

Evidence & Policy

eHealth technologies and the know-do gap: exploring the role of knowledge mobilisation --Manuscript Draft--

Manuscript Number:	EVIDPOL-D-19-00069R2	
Full Title:	eHealth technologies and the know-do gap: exploring the role of knowledge mobilisation	
Article Type:	Practice Article	
Keywords:	ehealth; action research; knowledge mobilisation; NHS	
Corresponding Author:	Sheena Asthana, BA (Oxon) PhD University of Plymouth Plymouth, Devon UNITED KINGDOM	
First Author:	Sheena Asthana, BA (Oxon) PhD	
Order of Authors:	Sheena Asthana, BA (Oxon) PhD	
	Ray Jones	
	Rod Sheaff	
	Arunangsu Chatterjee	
Abstract:	<p>Background: eHealth technologies are widely believed to contribute to improving health and patients' experience of care and reducing health system costs. While many studies explore barriers to and facilitators of eHealth innovation, we lack understanding of how this knowledge can be translated into workable, practicable and properly resourced knowledge mobilisation strategies.</p> <p>Aims and objectives This paper describes the aims, methods and outputs of a large European Union funded project (eHealth Productivity and Innovation in Cornwall and the Isles of Scilly (EPIC)) to support the development of a sustainable innovation ecosystem in Cornwall and the Isles of Scilly, in order to explore how knowledge mobilisation activities can help bridge the know-do gap in eHealth.</p> <p>Conclusions: Preparatory knowledge-sharing, linkage-making and capacity building are necessary preliminaries to co-production with an emphasis on capturing the uses to which patients, carers and health workers want to put new technologies rather than promoting new technology for its own sake. Financial support can play a key role in supply-side dynamics, although the contextual and organisational barriers to eHealth innovation in England should not be underestimated.</p>	
Order of Authors Secondary Information:		
Funding Information:	European Regional Development Fund (05R16P00385)	Not applicable
Author Comments:	Thanks for accepting the paper. A final non-anonymised version has been uploaded. All the best	
	Sheena	
Response to Reviewers:	No need for response. Manuscript accepted	
Additional Information:		
Question	Response	
Key messages	KM strategies can address the 'know-do gap' in eHealth, particularly if action is taken to reach out to stakeholders, link and co-produce at the earliest stages of the design of innovations	
Please summarise the main messages from the paper in up to four bullet points.		
The contribution made by the paper to the field should be clear from these key	Knowledge mobilisation takes considerable time and resources to be effective. We describe the aims, actions & outcomes of a very well-funded project. Yet, its long-term	

messages. Each bullet point must be less than 100 characters.	legacy has yet to be established.
Conflicts of Interest Please declare any possible conflicts of interest, or state 'The Author(s) declare(s) that there is no conflict of interest' if there are none. Further information about conflicts of interest can be found in our Ethical Guidelines .	None

eHealth technologies and the know-do gap: exploring the role of knowledge mobilisation

Sheena Asthana¹

Rod Sheaff¹

Ray Jones¹

Arunangsu Chatterjee¹

¹University of Plymouth

Abstract

Background: eHealth technologies are widely believed to contribute to improving health and patients' experience of care and reducing health system costs. While many studies explore barriers to and facilitators of eHealth innovation, we lack understanding of how this knowledge can be translated into workable, practicable and properly resourced knowledge mobilisation strategies.

Aims and objectives This paper describes the aims, methods and outputs of a large European Union funded project (eHealth Productivity and Innovation in Cornwall and the Isles of Scilly (EPIC)) to support the development of a sustainable innovation ecosystem in Cornwall and the Isles of Scilly, in order to explore how knowledge mobilisation activities can help bridge the know-do gap in eHealth.

Conclusions: Preparatory knowledge-sharing, linkage-making and capacity building are necessary preliminaries to co-production with an emphasis on capturing the uses to which patients, carers and health workers want to put new technologies rather than promoting new technology for its own sake. Financial support can play a key role in supply-side dynamics, although the contextual and organisational barriers to eHealth innovation in England should not be underestimated.

Keywords: ehealth; action research; knowledge mobilisation; NHS

Word count: 4608 (without references); 6247 with references

Key messages:

KM strategies can address the ‘know-do gap’ in eHealth, particularly if action is taken to reach out to stakeholders, link and co-produce at the earliest stages of the design of innovations.

Knowledge mobilisation takes considerable time and resources to be effective. We describe the aims, actions & outcomes of a very well-funded project. Yet, its long-term legacy has yet to be established.

Introduction

Making healthcare delivery more responsive to an ageing population is a priority in most higher income countries experiencing late demographic and epidemiological transition. In the United Kingdom (UK), parliamentary and government reports have called for the National Health Service (NHS) to incorporate more health and medical technologies (Accelerated Access Review, 2016; DHSC, 2018; NHS England, 2019). Yet, ten years after Lord Darzi wrote that “(i)n this country, we have a proud record of invention, but we lag behind in systematic uptake even of our own inventions” (Darzi, 2008, p.55), the idea that the UK is great at generating innovations (‘know’) but poor at adopting them (‘do’) remains received wisdom.

