



First year report

Independent Evaluation of the Global Digital Exemplar (GDE) Programme

Submitted to NHS England

Robin Williams and Kathrin Cresswell

on behalf of GDE Evaluation team

7th February 2019

Contact details:

Professor Robin Williams

School of Social and Political Sciences

The University of Edinburgh

Old Surgeon's Hall

Edinburgh, EH1 1LZ

Email: R.Williams@ed.ac.uk

Dr Kathrin Cresswell

Usher Institute of Population Health Sciences and Informatics

Edinburgh Medical School

The University of Edinburgh

Teviot Place

Edinburgh, EH8 9AG

Email: Kathrin.Cresswell@ed.ac.uk

Global Digital Exemplar Evaluation Programme website:

<https://www.ed.ac.uk/usher/digital-exemplars>

Please, use the following statement for citation:

R. Williams, K. Cresswell et al. (2018) First Year Report - Global Digital Exemplar Evaluation Programme, Edinburgh, The University of Edinburgh.

Funding: This article has drawn on a programme of independent research funded by NHS England. The views expressed are those of the author(s) and not necessarily those of the NHS, NHS England, or NHS Digital. The results presented in the current report are formative and are based on findings up to February 2019.

Programme Team:

University of Edinburgh

Kathrin Cresswell
Catherine Heeney
Susan Hinder
Marta Krasuska
Hajar Mozaffar
Aziz Sheikh
Serena Tricarico
Robin Williams

University College London

Bryony Dean Franklin
Henry Potts

NHS Arden & GEM Commissioning Support Unit

Sally Eason
Wendy Lane
Kathy Mason
Adrian Smith
Jayne Rooke

Table of Contents

Introduction	8
Update on data collection.....	9
Findings confirming previous preliminary evidence presented to the Steering Group	12
Findings since the last meeting and emerging lines of enquiry.....	16
Conceptual framework	16
Digital transformation within GDE/FF sites	16
Framing and measuring digital excellence.....	17
Providing a target for a journey with an unknown endpoint	18
Unintended consequences of tight coupling	19
Spread anticipated under the GDE Programme between GDEs and FFs.....	19
Relationship between GDEs and FFs.....	19
Blueprinting.....	20
Development of a broader learning ecosystem	21
Emerging networks	21
GDE funding models.....	22
Widening gap between GDE and wider NHS	23
Transformation through infrastructures and innovation	23
Preliminary implications for policy-making emerging from our work.....	24
Digital transformation.....	24
Spread	24
Building a broader learning ecosystem.....	25
Appendix 1	26
Appendix 2	40
Delivery of care and clinical excellence	40
Healthcare organisations and their wider environment	40
Role of non-technological factors.....	41
One size fits all or multiple pathways to excellence.....	41
Appendix 3	42
Appendix 4	45
What is an international centre of digital excellence in healthcare?	45
Definition of digital excellence in healthcare	46
Characteristics of digitally mature organisations	47
Implications for the notion of digital centres of excellence	48
Conclusion.....	48

Executive summary

The Global Digital Exemplar (GDE) Programme and associated initiatives to promote digital transformation capability in healthcare represent an ambitious attempt to achieve digital excellence and promote the wider uptake and optimisation of technologies across the National Health Service (NHS) in England. The core strategy of the GDE Programme consists of supporting digital transformation in selected digitally mature sites, followed by its spread to Fast Follower (FF) sites and to the wider NHS. There are few, if any, precedents for such large-scale, concerted change programmes across diverse organisational settings anywhere in the world. Existing mechanisms for technology management and evaluation, developed to address episodic changes, are not well-equipped to tackle the evolving, longitudinal nature of these developments and their extraordinary complexity. They are also not well-equipped to manage the real-time, evolving nature of such large-scale infrastructural initiatives. As a result, all stakeholders (including policy makers, programme managers hospital staff and ourselves as evaluators) are learning as the Programme unfolds, necessitating a flexible adjustment to changing circumstances and needs.

Our initial evidence, acknowledging that it assessing spread is relatively early, shows that the GDE Programme has helped to accelerate and focus local efforts of digital transformation in the NHS. This is being driven by a number of factors including: concerted national activities to shape local implementation strategies and market management, emerging relationships between GDEs and FFs initiated and/or strengthened by the Programme, and the emergence of a broader learning ecosystem of which the Programme is only a part (including formal and informal, for example, the NHS Digital Academy and the Chief Clinical Information Officer Network). We are heartened by the open, honest and reflexive approach of NHS England/Digital staff leading the Programme to listen to our findings and their willingness to incorporate our formative recommendations into ongoing strategy.

However, as this is a ground-breaking and ongoing Programme, it must address tensions that are to be expected - given the scale of the change and the need for a period of embedding and evolving – but which cannot be easily resolved. Tensions observed in our ongoing work include:

- Digital Maturity: balancing the need to assess progress towards agreed targets with the need for flexibility and continual updating of future visions in a context of often contested and changing conceptions.
- Blueprinting: coordinating flows of knowledge through formal means to reduce reinvention and increase the pace of uptake whilst not restricting local ownership, ingenuity and informal methods of knowledge transfer.
- Wider spread: encouraging the development of a learning ecosystem across a fragmented landscape of independent organisations with potentially diverging priorities and capabilities
- Priorities: balancing tightly managed national targets (e.g. achieving HIMSS Level 7 capabilities) with emerging local priorities.
- Progress: balancing a political need to demonstrate progress with the long time-frames needed to realise benefits.
- Delivery: managing delivery against milestones with ensuring developments delivered remain relevant.
- Funding: balancing focusing investments on a small range of advanced sites while bringing a wider range of less advanced sites up to a minimum level of digital capability.

In order to address these early tensions, we suggest the following preliminary key steps:

- The GDE Expansion is a welcome development. It has energised and accelerated digital transformation. Although we understand the urgency of expectations for progress, and

unrealistic goals may have undesirable unintended consequences. We therefore recommend careful planning and more realistic timelines for achieving national targets.

- Revise the Digital Maturity Index by adding additional capabilities surrounding novel exploitation of data across the wider health community emerging from our Delphi study (see Appendix 1). The revised index needs to be proposed presently as a guideline for future change from this point forward to avoid perceptions of shifting goalposts.
- Develop a more nuanced benefits realisation framework that combines locally relevant measures determined by sites themselves with national progress measures coupled with funding milestones.
- Reaffirm the notion of FFs as a partnership in which actors may not merely adopt solutions emerging from GDEs but further enhance them and perhaps leapfrog over original solutions.
- Frame Blueprinting as an ongoing process involving creation and curation of living documents (or other vehicles consolidating learning) amongst communities of shared practice and concern. We strongly recommend designated in-depth evaluation of the Blueprinting initiative (separate to our work) and careful piloting of spread processes. This is particularly relevant for the foundational Blueprints currently in development and the communications approach to support the launch of the GDE Blueprinting platform.
- Informal relationships between sites have proved crucial for accelerating knowledge flows around GDE and need to be fostered systematically perhaps through scoping existing relationships before pairing up GDEs with FFs. Links between sites sharing common platforms and applications have proved beneficial (but may require encouragement e.g. with smaller/newer user communities). Some regional groupings already appear to be productive (though differences here require further investigation).
- New forms of digital transformation skills capability (interdisciplinary specialists with experience-based and hybrid clinical managerial and technical skills) is needed and should be a key priority – but one that is not assisted by existing human resources and professional structures. Establishing mechanisms for secondment/fellowships – particularly at regional level may also be productive to creating learning ecosystem.
- Allocate long term sustained expenditure that is both sustainable and flexible. We recommend a ‘long-thin’ funding stream to sites to retain GDE/FF status, with resource flowing slow and light to reduce central managerial costs and allow sites time to work through existing and emerging challenges and sustain contributions to Blueprinting.
- Avoid reinforcing the gap which may otherwise be opened up between GDEs and the wider NHS through promotion of formal networks.

As we are in the early stages of our work, we expect that the assessment of spread and developments over time will be much clearer once we are able to collect longitudinal data and subject it to systematic analysis. Spread and the creation of a learning ecosystem will be key foci of our next yearly report.

Introduction

Healthcare systems internationally strive for excellence. Excellence is often expressed through health systems achieving the “triple aim”: better outcomes, better value and better experience.¹ Policy initiatives throughout the developed world have sought to speed up 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.^{2,3}

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 have not been demonstrated as yet.⁴ Similarly, the envisioned large-scale EHR adoption through centralised procurement of systems in the English National Programme for Information Technology (NPfIT) in 2002 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.⁵ 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.⁶ There was further a lack of standards utilisation threatening the interoperability agenda, and a focus on IT deployment projects rather than wider service improvement strategies.⁷

In 2016, the English government therefore commissioned the US physician Robert Wachter to lead an independent review of the state and future strategic direction of digital health strategy in England.⁸ One of the key recommendations from this was to invest limited existing resources selectively to create a cohort of digital centres of excellence. As a consequence, NHS England's flagship Global Digital Exemplar (GDE) Programme was conceived in 2017 with £395 million national investment designed to support “selected digitally advanced mental health, acute Trusts, specialist Trusts and ambulance Trusts, who through funding and international partnership opportunities will become Exemplars over the next two to three and a half years”.⁹ The underlying assumption was that digitally advanced sites would become international centres of excellence and create Blueprints of action and learning for later implementers. The idea of Blueprints was designed to help Fast Follower sites paired up with GDEs to leapfrog and accelerate the spread of this learning nationally. A £200 million expansion of the GDE Programme was announced in late 2018.¹⁰ Our team has been commissioned to evaluate this initiative over a period of three years, with evaluation activities commencing in January 2018. We are also intimately involved in delivering the NHS Digital Academy, a related initiative also emerging from

¹ Berwick DM, Nolan TW, Whittington J. The triple aim: care, health, and cost. *Health affairs*. 2008 May;27(3):759-69.

² Blumenthal D. Launching hitech. *New England Journal of Medicine*. 2010 Feb 4;362(5):382-5.

³ <https://conversation.digitalhealth.gov.au/framework-for-action>

⁴ 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.

⁵ 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.

