



NHS e-Labs: Engineering Digital Health Economies

[Link to publication record in Manchester Research Explorer](#)

Citation for published version (APA):

Buchan, I., Ainsworth, J., Thew, S., & Leeming, G. (2010). NHS e-Labs: Engineering Digital Health Economies. In *Proceedings of the Digital Economies Conference 2010*

Published in:

Proceedings of the Digital Economies Conference 2010

Citing this paper

Please note that where the full-text provided on Manchester Research Explorer is the Author Accepted Manuscript or Proof version this may differ from the final Published version. If citing, it is advised that you check and use the publisher's definitive version.

General rights

Copyright and moral rights for the publications made accessible in the Research Explorer are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

Takedown policy

If you believe that this document breaches copyright please refer to the University of Manchester's Takedown Procedures [<http://man.ac.uk/04Y6Bo>] or contact uml.scholarlycommunications@manchester.ac.uk providing relevant details, so we can investigate your claim.



NHS e-Labs: Engineering Digital Health Economies

Iain E. Buchan, John D. Ainsworth, Sarah Thew, Gary Leeming

School of Community Based Medicine, University of Manchester
Manchester M13 9PL, United Kingdom

Tel. +44 (0)161 275 5160

{iain.buchan, john.ainsworth, sarah.thew, gary.leeming}@manchester.ac.uk

1. INTRODUCTION

A health economy concerns the production of health by citizens and the distribution of healthcare by health professionals. In this paper we will address the digital economy challenge of citizens and professionals co-producing health and healthcare with greater flexibility and transparency than usual.

1.1 Targeting scarce healthcare resources

Reviews of most developed health economies internationally have concluded that current healthcare will become unaffordable unless more preventive and early care is developed. Health policy makers have been advised to take longer term views so that more emphasis can be placed on prevention. This is even more relevant in the current economic downturn, but perversely, cutting healthcare costs is likely to sacrifice longer term initiatives in favour of what are perceived as more 'immediate' needs. In reality, many lifestyle measures such as smoking, diet and physical activity, are as important as medication in slowing the progression of common chronic diseases. In addition, many diseases share common pathways of damage, but treatments focus on the organs damaged and the high technology care given towards the end of life. Most healthcare evidence is therefore specialist. There is a lack of realistically complex evidence on the needs of people with multiple diseases, cared for by different professionals in different settings – this is central to targeting resources to meet the healthcare needs of communities.

1.2 Localising evidence

The digital challenge for health economies is to empower citizens to co-produce health and healthcare with health professionals. An important part of this challenge is to make information about a population's health and the effects of healthcare accessible, so that decisions are fully informed. This evidence cannot be derived from literature alone. For example trials of new medicines exclude women of child-bearing age and people with multiple diseases or on other medication – often comprising the majority of patients eventually receiving the treatment 'in the wild'. Regarding prevention – Public Health interventions are seldom studied in trials. So healthcare involves many 'natural experiments'. We address the potential for digital innovation to harness collective insights into the health of populations and support decisions in timely, transparent and locally-relevant ways.

2. MOTIVATING USE CASES

2.1 Identifying and involving people at risk

The aim is to reduce cost and improve outcomes for people with common chronic diseases by avoiding emergency admissions to hospital or out-of-hours primary care treatment. The Informatics

challenge is to identify individuals at increased risk of 'unscheduled' care. The models available to predict risks do not apply equally to all populations and may be fed with data of different quality in different areas. So there is a need for local refinement of the modelling, which means the models must be accessible. Furthermore, new sources of data from mobile technologies and social media may improve risk prediction – there is a need to understand how to involve patients and carers fully.

2.2 Improving clinical quality

The aim is to increase the amount of clinical quality improvement activity driven by local professionals – who understand the services and are best placed to improve them. The Informatics challenge is to make it easier for health professionals to use the care record data to reveal the outcomes of their care. Part of the challenge is to deliver templates for clinical audit that reduce duplication of effort across teams. Another part is to share collective knowledge of what works and what doesn't in a timely way – potentially rewarding the sharing.

2.3 Mobilising research

The aim is to study the 'natural experiments' of healthcare using health record data – generating understanding about the common complexities to enable greater personalisation & localisation of care. The informatics challenge is to extract research-ready data from care records while protecting the privacy of individuals and involving the local community.

2.4 Simulating the impacts of policies

The aim is to enable local policy-makers to explore scenarios such as "what is the likely impact for the population's health of (dis)investing £x in smoking cessation vs. £x in statins over the next y years?" The Informatics challenge is to combine local data with generic information from multiple studies in realistically complex models. Again, transparency is key – open models can be taken apart, studied and improved by independent groups, and thus the uses can be defended.