Much literature now discusses factors influencing the adoption of technological innovation (e.g. Greenhalgh et al, 2004; van Gemert-Pijnen et al, 2011; van Dyk, 2014; Abbott et al, 2014; Greenhalgh et al, 2017; Lennon et al, 2017; May et al, 2018;). Yet, a significant ‘know-do’ gap remains between the articulation of these models and their translation into workable, practicable and properly resourced strategies (Davies et al, 2015). Traditional approaches to ‘knowledge translation’ (e.g. production of evidence-based guidelines, formal dissemination) are often problematic in eHealth, where the nature of ‘evidence’ is often uncertain (Black et al, 2011) and where complex, interacting domains shape what happens in practice (Greenhalgh and Wieringa, 2011; van Gemert-Pijnen et al, 2011; Greenhalgh, 2018).

Models of knowledge mobilisation (KM) have begun shifting from passive, linear and instrumental conceptions that see ‘knowledge’ as a transferable product to more relational approaches that involve linkage and exchange to connect researchers and decision-makers to the idea that knowledge is neither fixed nor privileged (Ward et al, 2009; Ferlie et al, 2012; Davies et al, 2015). Various practical strategies have been proposed to support such innovation (Ward, 2017). Some propose deploying dedicated researchers, professionals or managers as

“knowledge brokers” (Ward et al, 2009; 2012 Chew et al, 2013; Bornbaum et al, 2015), “boundary spanners” (Currie et al, 2007; Williams, 2012; Long et al, 2013) or “researchers in residence” (Marshall et al, 2014) to support knowledge management, linkage and exchange, capacity building and co-production (Vindrola-Padros et al, 2017). Others, focussing on engaging stakeholder networks such as “Communities of practice” (CoPs) (Wenger, 1998; Kislov et al, 2012), tend to involve networking within one profession or across professions around a particular clinical area. By contrast, multidisciplinary networks such as “innovation platforms” may comprise policy makers, researchers, health care professionals and service users and address problems that go beyond the scope of any one agency (Ferlie et al, 2017; Bailie et al, 2018).

The English NHS has long anticipated that technological innovation will help improve efficiency and productivity in a system facing severe financial pressures. Yet, there remains significant geographical variation in digital readiness, infrastructure, procurement competencies and local capacity for, and experience in, adopting eHealth projects. What role can knowledge mobilisation play in addressing the barriers to eHealth innovation and adoption? In this paper, we describe some of the aims, activities and achievements of the eHealth Productivity and Innovation in Cornwall and the Isles of Scilly (EPIC) project. Established with European Regional Development Fund support to assist development of ‘a thriving ecosystem’ in eHealth (Jones et al, 2019), EPIC has used a range of KM methods to support eHealth sector development in Cornwall and the Isles of Scilly (CIoS). What can we learn from this project about KM as a means of bridging the know-do gap in eHealth, including the barriers to using KM for that purpose?

The EPIC Project

Corresponding to the European Commission's Smart Specialisation Framework priorities, EPIC aims to stimulate both demand and supply of eHealth by helping health and social care professionals and patients identify their needs for eHealth innovations and work with local businesses to explore how digital technologies might address them; supporting the development of a Cornwall marketplace or platform for eHealth businesses, through knowledge creation, business support, access to wider stakeholder networks and financial support, mainly through a £600,000 'Challenge Fund' to invest in small and medium sized enterprises (SMEs); and develop translational skills, for example by incorporating eHealth skills into mainstream professional health and care courses.

This has involved a sizeable project team, including knowledge mobilisers working with the full range of stakeholders, a not-for-profit organisation that works with local digital and software industries, and researchers with technical expertise in robotics, apps, behaviour change and evaluation who work somewhere in-between. A senior representative from the Patients Association (an advocacy group) and a local management consultant with extensive knowledge of the people and networks in Cornwall were recruited to the KM Team. EPIC also established close partnerships with GP practices and care homes in order to become 'grounded' in the reality of the health and care 'coalface' and have geographical coverage across a diverse county.

Strategies of knowledge mobilisation for eHealth in EPIC

Given considerable uncertainty about how to address the know-do gap in technological innovation, EPIC has had to be reflexive, adaptive, pragmatic and participatory, combining action and research, reflection and action in an ongoing cycle of co-generative knowledge (Checkland and Holwell 1998; Greenwood, 2007 p.131). We therefore selected action research as our method because it combines the co-production and implementation of innovative

projects with reflection and research upon whether, why and under what conditions those practical activities worked as intended. Action research follows a ‘spiral of steps’ (Levin 1997, p.144) involving planning, action and evaluation of that action. In EPIC, the actions included range of KM strategies:

1. Sharing and disseminating *knowledge and awareness* of the project contexts and the facilitators and barriers to developing eHealth projects in them,
2. Building *linkages and exchange* among EPIC stakeholders,
3. *Capacity-building*
4. *Co-production*: agreeing and then co-implementing action plans for developing eHealth projects with co-participants.

Action research inherently involves practical tensions between formal research requirements (e.g. to collect data systematically, trace the logic of inquiry, establish the rigour by which the findings are extracted, show the systematic nature of the analysis) and simultaneously participating in the sometimes rather emergent, unscripted actions about which data are to be collected. We collected some data systematically, for example, from the recorded results of 33 Focus Group Discussions held with stakeholders; the formal monitoring of business engagement; monitoring of wider stakeholder engagement through the EPIC database and social media (e.g. Twitter); and analysis of fortnightly team meetings, in which research team members provide updates of recent activity. Further data were collected opportunistically by observation (recorded in fieldnotes) and from administrative data (e.g. minutes, e-mails, event programmes) as EPIC activities occurred.