⁶ https://www.kingsfund.org.uk/sites/default/files/field/field_publication_file/A_digital_NHS_Kings_Fund_Sep_2016.pdf

⁷ <https://www.digitalhealth.net/2016/02/hunt-announces-4-2-billion-for-nhs-it/>

⁸ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/550866/Wachter_Review_Accessible.pdf

⁹ <https://www.england.nhs.uk/digitaltechnology/connecteddigitalsystems/exemplars/>

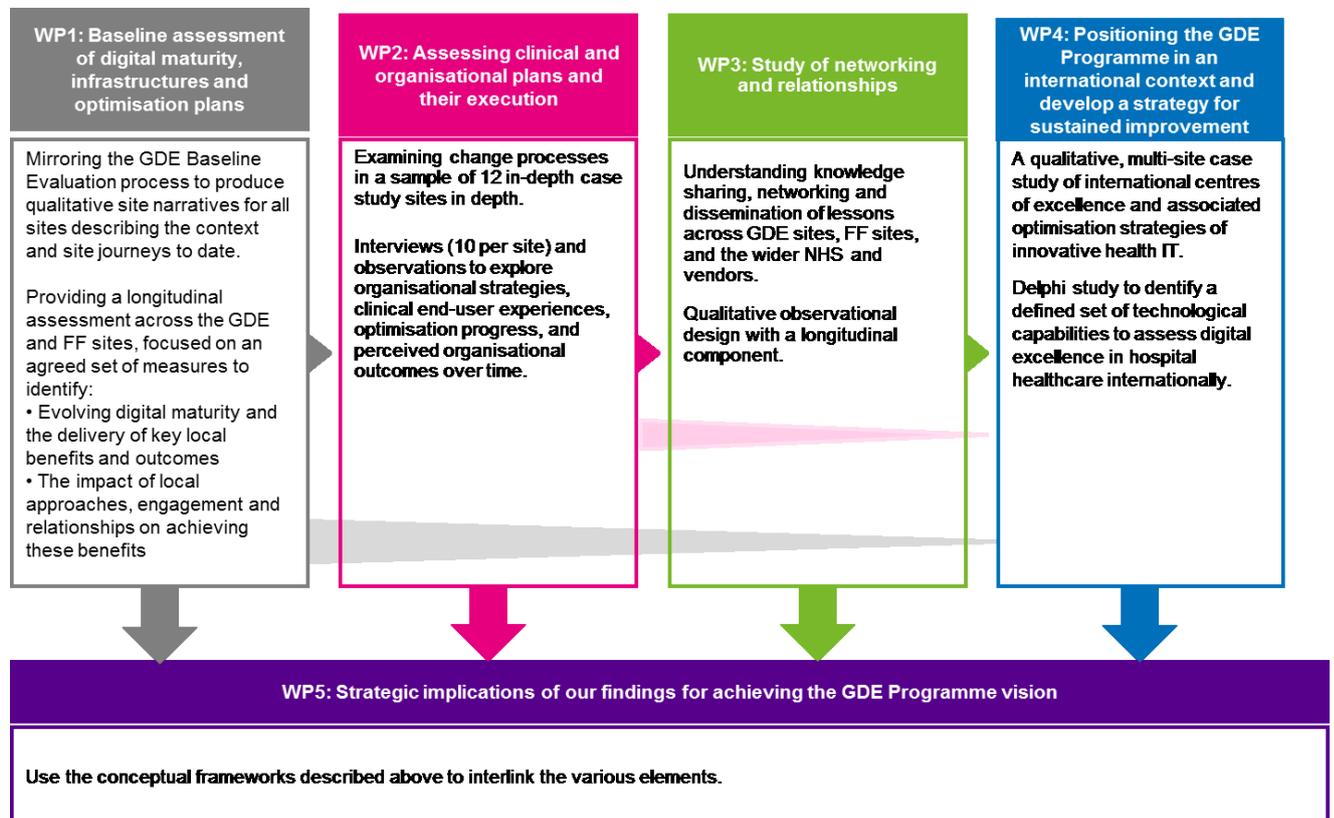
¹⁰ <https://www.digitalhealth.net/2018/08/nhs-england-planning-further-waves-of-global-digital-exemplars/>

the Wachter report. The NHS Digital Academy is a virtual organisation training NHS staff in digital leadership.

Update on data collection

An overview of the methods employed to evaluate the GDE Programme is presented in Figure 1.

Figure 1: Overview of methods



Data collection activities have consisted of the following to date:

- We have completed the initial baseline round of visits to all sites, interviewing key stakeholders and observing site meetings and digital deployments (WP1).
- Our researchers have conducted 11 visits to in-depth case study sites and conducted 37 interviews in nine case study sites (see Table 1 for a detailed description of case study sites and data collected to date) (WP2).
- We have conducted 32 high-level interviews with policy makers (WP5).
- We have observed 38 meetings, workshops, and conferences both at in-depth case study sites and exploring policy/strategy connections (WP2 and 5).
- We have successfully delivered two round of the Delphi exercise to establish consensus surrounding a defined set of technological capabilities to assess digital excellence (34 respondents in first and 30 respondents in second round).
- We have arranged three interdisciplinary workshops:
 - GDE Programme Benefits Realisation Workshop: held 18 June 2018 in London (WP2)

- GDE Programme/TechUK Workshop: How can we improve NHS procurement (to be held 7 March 2019 in London) (WP3)
- Research Workshop: International perspectives on emerging health information infrastructures (to be held 29 January 2019 in Edinburgh) (WP4)

Some of our recommendations from previous reports to the Steering Group have already been incorporated in policy making. These include, for example, a reconceptualisation of the *Fast Follower* relationship in terms of *Partner*, to reflect the two-way and ongoing contribution of both GDE and FF to optimising and further developing solutions and an ongoing consideration of a longer and thinner funding stream to support digitisation efforts that go beyond the duration of the GDE funding agreements and Programme.

Table 1: Description of in-depth case study sites and data collected to date

GDE/FF	Vendor/procurement configuration	Duration	Site characteristics	Core GDE activities	Data collected to date
<p>Six GDEs (five acute, one mental health)</p> <p>Two FFs (one acute, one specialist)</p>	<p>Different systems: three have Cerner, one has Epic, one has Allscripts, one has Meditech, one has System C, one has RiO</p>	<p>Four have a 2-year duration</p> <p>Four have a 3.5-year duration</p>	<p>Various levels of digital maturity, various geographical locations, various levels of existing local relationships, implementation strategies varied from 'Big Bang' to incremental</p>	<p>GDE provided an opportunity to achieve already present digital agenda; EHR implementation/optimisation was a frequent core GDE</p> <p>some sites have badged multiple projects as GDE, in many instances part of a bigger integrated care agenda which is around interoperability</p>	<p>Five meetings observed</p> <p>Eight group interviews</p> <p>22 one-to-one interviews</p> <p>One focus group</p>

Findings confirming previous preliminary evidence presented to the Steering Group

Findings from the baseline visits to all sites were presented to the Steering Group on 23 May 2018. Further study to date has confirmed this previous evidence. Our key findings to date are summarised in Table 2.

Table 2: Key findings to date

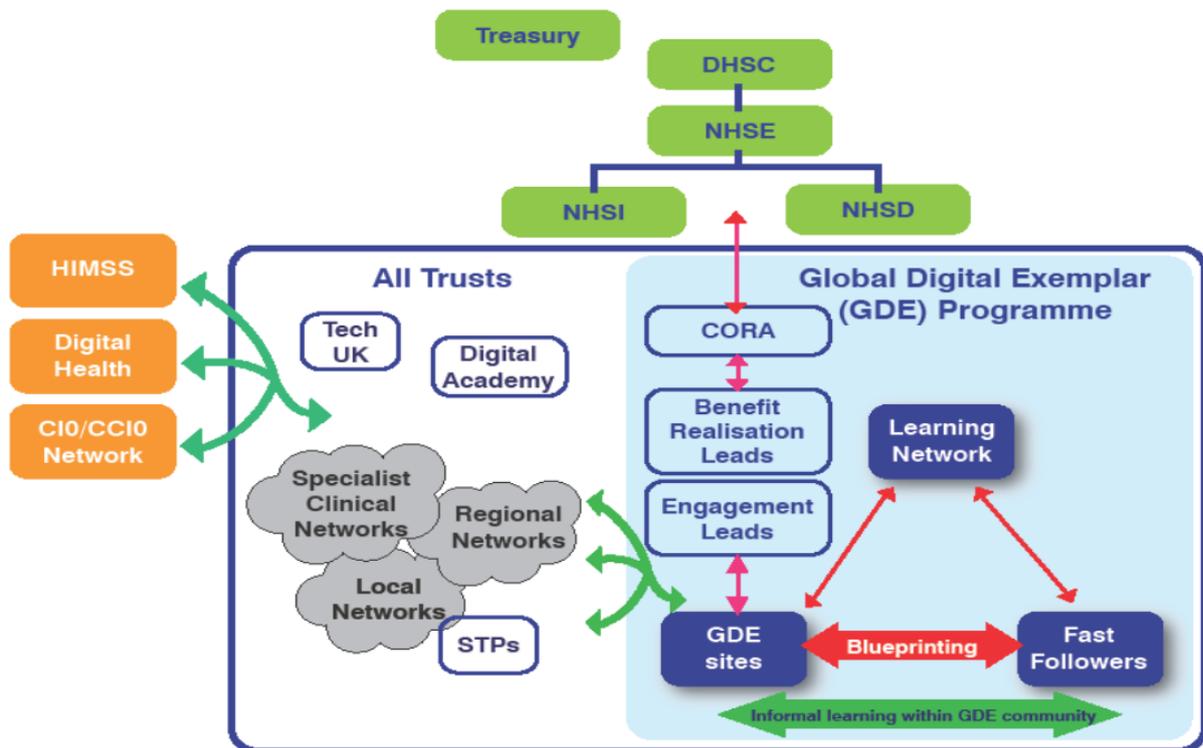
Key emerging theme	Explanation of theme
Organisational incentives of being part of GDE	<p>The GDE Programme has created considerable interest and activity in the NHS in realising the potential for digital transformation in health and care.</p> <p>The Programme is viewed by sites as being a catalyst with synergistic effects helping advance existing digital strategy in supporting procurement and implementation with a stronger focus on optimisation/benefit realisation. It facilitates staff engagement and alignment of effort within sites, networking between sites and helps adopters to negotiate with vendors (in acute sites).</p> <p>Large sites receive the same amount of funding as smaller sites. For large sites the sum of money is relatively lower (just about pays the electricity bill). However, the reputational benefits of membership are significant and pertain across the board.</p>
Organisational GDE activities	<p>Sites were able to advance the digitisation agendas – these had often already been mapped out as part of a bigger long-term programme of digital transformation. In some instances, the GDE Programme enabled major upgrades in core information infrastructure (e.g. EHR).</p>
Benefits measurement and realisation	<p>NHS benefits measurement frameworks are currently immature and inconsistent. There is thus a compelling requirement to further explore, agree and develop a consistent and manageable framework of outcome measures that relate to the GDE Programme. Outcomes may take a long time to realise but should be locally meaningful whilst still being measurable across GDE sites to allow for comparison. They should ideally also align with wider NHS quality, safety and efficiency targets.</p> <p>GDE/Fast Followers sites are struggling with how they can define, collect and quantify benefits. National level benefits do not align readily with local level drivers.</p> <p>There is currently no clear international policy, organisational or clinical consensus on the capabilities and characteristics of digital excellence in healthcare. Existing templates are broadly aligned with currently best practice solutions in advanced acute hospitals but need to consider possible new and emerging integrated care models and disruptive technologies. This raises challenges for the GDE Programme and its evaluations, but also major opportunities for the UK to take a leadership role in this respect.</p>

<p>Programme management and reporting structures</p>	<p>Sites have found national reporting mechanisms administratively burdensome. The Cora tool, as a proprietary solution that was commissioned to consolidate national reporting across sites, could be used to harmonise reporting requirements but there is evidence of duplication of effort arising from the current misalignment of local and national reporting. There are also duplicated national reporting requirements that might be ameliorated with Cora.</p> <p>Expectations of senior stakeholders are perceived as unrealistic (e.g. timelines and what can be delivered with the limited budget, and benefits of capturing the level of detail requested are not seen as justified in some cases).</p> <p>Different forms of innovation have different pathways to impact. Major infrastructure upgrades have extended implementation and optimisation timeframes – and benefits may be slow to appear – but may pave the way for faster innovations, through reusing data, with quicker pathways to impact.</p>
<p>Blueprinting</p>	<p>There is great current effort in the production of Blueprints. A key line of enquiry going forward will be around their uptake and use. There is a need to capture lessons from this over time, particularly regarding social and organisational processes. Cultural change is difficult to convey.</p> <p>There is a lack of clarity on the ground about the Blueprinting process e.g. What is the timeframe? How many Blueprints per site? How will the documents translate into learning?</p> <p>Being involved in the Blueprinting process is perceived to have led to increased reflection and better documentation of and reflection on the journey in sites.</p>
<p>Promoting broader learning ecosystem</p>	<p>GDE also promotes broader engagement. Informal networking and knowledge exchanges are developing rapidly and fruitfully (alongside structured networking activities within the GDE Programme) amongst an emerging NHS digital leadership. Supporting this emerging learning economy that goes beyond GDE/FF sites, needs to be a key priority going forward.</p> <p>We wish to further explore the potential contribution of intermediaries and other informal channels in regional exchange. Mechanisms to allow circulation of experienced staff (e.g. through secondments and a directory of expertise) might support deployment at different sites.</p> <p>Sites highlighted the lack of expertise to support implementations, and the fact that current NHS career structures and inflexible human resources systems do not support the secondment, circulation and development of expertise of clinical staff with IT implementation experience.</p>

