developing and Applying a Formative Evaluation Framework for Health Information Technology Implementations: Qualitative Investigation. J Med Internet Res 2020;22(6):e15068
- Krasuska M, Williams R, Sheikh A, Franklin BD, Heeney C, Lane W, Mozaffar H, Mason K, Eason S, Hinder S, Dunscombe R, Potts, Cresswell K. Technological Capabilities to Assess Digital Excellence in Hospitals in High Performing Health Care Systems: International eDelphi Exercise. Journal of Medical Internet Research. 2020;22(8):e17022.
- Cresswell K, Sheikh A, Franklin BD, et al. Formative independent evaluation of a digital change programme in the English National Health Service: study protocol for a longitudinal qualitative study. BMJ Open 2020;10:e041275. doi: 10.1136/bmjopen-2020-041275
- Williams R, Sheikh A, Franklin BD, Krasuska M, Hinder S, Lane W, Mozaffar H, Mason K, Eason S, Potts HW, Cresswell K. Using Blueprints to promote interorganisational knowledge transfer in digital health initiatives—a qualitative exploration of a national change program in English hospitals. Journal of the American Medical Informatics Association. 2021 Mar 11.
- Cresswell K, Sheikh A, Franklin BD, Krasuska M, Hinder S, Lane W, Mozaffar H, Mason K, Eason S, Potts HW, Williams R. Inter-organisational knowledge sharing to establish digital health learning ecosystems: qualitative evaluation of a national digital health transformation programme in England. Journal of Medical Internet Research. J Med Internet Res 2021;23(8):e23372.
- Hinder S, Cresswell K, Sheikh A, Franklin BD, Krasuska M, The Nguyen H, Lane W, Mozaffar H, Mason K, Eason S, Potts HW. Promoting inter-organisational knowledge sharing: a qualitative evaluation of England's Global Digital Exemplar and Fast Follower Programme. PloS one. 2021 Aug 2;16(8):e0255220.

Review and discussion papers based on this work are:

- Cresswell K, Sheikh A, Krasuska M, Heeney C, Franklin BD, Lane W, Mozaffar H, Mason K, Eason S, Hinder S, Potts HW. Reconceptualising the digital maturity of health systems. The Lancet Digital Health. 2019 Aug 22.
- Cresswell K, Williams R, Sheikh A. Bridging the growing digital divide between NHS England's hospitals. Journal of the Royal Society of Medicine 2020. https://doi.org/10.1177/0141076820974998
- Cresswell K, Williams R, Sheikh A. Accelerating health information technology capabilities across England's National Health Service. The Lancet Digital Health (in press).

Appendix 1: Coding framework

Name	Description
Characteristics of the organisation	Local specificities e.g. size, type, geographical area and demographics, local relationships
Baseline digital maturity	Existing digital/IT infrastructure and digital culture
Drivers	
Vision	
History of IT deployments	Successes and failures
Digital maturity accreditation	Ways of measuring digital maturity
Digital strategy	General, GDE and alignment of the two
Business continuity planning	Back-up systems and plans in an event of shut down
Digital transformation	Narrative about a digital transformation of an organisation and their digital journey
GDE projects	
Governance	
Finance	E.g. matched funding, budget
Organisational structure	Where GDE sits within management structure
Standards and protocols	National and hospital guidance for practice
Innovation	Mentions of innovations or lack thereof or anything in relation to innovation
Learning networks	E.g. planned learning networks, de-facto informal networks
Blueprints	Creating, adoption and reflections
Fast-Follower	Fast-Follower GDE relationship and any evidence of leapfrogging such as never versions of the system; barriers and facilitators
Learning Networks	Set up as part of the GDE programme
Informal networks	E.g. people giving each other a call because they are friends
Intermediaries	Engagement leads but also people moving between industry and provider organisations and (changing role) and people moving between provider organisations with similar roles
Other collaborations	E.g. international, academic, other NHS

Name	Description
Professional networks	
Resistance to knowledge sharing	Refusal to share knowledge; avoidance and failures to pass on knowledge and expertise
Vendor user groups	Forums that are facilitated by a vendor
Monitoring and Reporting	
Benefits realisation	Including measurements and views thereof
Milestones	
Payments	
Non-GDE digital projects	
People	
Culture	Ethos, implicit values, attitudes, ways of working
External contractors	E.g. vendors, outsourcing,
Skills shortage	Problems with recruitment in GDE related areas
Provider organisation staff	E.g. size of digital team
Career history	
Clinical engagement	E.g. communication with staff, clinical project leads, clinical super users
Mobile staff	E.g., nurses and junior doctors and staff working in a non-continuous manner
GDE focused recruitment	Specific hiring related to GDE programme
Relationships with central NHS bodies	NHS Digital / England / Improvement
Shared Care Records	Sharing records across a geographical path beyond a given organisation and possibly with other non-health public services
Vendors	
Collaborative developments	E.g. co-developed projects and technologies
Vendor relationship	E.g. responsiveness to needs, length of time, people going back and forth
Vendor market	Comments relating to the vendor market
Systems	As different systems are used within hospitals