Because it involves the actors self-evaluating their own interventions, action research inherently risks self-justificatory bias in reporting activities and outcomes. To minimise that risk, we triangulated data across different sources (see above), grouping and structuring the

data under the first four stages of our action research cycle, i.e. the KM activities listed above to order to link our KM activities with interim outcomes. We fed our findings back to other participants in the project for them to correct or comment on but also included ‘clean room’ data analysis by having the data co-analysed by (and this paper written by) team members not personally involved in the practical interventions).

Knowledge and awareness

We assumed that sharing and disseminating knowledge can play an important role in raising awareness among stakeholders who are not very familiar with eHealth. We therefore explored participants’ views about what challenges eHealth technologies might address. In its first two years, the EPIC project hosted three large conferences and six webinars, produced videos and social media releases and ran a series of technology showcases through both ‘drop-in’ roadshows (n=22) and more formal workshops (n=8 with 33 focus groups), in addition to demonstrations of companion and humanoid robots, virtual reality, smart home speakers and tablets with various software. These workshops involved 223 participants (108 health or social care professionals, 20 SME representatives, 34 service users, 24 students and 37 others). The researchers made field-notes of the focus group discussions. Each focus group voted (electronically) to prioritise the ‘challenges’ identified by participants. By undertaking a quasi-thematic analysis, we grouped the challenges grouped into categories. This pragmatic clustering of concepts indicated a list of relevant technologies, including those challenges that were of a scale that SMEs could address.

We found that people at the coalface of health and social care had plenty of good ideas about how technologies could improve their lives or those of their patients or relatives (corroborating Coulter and Mearns, 2016). Although, say, robots and autonomous systems were new to many participants, the latter quickly recognised the potential of such technologies. Stakeholders also

recognised the potential of eHealth technologies to address challenges across the journey of care from prevention and self-management to clinical, domiciliary and residential care, and recognised the need to improve mental well-being and access to mental health services. They were interested in technologies that addressed everyday problems, not technology for technology's sake. This is important as there is often a disconnect between those producing eHealth innovations and those who are expected to use them. That said, the ideas that stakeholders put forward in the workshops were pretty much those that we suggested in the demos and introductions.

Linkage and exchange

This element essentially involved building up a critical mass of connections: interpersonal connections are critical for creating the necessary trust in innovation (Liebe et al, 2016). Many of our meetings involved stakeholders on the 'demand' side so that health and social care professionals and patients could identify their needs and SMEs consider potential solutions. While we have identified and supported several examples of innovations being championed by local clinicians, wider roll-out requires opportunities for interactions between clinicians, commissioners and other health and care professionals, technology developers and patients as well as their respective networks (Cresswell et al, 2013; Lennon et al, 2017; Albury et al, 2018). In particular, we brought SMEs from the technology business sector together with users to collaborate on defining the problems and technological solutions. We organised round-table events around specific health and social care themes (such as Social Prescribing: GPs referring patients to informal providers of opportunities for physical activity, social contact and recreation). Increasingly the focus shifted towards the research assistants identifying opportunities for linking service user/provider needs with companies that might offer technological solutions. Facilitating these 'matches' was labour-intensive and required a wide-ranging skill set.

Two years into the project, the number of contacts on the EPIC database is still growing (600 at 1 year and 1000 at 2 years). The third project conference sold out its 150 places well before the event, resulting in a waiting list. We have never had to postpone or cancel a seminar or conference due to low uptake. We have 964 Twitter followers, and average 27.6k impressions per month. Over 1300 people subscribe to our newsletter. 32% of them are rated 'highly engaged'. EPIC continues to seek ways to expand its reach, e.g. through developing other channels such YouTube so that potential audiences can find EPIC via search engines, not just from EPIC linked materials or platforms.

Greater numbers of health and social care professionals are becoming involved in the eHealth ecosystem. For all the 41 Challenge Fund grants awarded (from the 62 applications received) we tried to make sure there was involvement from health and care professionals and patient groups. We have had some 30-40 health and care professionals in other groups developing additional feasibility applications. These include a consultant psychiatrist proposing an avatar-based decision support app for psychiatric illnesses, a behaviour therapist wanting to develop an app to support emotional coping skills for individuals affected by personal disorder, and a charity interested in developing a diagnostic app for monitoring and delivering support to individuals with mental health problems, all of whom EPIC has linked to SMEs.

For linkage with technology businesses, EPIC has held 10 focused webinars and 22 workshops as well as the roadshows, focus groups and conferences that involve cross-stakeholder participation. We have been in contact with 194 enterprises and 91 have registered on the project. We have invited expert speakers to talk about accessing NHS customers, the NHS Digital Roadmap and open standards like openEHR. Such events provide networking opportunities for these businesses and critical mass of businesses to share information, build partnerships and develop technological solutions together.