	<p>There is currently great interest in integration of community, mental and acute health and care. However, GDE investments have not been explicitly addressing these.</p>
Market management	<p>There is insufficient incentive for vendors to change as the digital health market is moribund (entrenched by a small number of dominant players). Current procurement approaches are often cited as a barrier for vendors seeking more productive relationships with customers. Vendor market strategy may need to be reviewed, as the ability of large enterprise system vendors to deliver innovation is currently problematic.</p> <p>There is a need to support and encourage a vibrant mix of vendors able and willing to integrate applications with electronic health record enterprise platforms. Support for SMEs and start-ups should focus on scale-up and sustainability.</p> <p>There are issues about the uneven international capacity of technology supply including a lack of alternative vendors of hospital-wide mega package infrastructures (e.g. Cerner, Epic).</p> <p>The key challenges to be addressed in relation to supply are:</p> <ul style="list-style-type: none"> • Applications: How can the NHS market be made more favourable to new entrants (in terms of access to market and scope for sustained scale-up)? • Core acute enterprise systems: How to make the enterprise system market more competitive? • Integrated health and social care infrastructures: What will be the overall architecture for integrated infrastructures encompassing acute (plus e.g. Ambulance and Mental Health sites), primary and social care? What would be the minimal and optimal capability for acute/mental health sites to play their role most effectively within these integrated infrastructures?
Widening gap between GDE and the wider NHS	<p>Although there is broad consensus of the value of targeted investment, some have expressed concerns about a widening gap between more and less digitally advanced segments of the NHS.</p>

We have further developed a map of the digital health ecosystem facilitated by the GDE Programme, summarised in Figure 2. This highlights the multiplicity of relationships in play. We will develop this mapping further to capture ongoing developments (e.g. LHCREs) and emerging informal channels (green arrows) as well as planned knowledge transfers (red arrows) We are beginning to chart these relationships in our fieldwork.

Figure 2: Map of digital health ecosystem



These findings have been broadly confirmed by ongoing data collection, but we are discovering increasingly marked differences between acute and mental health sites and the way vendor relationships are governed, the latter characterised by:

- A longer history of collaborative working with primary care and social care (e.g. patients receiving treatment in the community by a mobile workforce)
- Close links among Mental Health sites that span geographical boundaries
- Different enterprise system vendors - suppliers have been able to sustain a position in this specialised market, whilst the information complexity keeps the smaller suppliers out of the acute enterprise mega-system market
- Different clinical practice: psychiatrists may wish to delay diagnosis until discharge or beyond (which affects EHRs)

Building on these findings, our conclusions and recommendations from previous Steering Group meetings throughout the last year have highlighted that:

- If the experiences of other non-healthcare sectors are anything to go by, becoming a high performing, high reliability sector/organisation is likely to take both greater time and investment than is currently being afforded to GDE sites. This initial wave of funding/sites should therefore be seen as the start of a longer-term strategy. Such strategies should consider the requirement to promote understanding and incentivise participation across the whole health system, particularly where investment is required from one player that will mainly benefit other players or the system as a whole.
- The GDE Programme should not be viewed in isolation from the wider drive to digitise health and care but needs to be aligned with other ongoing groupings (e.g. Sustainability and

Transformation Partnerships (STPs), Local Health and Care Record Exemplars (LHCRES)). At minimum, it should continue to align with the investments in the NHS Digital Academy and wider NHS and health service digitisation policy and strategies; and also extend to other investments such as through UKRI, particularly Health Data Research UK (HDR UK) and Innovate UK.

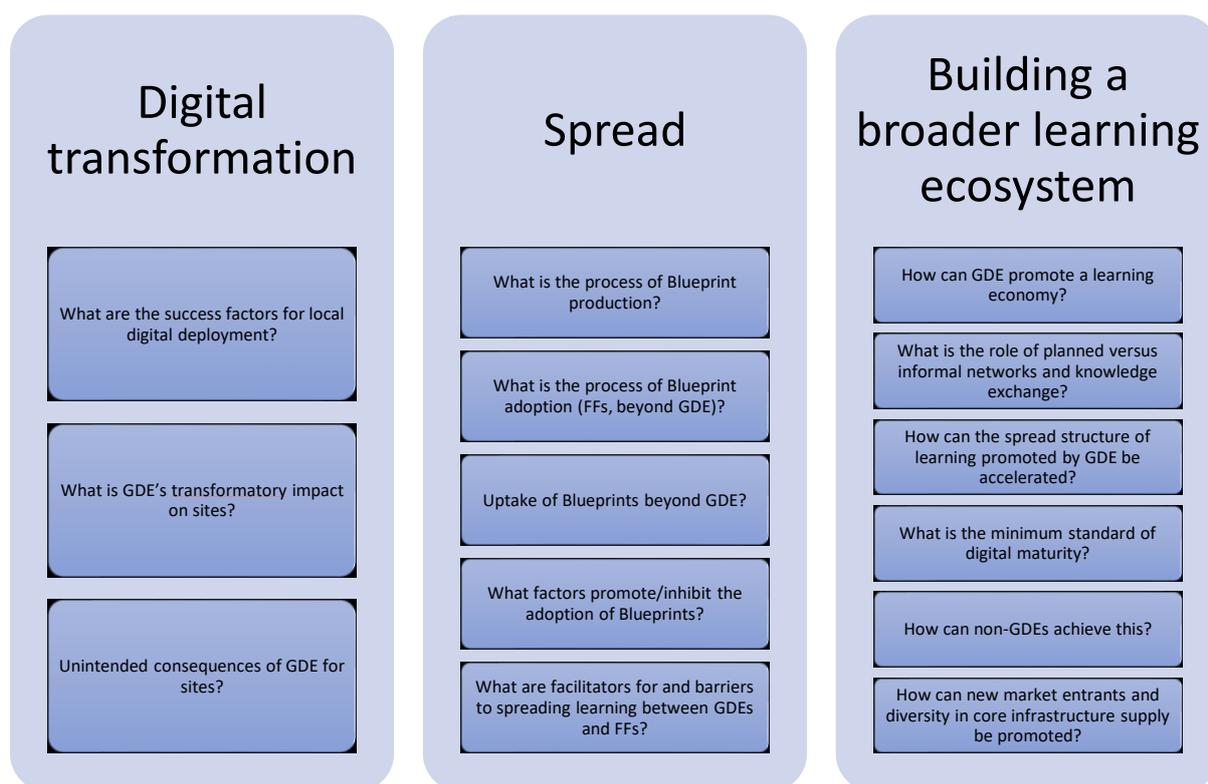
- Capabilities created through GDE initiatives may be dissipated when funding ends, reducing prospects for longer-term transferable learning. Sustainable long-term strategies should be considered in relation to developing, retaining and exploiting core personnel/skills/capabilities beyond the duration of the GDE Programme.

Findings since the last meeting and emerging lines of enquiry

Conceptual framework

Figure 3 illustrates our main current and emerging key lines of enquiry. We have grouped these around three themes: *digital transformation* within GDE/FF sites; *spread* anticipated under the GDE Programme between GDEs and FFs; and the broader networks and knowledge flows that may contribute towards *building a broader learning ecosystem*. The following sections will explore emerging findings in relation to each overall theme.

Figure 3: Key lines of enquiry



Digital transformation within GDE/FF sites

Most participants agreed that the GDE Programme helped to accelerate the pace of digital transformation and focus their efforts:

“I think it means that some of that transformation has happened much quicker than it would’ve happened had we not been part of the GDE...” (Site I, Chief Nursing Information Officer)

The existing drive to address an apparent lack of skills relating to hybrid roles spanning clinical, leadership and informatics professions through the NHS Digital Academy was seen as a welcome development. Due to our involvement, we taught many key individuals in case study sites in this capacity (13 from in-depth case study sites alone) and to some extent therefore also influenced local implementation strategies.

Framing and measuring digital excellence

Additional technological capabilities emerging from the first round of the Delphi study

Based on the feedback of experts in the first round of the Delphi study (delivered between July-October 2018), we have amended the table of technological capabilities to include the following additions:

1. Capturing clinicians’ thinking (diagnostic assessments, reasons for medications, reasons for overriding alerts, reasons for discontinuing medications)
2. Patients and carers can review and add clinical data (e.g. to say how they are feeling)
3. A single list of all medication for one patient is available
4. Linkages with hospital pharmacy dispensing data
5. Third party tools can be added through Application Programming Interfaces
6. Unique patient identifier used across healthcare settings
7. Use of machine learning and automation when appropriate (e.g. analysis of radiology images)
8. Reducing need for duplicate entry of patient data to near zero
9. Access to clinical knowledge management tools and services (e.g. ePrescribing decision support systems, NICE/SIGN guidance, hospital antimicrobial handbook, lab handbook etc.)
10. Consent system for use of blood / tissue / data for research
11. Link in with third sector, social care, emergency services including police
12. Effective Natural Language Processing tools
13. Ability to interoperate with other standards-based external systems

Many of these highlight the need to include novel exploitation of data across the wider health community. Appendix 1 shows a table that details capabilities included in the second round (first column) as well as quantitative (middle column) and qualitative (third column) feedback from first round.

Framing digital excellence: analysis of qualitative data

As part of the first round of the Delphi exercise we asked experts to share their comments on one current definition of digital maturity in the context of healthcare and to comment on the role of non-technical factors (e.g., workforce, organisational culture, leadership, etc.) in digital excellence.

Detailed analysis of experts’ qualitative feedback, including quotes, can be viewed in Appendix 2. The data indicated that the concept of digital maturity is seen as helpful in the context of healthcare and improving clinical care. It was, however, also evident that factors such as organisational culture (e.g.

being risk averse, culture of support and trust) were viewed as being more important in characterising a digitally mature organisation than technological capabilities alone.

We further observed a tension between attempts to define the concept of digital maturity promoted through the Delphi study and critiques of the usefulness of the overall concept. Delphi exercises seek to align and reconcile experts' opinions. This may be at the expense of losing the divergent views and identify concerns. Although we do not question the need for measuring digital maturity pragmatically in order to define baselines and assess progress, we highlight that consensus building risks reinforcing past practices and embedded existing processes.

Some experts also expressed concerns that the models of digital maturity emerging represent a convergence around the priorities of large technologically advanced acute hospitals. This may be reflecting an unconscious/unintended alignment of views (groupthink).¹¹

There is an implicit assumption (made explicit in HIMSS with its 7 levels) that Digital Maturity is a set sequence of steps that all organisations must pass through. As a result, it may not be achievable, and it may not represent the most immediate priority locally. The notion of Digital Maturity does also not consider potential emerging innovations that may enable radical reconfigurations of care delivery. This is because (1) they focus on carrying out existing reporting in a faster and more efficient and reliable manner; and (2) they do not consider radically different ways of delivering care (organisational innovation), which may be supported by further technological innovation.