Name	Description
Data analytics	
Interoperability	Interfacing and integration
Type	
Best-of-Breed	Platforms plus application programming interfaces
Mega suites	Integrated record
Views on GDE impact	
Perceived benefits	Types of benefits including national and local, patient safety, effectiveness etc.
Suggested improvement	What worked and what did not work
Unintended consequences	E.g. interrupting workflow due to monitoring requirements
Views on next steps	Including expansion, other local/regional initiatives and collaborations, sustainability of current programmes, future digitisation plans

Appendix 2: Table 2 GDE/FF pairings, systems, local institutional contexts and mergers

Global Digital Exemplar	Fast Follower	Main Information Technology system	In the same regional group?*	Prior relationship?	Other changes**
Alder Hey (paediatrics) 270 beds	Clatterbridge (oncology) 103 beds	Meditech	Yes	No	
Cambridge 1,268 beds	University College London Hospital 1000 beds	Epic	No	No	
Sunderland 1010 beds	South Tyneside N/A	Meditech	Yes	Yes	Merged during GDE
Imperial, London 1,412 beds	Chelsea and Westminster 430 beds	Cerner (Imperial) Meditech (Chelsea and Westminster	Yes	Yes	In partnership
Luton and Dunstable 742 beds	Bedford 400 beds	Best-of-Breed /	Yes	Yes	Shared clinicians Merged April 2020
Newcastle 1,800 beds	Gateshead 600 beds	Cerner (Newcastle) System C (Gateshead)	Yes	Yes	
Oxford 1,185 beds	Royal Berkshire 687 beds	Cerner	Yes	Yes	Clinicians rotate
Royal Free, London 1,770 beds	North Middlesex 443 beds	System C	Yes		
Royal Liverpool 850 beds	(1) Liverpool Women's (2) North Tees and Hartlepool 572 beds	Best of Breed Best of Breed based on Trak Care	Liverpool Women's – Yes North Tees and Hartlepool- No	Liverpool Women's – yes North Tees and Hartlepool - no	Liverpool Women's – shared CIO and executive team with Royal Liverpool and merger into Liverpool Hospitals Trust
Salford Royal 828 beds	Pennine Acute N/A	Allscripts	Yes	yes	Merged 2017
Taunton and Somerset 660 beds	Wye Valley 320 beds	Best of Breed based on IMS-Maxims	No	Yes – based on same system	Taunton merged with local mental health Trust 2020 Wye Valley merged with Gloucestershire 2020
Birmingham 2,366 beds	Heart of England N/A	Best of Breed – in - house	Yes		Merged pre-GDE Programme
Bristol 1085 beds	Whittington 346 beds	System C	No	No	
Southampton 1,100 beds	Hampshire 806 beds	Best of Breed	Yes	No	Merged procurement team as a result of GDE Programme

West Suffolk 442 beds	Milton Keynes 457 beds	Cerner	No	No	
Wirral 855 beds	Countess of Chester 625 beds	Cerner	Yes	Yes	Shared departments and clinicians
Mental Health Trusts					
Worcestershire 403 beds	Sheffield 72 beds	RIO and Best of Breed (Worcester) Self-build (Sheffield)	No	Yes	
Berkshire 323 beds	Lancashire 518 beds	RIO	No	No	
Birmingham and Solihull 702 beds	Coventry and Warwickshire N/A	RIO	Yes	Yes	
Oxford Health 562 beds	Sussex Partnership 588 beds	Advanced	No	No	
Mersey Care 766 beds	North West Boroughs 297 beds	RIO	Yes	Yes	Previously implemented RIO together
Northumberland Tyne and Wear N/A	Cumbria Partnership	RIO	Yes	Yes	Merged 2020
South London and Maudsley 786 beds	Oxleas N/A South West London and St Georges 391 beds	RIO	Yes	Yes	

* Many (14) GDE/FF pairings were within the same regional coordinating structures (Sustainability and Transformation Partnerships [STPs] which include all health and social care providers within a geographical area, and or Integrated Care Systems [ICSs] which are a similar group of providers over a larger geographical area).

** Six organisations were involved in mergers of some kind in the course of the GDE Programme (five with their GDE/FF partner and one with another local hospital).

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