Engaging strategic players (e.g. those who commission services), will be key to sustaining eHealth innovation. Strategic involvement with Cornwall Council (a Unitary body responsible for part-funding social care) was successful from the outset, but it has been more difficult to engage senior NHS managers. Part of the challenge is knowing who the ‘right’ people were in a complex system and then coordinating inter-agency exchange at top management level. This process took several months. Nevertheless, these efforts culminated in a strategy day attended by around 40 national, regional and local NHS representatives, acute and mental health sectors, local government and several technological companies. The participants’ agreed action points included securing EPIC representation on a newly created ‘Digital Transformation Board’ to support wider networking; finding ways to make the way in to health and social care systems clearer to SMEs; moving away from emphasising cost saving towards emphasising service quality improvement; working with suppliers and Cornwall Council planning department to improve digital infrastructure; and upskilling of health and social care staff through collaborations with higher and further education. Participants agreed that EPIC should work with stakeholders around particular pathways (e.g. frailty or dementia) to demonstrate the potential of technology solutions. Finally, they announced that they would develop a Cornish ‘sand-box’ (test-bed) to allow developers to trial and evaluate their products within general practice.

Positives noted, it was nevertheless easier to expand EPIC’s own connections to stakeholders than to enable the latter to bridge and boundary-span between each other directly. Whilst EPIC had established a wide network of connections, connectivity between different clusters within it still required EPIC’s mediation. Maintaining such networks also requires ongoing effort in active network building and staging innovation workshops aimed at identifying topics around which local SMEs can host hackathons. Differential power relations (e.g. between senior

managers responsible for commissioning and those who produce technological innovations) remain a concern.

Capacity building

This activity involved providing business, technical and evaluation (e.g. usability) advice across all stages of the innovation process; developing CIOs as a test bed for new digital technology services/products); and, importantly, providing financial support for new products through EPIC's 'Challenge Fund', which made collaborative awards where health and social care stakeholders worked with the technology companies to design, produce and implement innovations relevant to users or the health and social care organisations' needs, whilst encouraging businesses to share information, build partnerships and develop technological solutions together.

An important capacity to build was the business 'community' knowledge of the vagaries of the eHealth market in the UK, which we did through the links between the SMEs and NHS organisations (see above). Other capacity building included work to encourage Further and Higher Education providers to include eHealth skills into their professional health and care courses; and to placements for students (e.g. of nursing and robotics) in health and care environments, and SMEs, using eHealth technologies. With the GP Consortium we developed and provided feasibility and evaluation advice in a test-bed or 'Sand-Box' where SMEs (both local and from wider afield) could discuss the technological feasibility of innovations with academics specialising in user-centred interaction design, test innovations for usability, and obtain evaluation advice and support to conduct small-scale pilots and full-scale effectiveness trials.

We found that many SMEs did not understand eHealth market conditions and dynamics, for instance what IT products and services are already available or the need to demonstrate

‘impact’ to a health and social care service that is highly concerned with achieving effectiveness and cost-effectiveness. Like Heitmueller et al. (2016) we found that the myriad of entry points at commissioner and provider organisation level is confusing to entrepreneurs and SMEs. Early meetings focused on where businesses might fit with in this market, who they might productively partner with, and whether there is a case for doing a feasibility study or evaluation (supported by EPIC), ideally with potential customers or users of their proposed product or service.

As SMEs start to assess whether there is an opportunity in the market for their proposed product or service, we move towards capacity building, partly through networking. For example linking SMEs with businesses that have brought products to market, with members of the EPIC team to learn about evidence on what works in behavioural change, and with providers, to better understand the pathways in delivering health and care services, the existing technology landscape and to facilitate processes of co-design. We have held workshops on a range of issues, from access to finance to product management.

Output measures suggest that EPIC has facilitated eHealth capacity building. EPIC has awarded 37 Challenge Funds totalling £480,000 with contracted match funding of £217,324. Five awards were to new enterprises. 23 business have received at least 12 hours of one-to-one support and a further 14 start-ups have been supported, including robotic spin-out companies. Through EPIC, 21 enterprises are engaging with a local University to explore ways of evaluating and marketing their products. The number of local eHealth companies has expanded (from one larger company and 14 eHealth SMEs in 2017 to 68 in 2018). EPIC has supported four of them to introduce products new to the firm, and three to introduced products new to the market.

Co-production

Authentic collaboration, partnership and engagement are considered prerequisites for co-production (Rycroft-Malone et al, 2016), indeed the most meaningful approach to KM, in part because they address power imbalances between the producers and users of knowledge (Cooke et al, 2017), for instance by listening to ideas from the grassroots, facilitating partnerships (see above) and working with organisations to move implementation outside its experimental niche (Farmer et al, 2018).

Our co-production activities recognised the wide range of eHealth knowledge ‘users’ (patients/families, health and care professionals, managers, policy makers, technology producers). The selection for each project varied. Thus, one example of co-production (developing an app to guide police decisions in helping people to access Places of Safety and Mental Health Act assessment) did not directly involve patients. Another (working with the ‘Breathers Group’ of patients experiencing Chronic Obstructive Pulmonary Disease (COPD)) directly harnessed patient preferences.