In order to contextualise these discussions, we asked experts in the second round of the Delphi study for suggestions around what they consider to be international examples of digital excellence in healthcare. The top four choices are summarised in Appendix 3, where we draw on the sociotechnical framework we have developed in previous work and existing dimensions of digital maturity and excellence identified in the literature.^{12,13}

Based on these findings, and informed by the current literature, we have drafted a discussion paper aiming to contribute to international discussions surrounding the concept and underlying assumptions of the pursuit of digital excellence in healthcare settings (see Appendix 4). By exploring the definition of digital excellence in the context of digitally mature organisations, we conclude that the notion of digital excellence serves an important purpose, providing a vision that can help coordinate activities towards the pursuit of the triple aim of health systems. Measuring digital excellence is however problematic, particularly in the context of large-scale policy initiatives such as the GDE Programme. Acknowledging the need to measure progress in such initiatives is likely to require recognition of the shortcomings of existing measurement tools and their pragmatic application. There is for example, a need to place current transformation within a longer-term vision of architecture and service evolution that is open to the probability (indeed inevitability) of further disruptive change and radical transformation. The proliferating digitisation opportunities may call for weighting of criteria, in which integration of care and exploitation of data assets arguably need to be given priority.

Providing a target for a journey with an unknown endpoint

Our analysis shows that these tensions surrounding the framing of digital maturity are visible in both strategic and local efforts to work out the path of a journey of which the end-point is unknown. At

¹¹ Esser JK, Lindoerfer JS. Groupthink and the space shuttle Challenger accident: Toward a quantitative case analysis. *Journal of Behavioral Decision Making*. 1989 Jul;2(3):167-77.

¹² Cresswell KM, Sheikh A. Undertaking sociotechnical evaluations of health information technologies. *Journal of Innovation in Health Informatics*. 2014 Mar 18;21(2):78-83.

¹³ Ahluwalia SC, Damberg CL, Silverman M, Motala A, Shekelle PG. What defines a high-performing health care delivery system: a systematic review. *The Joint Commission Journal on Quality and Patient Safety*. 2017 Sep 1;43(9):450-9.

strategic level, HIMSS accreditation (which has changed throughout the GDE Programme) provides a way to measure achievement of a political goal, whereas sites perceive shifting goalposts and changing measurements of success.

“We have kind of changing goalposts if you will throughout the Programme and have been attempting to modify and meet with the changing demands that have come up.” (GDE Programme Manager, Site A)

Some of this tension may be explained by HIMSS accreditation being based on episodic rather than programmatic change (which has a degree of national requirements and a need for a stable narrative surrounding continuing transformation for participating organisations).

Unintended consequences of tight coupling

Whilst GDE deliverables clearly focused efforts and momentum to implement change at sites, we also observed some unintended consequences of the strategic imperative to demonstrate progress. For example, implementation and optimisation efforts that did not fit with overall funding milestones and may not show directly relevant outcomes tended to receive less attention locally. This was particularly apparent in Site C and H, where implementations of ePrescribing and patient tracking systems were delayed as deliverables did not fit with GDE funding milestones. There was therefore in some instances a degree of trade-off between local benefits realisation and overall programme progress, where sites had to weigh the productive value of delays.

The tight coupling of measuring progress against the achievement of funding milestones seems however necessary to keep sites on track and consolidate national efforts. An alternative approach may be to include smaller and locally relevant measures determined by sites themselves.

There was an initial expectation that the GDE Programme would allow sites to flag their own priorities and pathways and local metrics. This desire (which emerged from the increasing local input in decision making associated post-National Programme), was overtaken by a concern to avoid problems of technological programmes that did not deliver organisational change. This, in turn, drove a concern to use benefits realisation the heart of the GDE Programme. This tension has been played out in relation to benefit tracking.

Spread anticipated under the GDE Programme between GDEs and FFs

Relationship between GDEs and FFs

The GDE Programme is seen as a vehicle to drive forward local collaboration within sites and also with FFs, and we have found evidence of relationships being strengthened through the Programme. These links seem to be considerably strengthened where they align with existing links and working relationships with other local organisations (and individuals). Formal and informal links seem to be greatly strengthened by attempts to promote regional links (e.g. links to STPs, LHCREs).

In some cases, where relationships between GDEs and FFs were good already, these were perceived to be solidified by the GDE Programme (e.g. Site H, L and I).

“It’s funny isn’t it because the networks, quite a few of the networks already existed didn’t they but I think having GDE in place has encouraged more communication between us.” (Programme Manager, Site H)

In these sites, a focus on rolling out common local technological solutions across localities seemed to work well to consolidate efforts (e.g. cancer portal). We further observed some sharing of expertise (e.g. sharing of an ePrescribing pharmacist between Site L and Site C).

In other instances, the relationship between GDE and FF was strained. Here, sharing appeared to be inhibited by competing local priorities (e.g. Site A had a software upgrade so wanted to concentrate

on this instead of helping their FF) and a perceived lack of incentives for helping with other implementations in sites that are less digitally mature and that would leapfrog others that were commonly perceived as national leaders. In one instance, for example, a site stated that they did not want to send their staff to a FF to help with a low profile implementation as this may not reflect well on them (as future funding is likely to be dependent on appearing as leaders).

The GDE Programme has clearly promoted a degree of competition for excellence, which may help some in accelerating the journey towards digital maturity. However, there is a danger that this competition becomes counter-productive, reinforced by existing organisational cultures/hierarchies and historical relationships.

The idea of shared learning may therefore be in tension with the broader environment that may encourage competition rather than collaboration:

“In a competitive market, where they’re also having to compete for services when they’re bidding for things, in the market we’re in, that means you don’t get the sharing that you want” (Policy)

However, it is also important to note that the degree of competition varies across diverse parts of the country, and within locales and organisations. There may therefore be scope to focus on exploring ways to overcome this competition and incentivise collaborative approaches going forward.

Blueprinting

Although the process of Blueprinting as a vehicle of distributing knowledge is becoming increasingly important for our work and indeed the perceived overall success of the GDE Programme, our findings are preliminary as they are just beginning to come on stream and we therefore do not yet have much concrete evidence around their production process, let alone their reception in other sites.

There appear to be benefits of Blueprints encouraging reflective practice, but sites have flagged the retrospective nature of the Blueprinting process due to immediate implementation pressures taking priority.

“The other thing that we were up against, was a time pressure. (...) Because we had to hit a milestone. So, 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, I think. And we probably wouldn’t have bothered, if we didn’t have to write a Blueprint, we would have just got on and done the next thing. (...) So, the [name of site], as our fast follower, has benefited from not having the same milestone, and not having to do it as quickly.” (Chief Clinical Information Officer, Site I)

Some also expressed concerns that no one will read/use the produced Blueprints and/or find them useful, and others highlighted the lack of incentives to produce Blueprints after GDE funding has ended.

Well why have we been asked to write blueprints after I’ve shut the programme down. It doesn’t exist. In fact, today it doesn’t, GDE doesn’t exist here. It’s closed. It is closed. (Information Management and Technology Lead, Site H)

Based on these limited early findings, we would like to raise the following for consideration:

- The notion of Blueprints emerged from military and corporate sectors as a comprehensive description of a standardised method for achieving (and evaluating) change that can simply be disseminated and adopted.¹⁴ The question may be posed as to whether the idea of Blueprinting can simply be transferred between commercial and healthcare contexts as these are

¹⁴ D’Adderio L, Glaser V, Pollock N. Performing theories, transforming organizations. *Academy of Management Review*. 2018 Oct 31:1-9.

arguably quite different (e.g. in terms of complexity of care processes and organisational complexity). There is, moreover a tension between replicating processes promoted through a Blueprint versus adapting Blueprints to other settings and improving on these processes. Rather than focusing on the production of Blueprints as a one-off process we propose their reconceptualisation as *Blueprinting* an ongoing process involving a community actively developing, adapting and enhancing innovations.

- Blueprints need to be produced as change happens and not as an afterthought as otherwise important elements may be left out. Some GDEs already have other means of documenting change, and they must re-do it in the Blueprint format. In addition, capturing of real-time challenges does not take place. Processes need to be in place to ensure that Blueprints are living documents allowing for constant reinvention and further evolution.
- There is a danger that Blueprints will not be taken up by the frontline to the extent that they did not emerge from local priorities. Demonstrating cases of Blueprint use in context, and their immediate and ongoing benefits will be crucial going forward.
- Sites need to be motivated to produce/use Blueprints. If the Blueprinting process is not unduly onerous it may best be motivated by open innovation principles – and motivated by the learning and reputational benefits accruing to the community involved. These kinds of inherent incentives can be most efficient/effective in a gift economy. They are likely to be assisted where the community of practices is aligned (e.g. through shared use of platforms; through shared clinical specialisation; through regional links and shared or converging culture and organisational goals). In these circumstances costs and frictions of participating may be minimised and knowledge and reputational benefits may be more immediate.
- The mechanism of spread facilitated by the produced Blueprints needs to be demonstrated in selected pilot sites. If this does not work through internal processes in the knowledge/gift economy, then complementary vehicles for spread of learning may need to receive resource originally allocated to Blueprinting activity (both nationally and locally) in order to promote motivation to produce/use Blueprints.
- There are unresolved issues around the ownership of Blueprints going forward and there is a need to consider intellectual property – e.g. to reward originators and to protect from vendors appropriating benefits of local innovation.
- Initial Blueprints will necessarily be vendor-specific, reflecting the local experience of implementing a particular offering in a single setting. GDE Blueprints are therefore likely to be site-specific and are likely to require adaptation to meet implementation exigencies in other settings. Collating this experience could generate site-neutral Blueprints. Vendor neutral Blueprints might be possible, but they would require a different production process. They are unlikely to emerge except for example in specialised clinical communities such as mental health.

Development of a broader learning ecosystem

Although the context is different in each organisation, we found some common threads that may be anticipated to pose challenges for wider transformation through the GDE Programme. Public funding rules (e.g. needing to avoid an under- or overspend at the end of the year) have complex cascades of consequences which impose complex consequences for both programme managers and sites.

Emerging networks

As well as planned networking (e.g. between GDEs and FFs, Blueprinting, Learning Network), we observed a range of existing and emerging networks through which knowledge was disseminated that powerfully augmented flows of knowledge and experience around the GDE. These included software-related networks and user groups, either organised by users or by vendors. These were used to share best practice, develop optimisation strategies, consider risks, share learning, and share innovation.

User-led groups were in some instances used as a tool to exert pressure on suppliers (e.g. to exert strategic pressure on vendors). However, these groups are proving most effective with large enterprise systems that already had a large user base. These systems may therefore develop at a speed that smaller systems cannot keep up with as a critical mass of users is needed to establish these networks.

Existing informal supportive relationships between adjacent sites seemed to be a particularly important catalyst for flows of knowledge.

I think having a lot of GDEs in one geographical area is a double edge sword. It's great because you can go and visit them – we've got really, really good links with everyone around in the STP around the patch (CMIO Site B)

These included planned relationships (e.g. established through secondments or GDE/FF networks) and unplanned relationships (e.g. where staff moved between sites). In many cases, such relationships were perceived as being facilitated by the GDE Programme. In some cases, regional collaboration is being pursued as part of GDE and related programmes (e.g. LHCREs, STPs) with considerable effect.

"I get lots of emails from people, like, the [Chief Nursing Officers] and people from other Trusts just asking questions and I have their contact so I can email them. So, there's quite a lot of informal, once you've met somebody, that, kind of, networking, you just...you know that they're doing a certain thing if you want to know about that, you can contact them. So, I think there's quite a good network for that but it's probably a little bit more informal." (Chief Nursing Officer, Site I)

However existing human resources systems and entrenched professional structures within the UK Health Service seem to mandate against the redeployment of implementation experience in other settings and thus the development and exploitation of hybrid skills (a factor long-recognised as crucial for successful technological change in commercial settings). Our sites flagged difficulties in recruiting and retaining these scarce skills.

"We've had real problems recruiting because everyone within the local area has been sucked up on GDE projects...I need a pharmacy trained project manager who has worked in I.T now I am sure there are hundreds up and down the country but there are none in (geographical region) because they have all been hoovered up. It is very, very difficult for us to get that level of expertise in now." (Chief Clinical Information Officer, Site B)

GDE funding models

Some interviewees raised that the current focus on capital funding meant that the NHS was "essentially creating quite a big mortgage" (Policy maker) and not investing in longer-term services to maintain, service, support, upgrade, and optimise systems.

"The other side of that is, part of that milestone would have been funding the devices, we don't want to buy the devices too early in case there's further delays but if we don't buy the devices before the end of the financial year, there's a risk that we can't roll the money over to the next financial year. Therefore, the Trust is still going to have to fund the devices but out of its own money, rather than the GDE money and that's a real practical example of where we're being constrained by financial reporting because it's capital funded, and you can't just roll it over from one year to the next." (Site D, Chief Clinical Information Officer)

This short-term funding model also meant that there was viewed to be a lack of sustainable skills and capacity development at sites. As a result, some stated that there may be reluctance in second wave sites to bid for funding as they would have to pick up depreciation costs.

Interviewees further mentioned that the presence of multiple funding streams (e.g. LHCRE, Health System Level Investment) meant that in some cases GDEs obtained funding from multiple initiatives. The consequences of this could be variable:

1. There may be a potential lack of value for money resulting from each individual funding stream as the delivery of the programmes may become a means to an end at sites resulting in overlapping deliverables
2. Those who do knit multiple funding streams together may optimise existing systems more effectively (which is backed up by successful sites appearing to have benefitted from multiple streams)

These two scenarios may however represent opposite sides of the same coin: although it is valuable to avoid double-counting (and in particular “double-dipping”: using an award from a programme as a source for local institutional support), the small size of funding relative to scale of upgrading required means that digitally mature sites are often those which have been successful in securing multiple funding streams.

GDE needs to be viewed as part of a wider transformation programme of healthcare that will require long term sustained expenditure that is both sustainable and flexible. In doing so, the funding needs to reflect the scale of expected transformation, which in turn needs to be realistic in terms of measurable benefits, implementation/optimisation activities and timeframes. If wider transformation expectations solely rely on the GDE Programme, there is a risk that this will fail to meet expectations.

Widening gap between GDE and wider NHS

We also found evidence surrounding concerns that the GDE Programme would contribute to a widening gap between GDE/FF sites and the wider NHS.

“The risk you have is that you could end up with a wider gap, for those that find it really hard to catch up. And we do have to invest in digital maturity in organisations that are in trouble.”
(Policy)

This could be reinforced by multiple streams of income through parallel initiatives mentioned above.

Transformation through infrastructures and innovation

Our data further highlighted that there was a perceived lack of focus on innovation promoted through the GDE Programme.

“Knowing some of the GDEs, and how the submission process worked, well, they’re almost only asking for funding for existing programmes that are in train. What’s new in that, what was innovative in that, what was actually truly exemplary in that, if we go by what the principle of GDE was?” (Policy)

Sites mainly invested in infrastructural digital initiatives that were contributing to overall longer-term local plans. Investing in infrastructural technologies such as EHRs and ePrescribing systems is at odds with the focus on benefits reporting mentioned above. Innovations have received less attention both locally and nationally, perhaps due to their long lead times that are at odds with the short-term funding models. However, there is scope to promote lightweight innovations that sit on these enterprise platforms. These would however require a loose management structure that allows flexibility and has a degree of tolerance for failure.

Preliminary implications for policy-making emerging from our work

Digital transformation

We recommend revising the Digital Maturity Index by adding the additional capabilities surrounding novel exploitation of data across the wider health community emerging from our Delphi study. The revised index needs to be proposed as a guideline for future change from this point forward to avoid perceptions of shifting goalposts.

The GDE Programme needs to be placed in the context of continuous transformation within a longer-term vision of architecture and service evolution that is open to scope for radical transformation. Visions of this continually-evolving landscape need to be periodically updated – and the changing nature of these targets should be explicitly addressed. The proliferating opportunities may call for weighting of Digital Maturity criteria, whereby integration of care and exploitation of data assets need to take priority. The evolving role of STPs and LHCREs in the expansion of the GDE Programme is a welcome development.

Rather than seeing digital transformation as a sequence of steps that all sites must progress through, there is a need to develop a more nuanced multi-stream approach that enables sites to target key local priorities. This also allows scope to leapfrog developments. This would require a more nuanced benefits realisation framework that combines smaller and locally relevant measures determined by sites themselves with national progress measures coupled with funding milestones

Spread

Links between GDEs and FFs are developing – but should not be considered as a one-way-street. The notion of FFs may need to be reconsidered and perhaps conceived as a partnership in which later actor may not just adopt but leapfrog over and further enhanced its solutions.

Currently knowledge flows between GDEs and FFs (and later adopters) are being supported by GDE sites. Some have expressed concern about how to resource this if the demand becomes more onerous once the GDE contracts end.

There is scope to focus on exploring ways to overcome the existing competition between sites and incentivise collaborative approaches going forward. Currently, Blueprinting and knowledge exchange are supported by the resources made available by sites as part of their joint support for GDE investments. These efforts have been greatly supported where a community with common concerns share information on a reciprocal basis (gift-economy). Some sites are concerned that ongoing support of Blueprints will place significant demands on their time after the end of their GDE contracts. Some financial support may be needed if reputational and learning benefits prove insufficient. Attention should also be given to issues of ownership of this intellectual property.

Rather than focus on the creation of Blueprints (conceived as a one-off process) and their adoption (conceived as a one-way street), we suggest that Blueprinting should be framed as an ongoing process involving the creation and curation of living documents (or other vehicles consolidating learning) amongst communities of shared practice and concern.

As Blueprinting is viewed as an important vehicle for spreading learning, it is central to the success of the Programme. We strongly recommend designated evaluation of this initiative and careful piloting of spread processes in restricted settings. This is particularly relevant for the foundational Blueprints currently in development and the communications approach to support the launch of the GDE Blueprinting platform.

Building a broader learning ecosystem

Informal relationships between sites need to be fostered systematically. Regional linkages seem to be effective here as do links between sites sharing the same software platforms (there may be a need to foster software-related networks for sites do not implement large-scale enterprise systems or where vendor communities are smaller/less established). It might be helpful to scope existing relationships before pairing up GDEs with FFs. Establishing mechanisms for secondment/fellowships at regional level might also be productive.

GDE needs to be viewed as part of a wider transformation programme of healthcare that will require long term sustained expenditure that is both sustainable and flexible (moving away from a focus on capital funding). In doing so, the funding needs to reflect the scale of expected transformation, which in turn needs to be realistic in terms of measurable benefits, implementation/optimisation activities and timeframes. If wider transformation expectations solely rely on the GDE Programme, there is a risk that this will fail to meet expectations.

Multiple streams of income through public funding for sites may to some degree reinforce the widening gap between GDEs and the wider NHS. They may also reinforce the status of acute hospital trusts and inadvertently act as barriers to the creation of integrated information infrastructures.

Appendix 1

The table below shows capabilities included in the second round of the Delphi study (first column) as well as quantitative (middle column) and qualitative (third column) feedback from first round.

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 1: Structured data (records, assessments and plans) captured digitally at the point of care.</p> <p>Capability 2: Unstructured data (e.g., notes, free text) captured at the point of care when appropriate.</p>	<p>Capability: Records, assessments & plans captured digitally</p> <p>Median: 1 ('Strongly agree') IQR¹⁶: 1 Proportion 'Strongly agreed' or 'Agreed': 79.4%</p>	<ul style="list-style-type: none"> - the term 'captured digitally' is not precise enough in this context; there is a difference between structured/coded data, free text or speech and a scan of a PDF. We should aim at a system that allows both to capture structured/coded data as well as free text/speech - data should be captured but also coded - proposed change to the wording: '...structured data capture at the point of care' - having a sophisticated digital system that captures records, assessments and plans is not enough; if the organisation is not digitally mature then such system would not be a good fit; each digital solution should be designed to match the level of digital maturity of the organisation for best results

¹⁵ Please note that several of the original 25 capabilities proposed in Round 1 were divided into two or more capabilities to achieve more precision, resulting in 38 capabilities in Round 2. In addition, most of the capabilities were re-worded to reflect experts' comments from Round 1.

¹⁶ IQR: the interquartile range is a measure of variability in a set of results; the IQR indicates the amount of spread in scores in the middle 50% of answers

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 3: Records, assessments and plans shared digitally and easily accessible to patients and carers to view the data securely and confidentially.</p> <p>Capability 4: Records, assessments and plans shared digitally and easily accessible to patients and carers to enter and amend the data securely and confidentially.</p>	<p>Capability: Records, assessments & plans available digitally to carers & patients</p> <p>Median: 1 ('Strongly agree') IQR: 1 Proportion 'Strongly agreed' or 'Agreed': 85.3%</p>	<ul style="list-style-type: none"> - provide that the digital records, assessments and plans are created, the digital access is straightforward digitally - these should be not only available but also easy to access (i.e., in terms of location such as from home and effort needed to access the data) - in the UK there are national barriers to it - should carers and patients be passive recipients, or should they also be able to contribute to the records - this is especially important in the context of managing long-terms conditions - issues of data restriction should be considered (e.g., adolescents and guardianship, care plans, assessment etc. are professional aspects, also subjective comments etc. should only be accessed by professional team) - need to consider issues around security and confidentiality

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 5: Orders (e.g., lab tests) are ordered and results reported in a coded form (i.e., using standard compendiums and international vocabulary standards including DM&D) and acknowledged electronically in the system.</p> <p>Capability 6: Person reading / acting on the results acknowledges this electronically in the system.</p>	<p>Capability: Digital orders and results management are done electronically</p> <p>Median: 1 ('Strongly agree') IQR: 1 Proportion 'Strongly agreed' or 'Agreed': 79.4%</p>	<ul style="list-style-type: none"> - this should be done in the context of a closed loop medication administration process - there is a distinction between orders and results being managed exclusively via a digital system and an opportunity for these to be managed electronically, these distinctions should be captured in the description of the capability - it is important to specify that orders and results should be entered in a coded form (i.e., using standard compendiums and international vocabulary standards) - to have this capability in place the two previous capabilities should also be there – could this be a progressive scale? - this should also include results acknowledgment