We found that real co-production takes time and sensitivity to different stakeholders’ needs. One such example has been our work with the ‘Breathers Group’ who had previously set up a support system and offered educational sessions at local schools. This group were initially sceptical about the use of technology. Over many months, this increasingly frail cohort embraced video-based technologies, engaged in a webinar with local school children and other interested stakeholders, and are presently exploring scope for further, digital educational activities framed around their personal histories, health risk factors and present health status. Another example is EPIC’s co-production with a new SME and care home residents, to explore options, develop and test companion robots (an adaptable casing is preferred).

One difficulty was the businesses' tendency to promote products that were already in development, rather than to responding to needs identified through (e.g.) EPIC workshops or engaging in co-creation; hence our shift towards proactive 'match-making'. While this has nurtured the development of co-produced innovations, only a few of them have yet (2019) reached the prototyping or pilot stages. The question of how to embed such linkages in the system also remains. Despite EPIC's extensive contacts with SMEs and its expanded outreach for business support, the SMEs we are working with remain more focused on their own business plans than on responding to bottom-up ideas. Demand side changes are required too. Too often, senior managers and health care professionals seem rather suspicious of SMEs' motives, preferring for example to hold on to (subsequently undeveloped) intellectual property rather than work in partnership with businesses. Resistance to technological innovation may reflect concerns that it will involve 'hidden work' (Greenhalgh et al, 2005) or undermine the quality of patient-professional interactions. Greenhalgh et al (2017) suggest that acceptance by professional staff may be the single most important determinant of whether a new technology-supported service succeeds or fails at a local level.

Discussion

Reflections on the challenges of knowledge mobilisation

Our experience corroborates that KM is less an exercise in expert knowledge transfer than a complex, iterative, social process (Bullock et al, 2016) that relies on developing productive relationships, shared learning and organisational capacity (Salter and Kothari, 2016). Part of the challenge of building up *linkage and exchange* around an innovation platform was the need to recognise and form connections in a health and social care system rich in clusters of activity, but unconnected clusters (Long et al, 2013). Another challenge was in forming linkages with stakeholders outside the health and social care system, such as technological developers. One

of EPIC's key roles was to bridge 'structural holes' between unconnected actors (Burt, 1992), to access and broker knowledge located in different communities, and to span boundaries that might normally act as barriers to KM, innovation and learning (Currie et al. 2007). As the project developed, we tested various approaches to doing this. We found that establishing online forums around common themes of interest achieved little engagement, necessitating a continued focus on interpersonal linkage. Creating 'matches' to link service users' and/or providers' needs with companies that might offer technological solutions was labour-intensive and required soft interpersonal skills in communication, flexibility, perseverance, coaching and NHS intelligence/experience (Gradinger et al, 2019). Different levels of linkage and engagement developed simultaneously, dynamically and interdependently, depending on the purpose of the links. Although this makes a neat categorisation of these activities somewhat challenging it nevertheless seems justified to extend Arnstein's (1969) 'ladder of participation' also to KM.

Capacity-Building (and co-production) grew as EPIC became more embedded. Strategic partners ostensibly supported EPIC but in practice, however, and facing considerable significant financial pressures (see below), they tended to remain somewhat risk averse. *Co-production*, in particular, requires significant time and resources. Even with EPIC's sizeable project team, it took several months to move from awareness raising and development of the project into activity aimed at the delivery of key strands. Achieving more creative co-production demanded active networking (see above); matchmaking stakeholders having clearly defined problems (among some groups, problem definition itself required several months of support) with those who may have the skills to develop solutions; and continuing to work with the matched partners to see their ideas worked through to implementation.

Barriers to innovation

Two years on, the EPIC project has some successes. However, the jury is still out as to its long-term legacy because various obstacles remain.

Some advocate a bottom-up change model for healthcare IT, freed from heavy-handed state control (Greenhalgh and Keen, 2013). However, we found that local commissioners were slow to procure new digital systems and technologies (including those needed to support local SME innovations). Recent developments, including a high-level secondment to lead on digital strategy suggest that bottom-up innovation might need to be balanced by national investment and clearer national guidance. The NHS's encouragement of 'let many flowers bloom', encouraging local diversity but still with mandatory interoperability, privacy and security standards has also contributed to confusing technology suppliers. Differential investment into digital ecosystems has, if anything, exacerbated the digital divide in the NHS. There are no 'global digital exemplars' (NHS providers using world-class digital technology and information to deliver exceptional care) in south-west England, hence no opportunity to receive the additional funding and international partnership opportunities that exemplar status attracts.

Our findings corroborate that national level expectations around regulation and accreditation also feel disproportionate to smaller companies (Greenhalgh et al, 2017; Lehoux et al, 2017; Lennon et al, 2017). Those responsible for planning and commissioning health care services for their local area are expected to inform their commissioning decisions with robust evidence of (e.g.) quality, safety and cost-effectiveness, which is also likely to increase professional uptake of eHealth innovations (Ross et al 2016). Despite a proliferation of eHealth technologies, few meet these evidential requirements. That probably says more about existing regulatory standards than the effectiveness of eHealth innovations themselves (Takian et al, 2012). Large pharmaceutical companies are adept at producing cost-effectiveness analyses for the technical appraisal and licencing of pharmaceutical products. Medical device producers

receive clear guidance about evidential requirements for NICE technological appraisals. By contrast, the eHealth sector is dominated by SMEs many of which lack the capacity to produce high quality observational or quasi-experimental studies demonstrating relevant outcomes, which NHS Digital and the most recent evidence standards framework for digital health technologies (NICE, 2019) now require. Our work with local SMEs found they have a real interest in evaluating their products for design, quality and marketing purposes, but NICE evidential requirements feel cumbersome and disproportionate. An increasingly important role for EPIC is co-designing robust but realistic evaluation frameworks.

Conclusions

From EPIC we learn several ways in which KM strategies can address the ‘know-do gap’ in eHealth. Because few of the innovations that EPIC supported had yet reached prototyping or pilot stage, this paper supplements existing studies (e.g. Abbott 2014, Cresswell et al. 2013, van Dyck, 2014, van Gemert-Pijnen et al. 2011) by indicating what KM strategies are relevant to the still earlier, indeed earliest, stages in eHealth innovation. Preparatory knowledge-sharing (cp. Chew et al. 2013), linkage-making (cp. Kislov et al. 2012, Ward et al. 2012) and capacity building (cp. DeCorby et al 2018) were necessary preliminaries to co-production (of which prototyping and piloting were only the last stages). To nuance Tritter and McCallum’s (2006) argument, what is relevant for initiating and developing eHealth projects are the uses to which patients, carers and health workers want to put new technologies, not just promoting new technology for its own sake. When developing linkages, it is therefore important to focus on specific, practically useful links between user (and/or carer) groups and those developing new eHealth technologies. EPIC required sustained efforts in knowledge sharing, one-to-one networking, building focused linkages and capacity building. These activities appeared to help mediate the different world views of stakeholder groups. Capacity building also required

financial support but did have a positive impact on supply-side dynamics. Co-production involves mutual adaptation between commissioners and service users (on one side) and eHealth technology suppliers (on the other) and more opportunities are required to span these boundaries. KM helps only a few SMEs grow into substantial businesses, but their impacts on the local health system are likely to be significant.

One negative finding is that the contextual and organisational barriers to eHealth innovation in England are considerable. The ‘outer setting’ (Ross et al. 2016) of current incentive and regulatory mechanisms ill-supports eHealth innovation. Parts of CIOs remain relatively digitally immature. Against this, there are signs that senior managers are now prioritising the need to invest in integrated data systems and moving away from a language that is always about cost saving and understanding that SMEs need clearer ways into the health and social care system.

Finally, different KM strategies do not have to be mutually exclusive or hierarchical. In light of our findings, we recommend using multiple approaches. Far from being ‘passive’ participation, the knowledge management events offered opportunities for public deliberation and networking. Thus, our experience suggests that action on lower rungs of the participation ladder can facilitate progression to higher levels. This suggests the need for a more pragmatic, reflective approach to KM; one that recognises that whilst there remain many barriers to eHealth innovation in England, universities, as key players in action-based research, can play a proactive role in this endeavour (Greenhalgh et al, 2018).

Funding

The eHealth Productivity and Innovation in Cornwall and the Isles of Scilly project (project reference 05R16P00385) was funded by the European Regional Development Fund (2017-2020).

Conflict of interest statement:

The Authors declare that there is no conflict of interest

Acknowledgements

Thanks to other members of the EPIC team who have contributed to the collective effort towards knowledge mobilisation, including Michael Paisey, Jay Amies, Katie Edwards, Deb Shenton, Inocencio Maramba, Daniela Austin, Gabriel Aguiar, Sebastian Stevens, Joanne Evans, Heather Eardley and Tracy North.

References

Abbott PA, Foster J, Marin HDF, Dykes PC. 2014. Complexity and the science of implementation in health IT--knowledge gaps and future visions. *Int J Med Inform.* 83(7):e12–22.

Accelerated Access Review. 2016. *Review of innovative medicines and medical technologies.*

Final

Report.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/565072/AAR_final.pdf

Arnstein, S. 1969. ‘A Ladder of Citizen Participation’. *Journal of the American Institute of Planners* 35 (4): 216–21.

Bailie J, Cunningham FC, Bainbridge RG et al. 2018. Comparing and contrasting “innovation platforms” with other forms of professional networks for strengthening primary healthcare systems for Indigenous Australians. *BMJ Global Health* 3(3)

Black AD, Car J, Pagliari C, et al. 2011. The impact of eHealth on the quality and safety of health care: a systematic overview. *PLoS Med.* 8(1):e1000387. doi: 10.1371/journal.pmed.1000387.

Bornbaum CC, Kornas K, Peirson L, Rosella RC. 2015. Exploring the function and effectiveness of knowledge brokers as facilitators of knowledge translation in health-related settings: a systematic review and thematic analysis. *Implementation Science* 10:162.

Bullock A, Barnes E, Morris ZS et al. 2016. Getting the most out of knowledge and innovation transfer agents in health care: a qualitative study. *Health Serv Deliv Res* 4(33).

Burt RS. 1992. *Structural holes: the social structure of competition*. Cambridge, Massachusetts: Harvard University Press.

Checkland, P and Holwell S. 1998. 'Action Research: Its Nature and Validity'. *Systemic Practice and Action Research* 11 (1): 9–21.