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 7: Referrals within and between hospitals are always managed electronically.</p> <p>Capability 8: Discharge to primary care and community is always managed electronically.</p>	<p>Capability: Digital transfers of care Including electronic referrals</p> <p>Median: 1 ('Strongly agree') IQR: 1 Proportion 'Strongly agreed' or 'Agreed': 76.5%</p>	<ul style="list-style-type: none"> - it is not immediately clear whether this means that capability is available or that all transfers and discharges are managed electronically - does this include all types of referrals (i.e., referrals within and between hospitals and discharge to primary care and community) - it is relatively easy to digitalise formal referrals and discharge, but what about capturing informal negotiations? - we should aim at the referrals to be in a structured CDC form rather than electronic PDFs, so that it can be sent by one EPR and received by another
<p>Capability 9: Closed-loop electronic medicines management & optimisation (electronic prescribing with technology-assisted identification of both patient and medication, e.g., bar codes or RFID tags).</p> <p>Capability 10: Exchange of prescription information in a structured way within and between organisations and sectors.</p>	<p>Capability: Electronic medicines management & optimisation</p> <p>Median: 1 ('Strongly agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 73.5%</p>	<ul style="list-style-type: none"> - ability for medication information to be exchanged between organisations (and not only internally) is very important here - the information should be entered and coded using internationally accepted data standards - this should be part of closed loop medication administration - there needs to be a possibility to monitor conflicts between prescribed medication - very important for patients with long terms conditions and complex medical needs

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 11: Advanced clinical decision support (e.g. integrated with lab data, diagnosis codes) with alerts that are both sensitive and specific and therefore less likely to result in alert fatigue.</p>	<p>Capability: Advanced clinical decision support</p> <p>Median: 2 ('Strongly agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 64.7%</p>	<ul style="list-style-type: none"> - this is potentially a controversial point; there might be a lot of unintended consequences to using an advanced decisions support system for clinicians (e.g., burn out, alert fatigue) - definition of advanced should be included; this should include concepts of sensitivity and specificity, effectiveness in terms of use, design and improved outcomes; it is important to reflect what is considered as simple (alerts and reminders?) and what counts as advanced; alerts should be priorities (e.g., alerts about allergy to a specific drug should have high priority) and delivered to right person (e.g., a nurse, a consultants etc.) - based on experience implementing digital decision support poses many challenges (e.g., support for an experienced clinician or a 'novice', support as a rule or as a suggestion); it might be that while the system delivers it, it is not used correctly - this is not so much a matter of a digital capability, but rather a maturity of an entire organisation and how it operates; this requires a systematic capture of clinical care and assessment in the first place and is therefore one of the more advanced capabilities

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 12: Infrastructure and governance in place for remote consultation with patients in other settings.</p>	<p>Capability: Remote & assistive care through virtual consultations</p> <p>Median: 2 ('Agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 55.9%</p>	<ul style="list-style-type: none"> - might not be applicable in the context of some types of specialised care - from technical point of view, this is technically feasible, but challenges lie in implantation and practice as well as issues related to trust, transparency and privacy - maybe replace the word 'virtual' with 'remote' - to really make a difference simply replacing a face-to-face consultation with a video call is not enough; to make a difference things should be done differently, e.g., patients should be connected to tertiary services
<p>Capability 13: Clinical intelligence through digital health data.</p> <p>Capability 14: Management intelligence through digital health data.</p>	<p>Capability: Clinical & business intelligence through digital health data</p> <p>Median: 1 ('Strongly agree') IQR: 2 P Proportion 'Strongly agreed' or 'Agreed': 73.5%</p>	<ul style="list-style-type: none"> - split into two to distinguish between intelligence for clinicians and for business - this might be an aspiration for future rather than what can be expected of today's systems, as it requires comprehensive trace of data beyond individual hospitals - for it to work, a prerequisite is that a good quality, coded data needs to be captured - this is very important and should include things such as: Leverage value of inputted data to inform service delivery performance, support clinical leaders leading services with proper data and defines KPIs. Identify patient cohorts for actionable data and pop health interventions

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 15: Asset and resource optimisation combining digital health data and data not immediately captured electronically (e.g., interviews with stakeholders).</p>	<p>Capability: Asset & resource optimisation through digital health data</p> <p>Median: 3 ('Moderately agree')</p> <p>IQR: 3</p> <p>Proportion 'Strongly agreed' or 'Agreed': 41.2%</p>	<ul style="list-style-type: none"> - this capability can only work if the underlying data is characterised by high level of completeness and accuracy - this might be more important for some areas within secondary health care (e.g., acute care) than others (e.g., ambulatory care) - there are potentially great benefits associated with this capability, but at the moment, the available systems are not good at it - this definition would benefit from being more specific (i.e., what assets and resources specifically) - asset and resource optimisation should be based on both data captured electronically but also on data not immediately captured digitally (e.g., interviews with stakeholders)
<p>Capability 16: Local sharing of relevant data across the local health care eco-system facilitated by interfacing or interoperability of electronic systems.</p>	<p>Capability: Local data-sharing across the local health & care ecosystem</p> <p>Median: 2 ('Agree')</p> <p>IQR: 2</p> <p>Proportion 'Strongly agreed' or 'Agreed': 70.6%</p>	<ul style="list-style-type: none"> - it is important to be more specific about what type of data is shared (too much data can overwhelm the clinician) and how (a true interoperability vs. a portal type approach) - this capability is similar to capability 4 - this should support complex care pathways - this capability is focused on institutions rather than patients - it should be made explicit whom the data is shared with (it might not be desirable to share data with everyone)

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 17: Open application programming interfaces allowing different software components to interact (wording unchanged from Round 1).</p>	<p>Capability: Open application programming interfaces allowing different software components to interact</p> <p>Median: 1 ('Strongly agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 73.5%</p>	<ul style="list-style-type: none"> - technically, this is definitely double, the challenge lies in an appropriate policy being implemented and enforced to ensure inclusion of open application programming interface - this should be a priority in the context on NHS software procurement exercise
<p>Capability 18: Clinical data recorded in a structured format when appropriate.</p> <p>Capability 19: Effective tools available to code narrative data where appropriate.</p>	<p>Capability: Clinical data recorded in a structured format</p> <p>Median: 2 ('Agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 55.9%</p>	<ul style="list-style-type: none"> - some structured data is needed (e.g., selected field for trials or experiments) but fully structured format doesn't seem to be the best approach - a careful study needs to be done to establish what data should be compulsory recorded in a structured way, and what data doesn't have to be recorded in a structured way - there is a value to rich narrative text and clinicians find it more comfortable to describe a situation using natural language and narrative description - evolving tools such as machine learning and AI allow to extract the required coded data when needed - open and independent data standards are key here - 'Structured' seems a vague and old term – maybe better 'data recorded according to a clinical data model'

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 20: Standard clinical terminology used for the direct management of care where appropriate.</p> <p>Capability 21: Effective tools available to extract standard clinical terminology from natural language input.</p>	<p>Capability: Standard clinical terminology for the direct management of care</p> <p>Median: 2 ('Agree')</p> <p>IQR: 2</p> <p>Proportion 'Strongly agreed' or 'Agreed': 61.8%</p>	<ul style="list-style-type: none"> - use of standard clinical terminology is desired and technically possible but its implementation should be done with caution; there should be place for natural language and narrative input; research should determine how to best combine both; also local variations in terminology exist - there should be a computer aided system that helps to translate natural language input into the standard clinical terminology
<p>Capability 22: Ability to produce data for audits and other reports based on routine collection of complete, accurate and quality data.</p>	<p>Capability: Complete, accurate & timely production of mandatory national data collections/submissions</p> <p>Median: 2 ('Agree')</p> <p>IQR: 3</p> <p>Proportion 'Strongly agreed' or 'Agreed': 52.9%</p>	<ul style="list-style-type: none"> - this capability should be focused more on an ability to produce a dataset as such specific mandatory submissions are less important here - this should be based on a routine data capture and designed as a background process drawing on digital documentations and forms, not a separate exercise (as is often the case at the moment) - reporting is already happening, the focus should be on the quality and accuracy of data used to produce reports - it is important to reflect what data must be shared and why; how does it benefit patients? It might be that so much data is requested that the burden adversely affect the quality of care provided to individual patients

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 23: Effective mechanisms to review & improve quality of patient/clinical data.</p> <p>Capability 24: Effective mechanisms to collect and record complete, accurate and high quality patient/clinical data.</p>	<p>Capability: Effective mechanisms to review & improve quality of patient/clinical data</p> <p>Median: 2 ('Agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 70.6%</p>	<ul style="list-style-type: none"> - this is a very important capability, the absence of data and / or its poor quality can greatly harm the process of health transformations in digital organisations - this is potentially a challenge as it depends on the availability and good will of the health professionals involved - this should be associated with the use of standard clinical terminology - this is essential for growth and development
<p>Capability 25: Ability to receive communications from primary care and social care through a variety of media.</p> <p>Capability 26: Ability to send communications to primary care and social care through a variety of media.</p> <p>Capability 27: Ability to receive communications from patients and carers through a variety of media.</p> <p>Capability 28: Ability to send communications to patients and carers through a variety of media.</p>	<p>Capability: Ability to receive all communications from primary care electronically</p> <p>Median: 2 ('Agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 64.7%</p>	<ul style="list-style-type: none"> - it is not clear from this definition what counts as electronic (e.g., would Efax count or information received via emails in a fragmented way); true interfaced messages into records should be the standard - hospitals should allow non-electronic communication (e.g., phone calls) from primary care providers too - this should be not only about substituting pen and paper with digital solutions, but also about changing how work processes are organised, otherwise there might be no gains from the change - we should also think about ability to receive information from patients directly (as well as from primary care)

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 29: Cyber security strategy and continuity processes in place and implemented effectively.</p>	<p>Capability: Cyber security strategy</p> <p>Median: 1 ('Strongly agree') IQR: 1 Proportion 'Strongly agreed' or 'Agreed': 79.4%</p>	<ul style="list-style-type: none"> - not just strategy but also an effective implementation is important, this includes adequate training and staff awareness, timely software updates etc. - it is also important to reflect on who will be trusted to hold, store and mine patient data in the future - resilience - 24 x 7 x 365 with rapid disaster recovery e.g., off-site mirrored data
<p>Capability 30: Using digital systems to enable the seamless (through interfaces/integration) flow and use of information/data across organisational boundaries within a local health ecosystem.</p>	<p>Capability: Using digital systems to enable the seamless flow of information across organisational boundaries within a local health ecosystem</p> <p>Median: 1 ('Strongly agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 73.5%</p>	<ul style="list-style-type: none"> - we are not there yet, this can be achieved when a health care system matures - this a measure of a process more than a capability – it says something about how much a process is used and not the ability of a system - this definition does not specify what information and what does seamless mean - the rationale for sharing should be clearly justified - flow of information is usually not enough, clinicians should also be able to know at which stage of the process the patients is at

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 31: Supporting end-to-end redesign and improvement of clinical pathways based on digital tools and services.</p> <p>Capability 32: The ability to monitor outcome data for modifying clinical pathways based on digital tools and services.</p>	<p>Capability: Supporting end-to-end redesign and improvement of pathways through digital systems</p> <p>Median: 2 ('Agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 67.6%</p>	<ul style="list-style-type: none"> - It should be specified that it is about 'clinical pathways' rather than just 'pathways' - replace '...through digital systems' with '..based on digital tools and services' - The ability to monitor outcomes for modifying pathways is a key - New clinical pathways should be co-designed with clinicians and pathways
<p>Capability 33: Advanced analytics capability to support the move from reactive to proactive/predictive models of care.</p>	<p>Capability: Using advanced data analytics to move from reactive to proactive/predictive models of care</p> <p>Median: 2 ('Agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 70.6%</p>	<ul style="list-style-type: none"> - it might be better to start with some basic analytics (to understand the population in question, what is currently happening and the consequences of it), more advanced analytics and predictive models can develop in the future with advance in AI - data driven approach such as this one should be supervised by experts - this is a measure of a process – it is how much something is used, not about the ability of a system - this key from the population health perspective - predictive modelling can help with designing data-based systems of care, but less with providing care for individual patients