Chew S, Armstrong N, Martin G. 2013. Institutionalising knowledge brokering as a sustainable knowledge translation solution in healthcare: how can it work in practice? *Evidence & policy* 9(3): 335-351.

Cooke J, Langley J, Wolstenholme D, Hampshaw S. 2017. "Seeing" the Difference: The Importance of Visibility and Action as a Mark of "Authenticity" in Co-production Comment on "Collaboration and Co-production of Knowledge in Healthcare: Opportunities and Challenges". *Int J Health Policy Manag.* 6(6):345-348.

Coulter A, Mearns B. 2016. *Developing care for a changing population: Patient Engagement and health information technology*. London: the Nuffield Trust.

Cresswell KM, Bates DW, Sheikh A. 2013. Ten key considerations for the successful implementation and adoption of large-scale health information technology. *J Am Med Inform Assoc.* 20(e1):e9-e13. doi: 10.1136/amiajnl-2013-001684.

Currie G, Finn R, Martin G. 2007. Spanning boundaries in pursuit of effective knowledge sharing within networks in the NHS. *J Health Organ Manag.* 21(4-5):406-17.

Currie G, White L. 2012. Inter-professional barriers and knowledge brokering in an organizational context: the case of healthcare. *Organization Studies* 33(10): 1333e1361.

Darzi, A. 2008. *High Quality Care for All: NHS Next Stage Review Final Report*. London: Department of Health.

Davies HTO, Powell AE, Nutley SM. 2015. Mobilising knowledge to improve UK health care: learning from other countries and other sectors - a multimethod mapping study. *Health Services and Delivery Research*, 3(27).

DeCorby-Watson K, Mensah G, Bergeron K, Abdi S, Rempel B, Manson H. 2018. Effectiveness of capacity building interventions relevant to public health practice: a systematic review. *BMC Public Health*, 18:684

DHSC (2018). The future of healthcare: our vision for digital, data and technology in health and care. London: Department of Health and Social Care. <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>

Farmer J, Carlisle K, Dickson-Swift V et al. 2018. Applying social innovation theory to examine how community co-designed health services develop: using a case study approach and mixed methods. *BMC Health Serv Res*. 18: 68.

Ferlie E, Crilly T, Jashapara A, Peckham, A. 2012. Knowledge mobilisation in healthcare: A critical review of health sector and generic management literature. *Soc Sci Med* 74: 1297-1304.

Ferlie E, Nicolini D, Ledger J, D'Andreta D, Kravcenko D, de Pury J. (2017). NHS top managers, knowledge exchange and leadership: the early development of Academic Health Science Networks – a mixed methods study. *Health Serv Deliv Res* 5(17).

Gradinger F, Elson J, Asthana S, Martin S, Byng R. 2019. Reflections on the researcher-in-residence model co-producing knowledge for action in an Integrated Care Organisation: a

mixed methods case study using an impact survey and field notes. *Evidence and Policy* 15(2): 197-215.

Greenhalgh, T. (2018). How to improve success of technology projects in health and social care. *Public Health Res Pract.* 28(3).

Greenhalgh T, Fahy N, Shaw S. (2018). The Bright Elusive Butterfly of Value in Health Technology Development. Comment on “Providing Value to New Health Technology: The Early Contribution of Entrepreneurs, Investors, and Regulatory Agencies”. *Int J Health Policy Manag* 7(1), 81–85

Greenhalgh T, Keen J. (2013). England’s national programme for IT. *BMJ* 346:f4130

Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O, Peacock R. 2005. Storylines of research in diffusion of innovation: a meta-narrative approach to systematic review. *Soc Sci Med*; 61(2):417-30.

Greenhalgh T, Wherton J, Papoutsi C. et al. 2017. Beyond Adoption: A New Framework for Theorizing and Evaluating Nonadoption, Abandonment, and Challenges to the Scale-Up, Spread, and Sustainability of Health and Care Technologies. *J Med Internet Res.* 19(11):e367. doi: 10.2196/jmir.8775.

Greenhalgh T, Wherton J, Papoutsi C. et al. 2018. Analysing the role of complexity in explaining the fortunes of technology programmes: empirical application of the NASSS framework. *BMC Med.* 16(1):66. doi: 10.1186/s12916-018-1050-6.

Greenhalgh T. Robert G. Macfarlane F. Bate P. Kyriakidou O. 2004. Diffusion of Innovations in Service Organizations: Systematic Review and Recommendations. *Milbank Quarterly* 82:581–629.

Greenhalgh, T. Wieringa, S. 2011. Is it time to drop the 'knowledge translation' metaphor? A critical literature review. *Journal of the Royal Society of Medicine* 104: 501-509.

Greenwood, D. (2007). Pragmatic action research. *International Journal of Action Research*, 3:131–148

Haynes A, Rowbotham SJ, Redman S, Brennan S, Williamson A, Moore G. 2018. What can we learn from interventions that aim to increase policy-makers' capacity to use research? A realist scoping review. *Health Research Policy and Systems*, 16:31

Heitmueller A, Bull A, Oh S. 2016. Looking in the wrong places: why traditional solutions to the diffusion of innovation will not work. *BMJ Innov* 2016; 41–47

Jones R, Asthana S, Walmsley A, Sheaff R, Milligan J, Paisey M, Edwards K, Aguiar Noury G, Eardley H, North T, Wyatt C, Austin S, Maramba I, Shenton D, Young K, Andrade J, May J, Newman C, Evans J and Arunangsu C. 2019. *Developing the eHealth sector in Cornwall*. University of Plymouth, pp34.