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 34: Data analysis at scale and use of insights to deliver targeted care for high-risk & high-use groups of patients (e.g. diabetes, COPD, asthma) across a population or area.</p>	<p>Capability: Advanced data analysis at scale to deliver targeted care for high-risk & high-use groups of patients (e.g. diabetes, COPD, asthma) across a population or area</p> <p>Median: 2 ('Agree') IQR: 1 Proportion 'Strongly agreed' or 'Agreed': 76.5%</p>	<ul style="list-style-type: none"> - simple analytics might be enough to improve the outcomes, the key is not the methodological sophistication of the analytics methods, it is the appropriate level of alarms and alerts, etc. - this is important from the population health perspective, but it is not a hospital target - might be difficult because much of the relevant data (e.g., what the patient wants, what are the barriers to receiving care) will not be available electronically
<p>Capability 35: Digital technologies (e.g. apps & digital therapies) to help patients manage long-term conditions more effectively and take greater control of their own care. (Wording unchanged from Round 1)</p>	<p>Capability: Digital technologies (e.g. apps & digital therapies) to help patients manage long-term conditions more effectively and take greater control of their own care</p> <p>Median: 2 ('Agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 64.7%</p>	<ul style="list-style-type: none"> - there is a lot of apps available but it is not clear if these are adopted used relatively and effectively; it is happening but it is still an immature field - is the procurement and development of these a task for primary or for secondary care? This is a move towards tele-medicine and virtual hospitals
<p>Capability 36: Using mobile technologies to support delivery of care outside traditional settings and closer to home.</p>	<p>Capability: Mobile technologies to support delivery of care outside traditional settings and closer to home</p> <p>Median: 2 ('Agree') IQR: 2 Proportion 'Strongly agreed' or 'Agreed': 58.8%</p>	<ul style="list-style-type: none"> - is the procurement and development of these a task for primary or for secondary care? This is a move towards tele-medicine and virtual hospitals - is it about these technologies being available or the extent to which they are used - the development of these technologies needs to be supported by evidence

Round 2: Proposed capabilities	Capabilities ¹⁵ and consensus indicators from Round 1	Summary of experts' comments from Round 1
<p>Capability 37: Flexible digital systems guiding clinicians along evidence-based, person specific, clinical pathways.</p>	<p>Capability: Digital systems guiding clinicians along defined clinical pathways</p> <p>Median: 2 ('Agree')</p> <p>IQR: 1</p> <p>Proportion 'Strongly agreed' or 'Agreed': 64.6%</p>	<ul style="list-style-type: none"> - the emphasis should be on guiding (i.e., not steer or override) and there must be ability to make exceptions; rigid pathways are not help for clinicians - it is still a long way away for the digital system to be a true assistant to the clinical work - data could inform the continuous refinement of pathways - it might be very difficult to maintain these systems as they require continual updates and the updates have to be programmed into the EHR which requires co-operation across specialities, if this doesn't happen the system becomes obsolete and clinicians no longer pay attention to it
<p>Capability 38: Functionality delivered at scale across a whole organisation, health ecosystem or provider chain. (Wording unchanged from Round 1)</p>	<p>Capability: Functionality delivered at scale across a whole organisation, health ecosystem or provider chain</p> <p>Median: 2 ('Agree')</p> <p>IQR: 4</p> <p>Proportion 'Strongly agreed' or 'Agreed': 55.9%</p>	<ul style="list-style-type: none"> - scalability is important, but choosing a unit to scale for most benefit can be tricky (e.g., clinical services, hospital, local health ecosystem?); different groups might have different needs - this can potentially reduce cost and improve quality of care

Appendix 2

Detailed qualitative results insights from the Delphi study are outlined below.

Overall, the data indicated that the concept of digital maturity is perceived as relevant to the healthcare sector, but perhaps a revised or refined conceptualisation is needed to capture the specific characteristic of healthcare organisation and the context within which these organisations operate.

One expert commented:

Although in essence it [the definition provided in the survey] is similar to what you would expect it to be in healthcare, it lacks the tone and language to make it so readily adaptable for the healthcare context.

Four key themes emerged in relation to discussion the concept of digital maturity in the context of health including: (i) 'Delivery of care and clinical excellence', (ii) 'Healthcare organisation and its wider environment', (iii) 'Role of non-technological factors' and (iv) 'One size fits all?'. These themes are further described below.

Delivery of care and clinical excellence

Several respondents flagged that the key goals of healthcare organisations revolved around delivering care (in terms of safety, quality and efficiency) and clinical excellence, rather than competing with other organisations:

This is weak on clinical benefits. Computerisation is a tool to improve clinical efficiency and clinical safety, not an aim.

Linked to this were a number of comments highlighting the potential difference between public and private healthcare and suggesting that the business-like approach and focus on competing as a key limitation of the current definition:

Agree with the omittance of "compete" which is not relevant for (public) healthcare.

Healthcare organisations and their wider environment

Most of the responses were focused upon how digitisation could improve speed and resilience of information exchange within a hospital environment. A minority drew attention to the wider health care context including other healthcare providers, social care, community and patients.

Digital maturity will allow healthcare professionals to get the patient's healthcare data on a role-environment basis (i.e. Physician, Nurse, Pharmacist, etc. at the Emergency room, ICU, general Ward, Operating room, Day care, Home care, etc.), whenever required, at the right moment, at the right place and by the right professional.

More patient centred approach to defining digital maturity was present in that context:

Information systems are too often aligned with organisational rather than patients' needs, and with organisational boundaries rather than supporting patients' journeys.

Role of non-technological factors

Notwithstanding the focus of digital maturity exercises on technical functionality required, responses emphasised a range of non-technical factors including organisational culture (being risk averse seen as a limitation to digital transformation, employees feeling supported and safe seen as a facilitator), workforce (high level of digital skills):

Building an appropriately trained workforce which is both IT and informatics literate is important. A safe and healthy organisational culture (free of bullying and harassment) is a central underpinning for leveraging the value that health IT systems present.

One size fits all or multiple pathways to excellence

Finally, respondents queried the current conceptualisation, which seeks a common definition of digital maturity that all health organisations should pursue as an end goal though they might be at different stage in that journey. Rather than proposing a single outcome towards which organisations should progressively align, alternative approaches might be more helpful that recognised different pathways to excellence. A solution appropriate for one organisation might not be appropriate for another organisation with a different technological and organisational history and context. Different organisations might follow different pathways, and define their maturity in different ways:

I agree what is within the scope, but I have a problem with the concept of maturity, given the continual change in systems referred to in the last sentence. Maturity is a categorical (yes/no) or at best ordinal measure. If ordinal it lacks an anchor - everywhere has some technology. So the definition will have to be fairly context and system specific (e.g., English acute hospitals).

Appendix 3

Characteristics of four international healthcare organisations that are commonly regarded as digitally excellent

	Demographics	Technological infrastructure	Organisational characteristics	Wider socio-economic environment	Outcomes
Kaiser Permanente Health System (USA) ^{17 18}	Provides care to 12.2 million people 217,173 employees 22,013 physicians 58,345 nurses 729 medical facilities	Initially aimed to build enterprise wide system with IBM Now using Epic across all eight regions	Each organisational entity has its own management and governance structure Some central degree of coordination Strong emphasis on preventive care Salaried doctors Shifting care to community	No uniform health system, no universal health care coverage HITECH Act promoting EHR adoption	More top-ranked health plans than any other care system in the US Specific areas of excellence: cholesterol and blood pressure management, childhood immunisation, preventive screenings, managing chronic conditions
Mayo Clinic Health system (USA) ¹⁹	Provides care for 1.3 million patients Has major campuses in Rochester, Scottsdale and Phoenix, and Jacksonville 4,729 physicians and scientists 58,405 administrative	Moved from Cerner and GE systems to implement Epic at all 90 hospitals and clinics	Focus on integrated clinical practice and data-driven research Strong emphasis on research and innovation (staff and patients routinely use Apple devices) Has an innovation centre and a well living lab	No uniform health system, no universal health care coverage HITECH Act promoting EHR adoption	Mayo clinic in Rochester ranked as number 1 overall hospital in the US ²⁰ Mayo Clinic Hospital — Rochester and Mayo Clinic Health System in Red Wing, Minnesota, ranked No. 1 in the 2017 Bernard A.

¹⁷ <https://atagance.kaiserpermanente.org/>

¹⁸ <https://m.kp.org/>

¹⁹ <https://www.mayoclinic.org/about-mayo-clinic/facts-statistics>

²⁰ <https://www.mayoclinic.org/about-mayo-clinic/quality/rankings>

	and allied health staff				Birnbaum, M.D., Quality Leadership Award
Karolinska University Hospital (Sweden) ^{21, 22, 23 24}	<p>One of the largest University Hospitals in Europe</p> <p>Affiliated with the Karolinska Institute, Sweden's single largest centre of medical academic research</p> <p>15,000 employees</p> <p>1,340 patient beds</p> <p>Based at two locations, recently built new hospital</p>	<p>Best-of-breed</p> <p>TrakCare EHR</p>	<p>Focus on patient care, research and education</p> <p>Centre for innovation focusing on novel technologies, medical breakthroughs, partnerships and developing tools to predict/monitor changes</p> <p>Focus on advanced analytics</p> <p>Strong focus of healthcare providers working collaboratively and the patient journey through the care system</p>	<p>Healthcare in Sweden is mainly organised by non-market principles</p> <p>Decentralised and funded by taxpayers</p>	<p>Karolinska is number two in the ranking for medical quality in Sweden</p> <p>Patient satisfaction is at 96.7%</p>
Hospital Clínic of Barcelona, Spain ^{25 26 27}	<p>Serves as a community hospital but also manages some primary care centres, mental health and social services</p>	<p>Best-of-breed</p> <p>Siemens Healthcare used to integrate its diagnostic, imaging and information</p>	<p>Strong emphasis continuity of care and the comprehensive provision of healthcare services</p>	<p>Activity-based contract with the Catalan public healthcare service insurer</p>	<p>Leader in oncology and pulmonology amongst all hospitals in Barcelona</p> <p>Ranks third in gynaecology</p>

²¹ <https://ki.se/en/about/startpage>

²² <https://www.karolinska.se/en/karolinska-university-hospital/about-karolinska/>

²³ <https://www.karolinska.se/en/karolinska-university-hospital/research-and-education/>

²⁴ <https://www.karolinska.se/en/karolinska-university-hospital/news/2018/09/ceo-melvin-samsom-has-taken-the-decision-to-leave-karolinska-university-hospital-during-spring-2019/>

²⁵ <https://www.hospitalclinic.org/en/clinic/about-us>

²⁶ <https://media.iese.edu/research/pdfs/ST-0383-E.pdf>

²⁷ http://ineed.es/en/pedia/article/best_hospitals-575818

	<p>Main public provider in Barcelona (540,000 inhabitants)</p> <p>4000 employees</p>	<p>technology systems</p>	<p>Long tradition of research and teaching, close links with university</p> <p>Strong focus on innovation</p> <p>Implementing new multidisciplinary units</p> <p>Strategy towards preventive, predictive, personalised and participative medicine</p>	<p>Free and universal coverage model in Spain</p>	<p>and rheumatology and second in dermatology in the country</p> <p>Institute of oncology and haematology is the best in the country</p>
--	--	---------------------------	---	---	--

Appendix 4

What is an international centre of digital excellence in healthcare?