Kislov R, Walshe K, Harvey G. 2012. Managing boundaries in primary care service improvement: A developmental approach to communities of practice. *Implementation Science* 7, 97.

Lennon MR, Bouamrane MM, Devlin AM et al. 2017. Readiness for Delivering Digital Health at Scale: Lessons from a Longitudinal Qualitative Evaluation of a National Digital Health Innovation Program in the United Kingdom. *J Med Internet Res*. 19(2):e42. doi: 10.2196/jmir.6900.

Levin, M. 2003. Action research and the research community. *Concepts and Transformation*, 8: 75–280.

Long JC, Cunningham FC, Braithwaite J. 2013. Bridges, brokers and boundary spanners in collaborative networks: a systematic review. *BMC Health Serv Res*. 13:158.

MacDonald, C. 2012. 'Understanding Participatory Action Research: A Qualitative Research Methodology Option'. *The Canadian Journal of Action Research* 13 (2): 34–50.

Maguire D, Evans H, Honeyman M, Omojomolo D. 2018. *Digital Change in Health and Social Care*. London: The King's Fund.

Marshall M, Pagel C, French C. et al. 2014. Moving improvement research closer to practice; the Researcher in Residence model. *BMJ Quality and Safety* 23(10):801-5

May CR, Cummings A, Girling M et al. 2018. Using Normalization Process Theory in feasibility studies and process evaluations of complex healthcare interventions: a systematic review. *Implement Sci.* 7;13(1):80.

NHS England (2019). *The NHS Long Term Plan*. London: NHS England.
<https://www.longtermplan.nhs.uk/publication/nhs-long-term-plan/>

NICE (2019). *Evidence standards Framework for digital Health technologies*. London: National Institute for Health and Care Excellence.
<https://www.nice.org.uk/Media/Default/About/what-we-do/our-programmes/evidence-standards-framework/digital-evidence-standards-framework.pdf>

Palmer VJ, Weavell W, Callander R, Piper D, Richard L, Maher L, Boyd H, Herrman H, Furler J, Gunn J, Iedema R, Robert G. (2018). The Participatory Zeitgeist: an explanatory theoretical model of change in an era of coproduction and codesign in healthcare improvement. *Med Humanit*, Jun 28. pii: medhum-2017-011398. doi: 10.1136/medhum-2017-011398. [Epub ahead of print]

Ross J, Stevenson F, Lau R, Murray E: Factors that influence the implementation of eHealth: a systematic review of systematic reviews (an update) 2016. *Implementation science* 11(1):146.

Rycroft-Malone J, Burton CR, Bucknall T, Graham ID, Hutchinson AM, Stacey D. 2016. Collaboration and co-production of knowledge in healthcare: opportunities and challenges. *Int J Health Policy Manag.* 5(4):221

Salter KL, Kothari A. 2016. Knowledge 'Translation' as social learning: negotiating the uptake of research-based knowledge in practice. *BMC Med Educ.* 16:76.

Takian A, Petrakaki D, Cornford T, Sheikh A, Barber N; National NHS Care Records Service Evaluation Team (2012). Building a house on shifting sand: methodological considerations when evaluating the implementation and adoption of national electronic health record systems. *BMC Health Serv Res.*12:105. doi: 10.1186/1472-6963-12-105.

Tritter JQ, McCallum A. 2006. The snakes and ladders of user involvement: moving beyond Arnstein. *Health Policy* 76:156-168.

van Dyk L. 2014. A review of telehealth service implementation frameworks. *Int J Environ Res Public Health* 11(2):1279–98. doi: 10.3390/ijerph110201279.

van Gemert-Pijnen JEWC, Nijland N, van Limburg M et al. 2011. A holistic framework to improve the uptake and impact of eHealth technologies. *J Med Internet Res.* 13(4):e111. doi: 10.2196/jmir.1672.

Vindrola-Padros C, Pape T, Utley M, Fulop NJ. 2016/ The role of embedded research in quality improvement: a narrative review. *BMJ Quality and Safety* 26(1):70-80

Ward V, House A, Hamer S. 2009. Knowledge Brokering: The missing link in the evidence to action chain? *Evid Policy.* 5(3): 267–279.

Ward V, Smith S, House A, Hamer S. 2012. Exploring knowledge exchange: A useful framework for practice and policy. *Soc Sci Med* 74:297-304

Ward, V. 2017. Why, whose, what and how? A framework for knowledge mobilisers. *Evidence & Policy*, 13(3): 477–97.

Waterman, H, Marshall, MN, Noble, J, Davies, H, Walshe, K., Sheaff, R and Elwyn G. 2007. 'The Role of Action Research in the Investigation and Diffusion of Innovations in Health Care: The PRIDE Project'. *Qualitative Health Research* 17 (3): 373–81.

Wenger E. 1998. *Communities of practice: learning, meaning and identity*. Cambridge: Cambridge University Press.

Williams P. 2012. *Collaboration in public policy and practice: Perspectives on boundary spanners*. Bristol: The Policy Press.