Introduction

Healthcare systems internationally strive for excellence. Excellence is often expressed through health systems achieving the “triple aim”: better outcomes, better value and better experience.²⁸ Policy initiatives throughout the developed world have sought to speed up 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.^{29,30}

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 have not been demonstrated as yet.³¹ Similarly, the envisioned large-scale EHR adoption through centralised procurement of systems in the English National Programme for Information Technology (NPFIT) in 2002 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.³² 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.³³ There was further a lack of standards utilisation threatening the interoperability agenda, and a focus on IT deployment projects rather than wider service improvement strategies.³⁴

In 2016, the English government therefore commissioned the US physician Robert Wachter to lead an independent review of the state and future strategic direction of digital health strategy in England.³⁵ One of the key recommendations from this was to invest limited existing resources selectively to create a cohort of digital centres of excellence. As a consequence, NHS England's flagship Global Digital Exemplar (GDE) Programme was conceived in 2017 with £395 million national investment designed to support “selected digitally advanced mental health, acute Trusts, specialist Trusts and ambulance Trusts, who through funding and international partnership opportunities will become Exemplars over the next two to three and a half years”.³⁶ The underlying assumption was that digitally advanced sites would become international centres of excellence and create Blueprints of action and learning for later implementers. The idea of Blueprints was designed to help Fast Follower sites paired up with

²⁸ Berwick DM, Nolan TW, Whittington J. The triple aim: care, health, and cost. *Health affairs*. 2008 May;27(3):759-69.

²⁹ Blumenthal D. Launching hitech. *New England Journal of Medicine*. 2010 Feb 4;362(5):382-5.

³⁰ <https://conversation.digitalhealth.gov.au/framework-for-action>

³¹ 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.

³² 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.

³³ https://www.kingsfund.org.uk/sites/default/files/field/field_publication_file/A_digital_NHS_Kings_Fund_Sep_2016.pdf

³⁴ <https://www.digitalhealth.net/2016/02/hunt-announces-4-2-billion-for-nhs-it/>

³⁵ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/550866/Wachter_Review_Accessible.pdf

³⁶ <https://www.england.nhs.uk/digitaltechnology/connecteddigitalsystems/exemplars/>

GDEs to leapfrog and accelerate the spread of this learning nationally. A £200 million expansion of the GDE Programme was announced in late 2018.³⁷

Despite these significant monetary investments in national digitisation efforts, there is to date little consensus internationally around how digital excellence in healthcare can be conceptualised and measured. This poses several challenges for the process of digitisation in healthcare settings, including the desire to set clear targets for technology development and assess progress towards meeting these. This calls for a somewhat flexible framework that can provide support and strategic direction to ongoing processes of innovation and rapidly evolving technologies rather than pursuing a defined end-point that would quickly become outdated.

How can organisations and countries strive to achieve a moving end point that is not clearly mapped out? How can they assess where they are on the journey? And how can progress be measured considering the absence of an agreed baseline and destination?

We would like to offer some discussion on the concept and underlying assumptions of the pursuit of digital excellence in healthcare settings. This discussion is informed by our ongoing evaluation of the GDE Programme.³⁸ It will involve exploring existing definitions and their limitations, characteristics of existing sites that are externally regarded as exemplary, and existing ways to measure digital excellence in healthcare.

Definition of digital excellence in healthcare

One way of capturing what digital excellence in healthcare constitutes is through the concept of digital maturity. The concept of digital maturity (a term we use synonymously with digital excellence) emerged in the commercial world, where it has been defined as “about adapting the organisation to compete effectively in an increasingly digital environment. Maturity goes far beyond simply implementing new technology by aligning the company’s strategy, workforce, culture, technology, and structure to meet the digital expectations of customers, employees, and partners. Digital maturity is, therefore, a continuous and ongoing process of adaptation to a changing digital landscape.”³⁹

In healthcare, the concept is less well-defined.^{40 41} Although numerous internationally leading organisations are using advanced digital health systems in sophisticated ways, there is to date no agreed definition of how digital excellence can be conceptualised and what the envisaged future state of digitally mature healthcare organisations (or systems) needs to look like. Systematic reviews of definitions of high-performing health organisations/systems may currently be the closest to this goal as digital maturity is a means to achieve excellent care,⁴² but these lack a clear alignment of relationships between high performance domains and levels of digital maturity over time and in a dynamic digital environment.

³⁷ <https://www.digitalhealth.net/2018/08/nhs-england-planning-further-waves-of-global-digital-exemplars/>

³⁸ <https://www.ed.ac.uk/usher/digital-exemplars>

³⁹ <https://sloanreview.mit.edu/projects/achieving-digital-maturity/>

⁴⁰ Carvalho JV, Rocha Á, Abreu A. Maturity Models of Healthcare Information Systems and Technologies: a Literature Review. *J Med Syst.* 2016 Jun;40(6):131.

⁴¹ Carvalho JV, Rocha Á, Abreu A. Maturity Models of Healthcare Information Systems and Technologies: a Literature Review. *J Med Syst.* 2016 Jun;40(6):131.

⁴² Ahluwalia SC, Damberg CL, Silverman M, Motala A, Shekelle PG. What defines a high-performing health care delivery system: a systematic review. *The Joint Commission Journal on Quality and Patient Safety.* 2017 Sep 1;43(9):450-9.

The Healthcare Information and Management Systems Society (HIMSS)⁴³ industry consortium has developed a strategic roadmap for developing hospital Electronic Medical Records (EMR) capabilities through the HIMSS Analytics Electronic Medical Record Adoption Model (EMRAM).⁴⁴ This framework maps out eight stages in the adoption and utilisation of EMR functions leading towards HIMSS Level 7 – a sophisticated digitally mature EMR and still a relatively rare achievement worldwide.

Although HIMSS Level 7 is regularly updated and widely used, the framework is not without some limitations. These include its close focus on technological infrastructure and its concomitant lack of focus on organisational culture and capacity, novel emerging technologies, and integrated healthcare communities. The EMRAM model has historically been primarily US-focused and may not be appropriate to assess digital maturity internationally (although a European arm was set up to redress this).⁴⁵ Further its portrayal of change as proceeding through a series of stages/levels, is also not necessarily reflective of real-world organisational and social contexts and may motivate inappropriate developments. Thus, it may generate unwelcome incentives to introduce capability outwith national policy (e.g. to introduce unit dose dispensing in order to achieve closed loop medication administration in the UK). There may also be multiple pathways to excellence.

Other countries, driven by the need for quantitative evidence to demonstrate progress and justify investment, have therefore sought to develop their own frameworks. However, these often draw heavily on HIMSS and have not been empirically tested. For example, NHS England have adapted EMRAM to add dimensions of interoperability, readiness and infrastructure components to assess the digital capabilities adopted by GDE Trusts through a nationally calculated Digital Maturity Index.⁴⁶

Characteristics of digitally mature organisations

Existing international healthcare organisations that are widely viewed as digitally mature may help to shed light on the issue. Although contexts and technological systems differ, these organisations have a few common features. These go beyond the individual hospital and include various forms of cross-sectorial and cross-organisational collaboration facilitated by digital data. There is, for example, a strong emphasis on creating integrated healthcare communities through technology strategy linking primary, secondary, and social care settings through promoting digital data flow. The Hospital Clínic of Barcelona is tackling several integrated care services for chronic diseases through a regional shared EHR: early discharge, health promotion, community-based prevention of hospitalisation and diagnosis transfer to primary care.⁴⁷ Similarly, Kaiser Permanente and the Mayo Clinic have a long history of integrating care across hospitals and the community facilitated by their large integrated EHR system.⁴⁸

⁴⁹

⁴³ HIMSS – the Healthcare Information and Management Systems Society - is a global, cause-based, not-for-profit organization focused on better health through information and technology. HIMSS leads efforts to optimize health engagements and care outcomes using information technology. <https://www.himss.org/>

⁴⁴ Analytics HI. Electronic medical record adoption model (EMRAM). Health Information Management Systems Society. 2013.

⁴⁵ <https://www.himss.eu/>

⁴⁶ <https://www.nhs.uk/service-search/performance-indicators/organisations/digital-maturity>

⁴⁷ Hernández C, Aibar J, Seijas N, Puig I, Alonso A, Garcia-Aymerich J, Roca J. Implementation of Home Hospitalization and Early Discharge as an Integrated Care Service: A Ten Years Pragmatic Assessment. *International Journal of Integrated Care*. 2018 May 16;18.

⁴⁸ <https://www.kingsfund.org.uk/sites/default/files/Clinical-and-service-integration-Natasha-Curry-Chris-Ham-22-November-2010.pdf>

⁴⁹ <https://www.bizjournals.com/milwaukee/news/2017/07/14/mayo-clinic-begins-shift-to-1-5b-digital-records.html>

Organisations regarded as excellent further have an important emphasis on research and innovation and associated close links to local universities. This appears to promote exploring new ways to capitalise on existing digital health information infrastructures through novel uses of existing data, and through developing new tools to maximise the exploitation of technological investments. These efforts are characterised by close relationships between healthcare, academia and industry partners; and the establishment of innovation centres that focus on digital applications and data.^{50 51 52}

Implications for the notion of digital centres of excellence

The notion of digital excellence in healthcare needs to involve patients and go well beyond the physical constraints of the hospital setting. It should also be closely linked to novel exploitation of data assets guided by relevant local/national standards (including for example risk stratification, case-finding using data, screening, algorithms to inform real-time clinical decision making).

Although we acknowledge that this insight does not solve the immediate practical problem of measuring progress within individual care settings faced by policy makers and implementers, it does provide a degree of direction in relation to weighting of digital excellence indicators. For example, the collection/storing of data in structured standardised formats is a key pre-requisite for meaningfully sharing data e.g. between hospitals and primary care settings.⁵³ This capability needs to be an essential, as opposed to a desirable, requirement of any digitally advanced healthcare setting. This will help to ensure to appropriately focus the scope of what is measured so as not to end up conflating too many impacts and falsely attributing gains.

Conclusion

The notion of digital excellence serves an important purpose, providing a vision that can help coordinate activities towards the pursuit of the triple aim of health systems. Measuring digital excellence is however problematic, particularly in the context of large-scale policy initiatives such as the GDE Programme. Acknowledging the need to measure progress in such initiatives is likely to require recognition of the shortcomings of existing measurement tools and their pragmatic application. There is, for example, a need to place current transformation within a longer-term vision of architecture and service evolution that is open to scope for radical transformation, particularly given other policy initiatives that will inevitably overlap. The proliferating opportunities may call for weighting of criteria, whereby integration of care and exploitation of data assets need to take priority.

⁵⁰ <https://www.karolinska.se/en/karolinska-university-hospital/Innovation/nyheter/2016/04/shaping-healthcare-of-tomorrow/>

⁵¹ <https://garfieldcenter.kaiserpermanente.org/>

⁵² <http://centerforinnovation.mayo.edu/>

⁵³ <https://www.gov.uk/government/publications/the-future-of-healthcare-our-vision-for-digital-data-and-technology-in-health-and-care/the-future-of-healthcare-our-vision-for-digital-data-and-technology-in-health-and-care>