2.5 Reducing healthcare intelligence costs

The aim is to create more healthcare intelligence from the same number of analysts – thereby reducing expenditure on external consultancy. The Informatics challenge is to enable large-scale finding, sharing and reusing of pieces of intelligence work across multiple healthcare localities. This involves sharing data, methods and expertise among a disparate community of practice. The UK NHS has rich common data sources but lacks a framework for sharing methods and expertise – so a dependency on external consultants is generated and organisational memory is limited.

3. RELATED WORK

Healthcare is not unique in needing to align data, methods and people to optimise collective insight and decision-making. E-Science has produced middleware for sharing computational and data resources for over a decade – with Grid deployments becoming successful not as universal architectures, as intended, but in vertical applications like the CERN Large Hadron Collider – and with workflow orchestration of Web Services becoming the predominant way of sharing information processes across sites and disciplines. The Open Archives Initiative developed a standard for aggregating Web-based resources through the Object Reuse and Exchange protocol (OAI ORE) [2] – this has been applied to finished pieces of work in the context of disseminating scientific knowledge, but the object paradigm applies equally to collaboration over work in progress. Various initiatives are exploring Virtual Research Environments, and we have previously described an architecture “e-Lab” applied to both scientific and healthcare intelligence collaborations [2]. At the same time the e-Commerce community, search engine providers and social media companies have developed tacit collaboration mechanisms – prompting users by relating their behaviour to that of other users.

4. NHS E-LABS

The Northwest e-Health (NWeH) project is developing “NHS e-Lab” software for “making sense of local healthcare”. NWeH is a partnership between the NHS and University of Manchester – recognising the need to share data, methods and expertise across the healthcare/academic boundary more efficiently, effectively and transparently. An e-Lab is an information system for bringing together people, data and analytical methods at the point of investigation or decision-making. It provides a secure environment for managing, exploring and analysing data from anonymised, integrated health records. The functional architecture of the e-Lab is shown in Figure 1. The e-Lab is secured through both software and operational governance procedures. Maintaining privacy and confidentiality of individuals whose anonymised medical records are stored in the e-Lab is paramount.

4.1 Work Objects and Method Objects

The central currency of the e-Lab is the Work Object, providing the capability to curate and share information, which in turn builds analytical capacity and organisational memory. Work Objects are collections of digital content assembled to support a specific work task or a series of work tasks. For example to provide a persistent record of an investigation, to publish to a community of interest a statistical method for reuse, or to group together training examples for a tutorial. A Method Object is a type of Work Object intended for large scale reuse as a template – e.g. a worked example of equity audit applied to coronary revascularisation – with could be repopulated with local data and re-run, or more extensively repurposed for an equity audit in another disease area. The technical characteristics of Work Objects are: repeatability; reuse; permanence; typing; and graceful degradation of understanding.

4.2 Social query and analysis

E-Lab users have profiles with which they can declare expertise in what they write, and imply expertise in their activities. The interface of the prototype system is illustrated in Figure 2. Actions such as publishing a Method Object or adding an interpretation of results to Work Object imply expertise. Users create a social network in which their expertise is visible. The visibility is

intended to lead to discussion over shared resources, in turn leading to common understanding, and eventually to collaboration. Sharing could be incentivised by allocating continuing professional development credits for e-Lab activities (which are audited for information governance purposes). ‘Amazon-like’ prompts such as “users who selected a dataset like yours also selected these other data items...” are being developed. The social and collaborative aspects of e-Lab are being studied in conjunction with a training programme for NHS analysts.

4.3 Federation and trust

An e-Lab can support collaboration within a defined community, but it may also enable sharing of resources and/or Work Objects between communities. We introduce the Resource Bus and the Work Object Bus as a means of federating e-Labs (Figure 3). If a community wishes to trust another community it can export a Work Object – this could be used by the receiving community as: a template for a particular intelligence task for which there is greater expertise in the sending community; or as a means of sharing data, in question-specific ways, across communities to increase the statistical power and generalizability of research. Any content item may be encrypted so that it is not visible without prior arrangement with the author or if the content item is indirectly referenced, the content provider may apply additional access control.

5. DISCUSSION

We outline the NHS e-Lab architecture and prototype above. The system is due to roll out to cover a patient population of around 2 million by the end of 2012. It supports a wide range of uses of healthcare record data for developing services and research. The central innovation is to harness social networks of health professionals sharing a currency of Work Objects for making sense of local healthcare. Pieces of work that are communicated in this way are likely to be easier to understand and reproduce than conventional healthcare intelligence. Additional incentives for sharing, such as continuing professional development credits, may be added. Mass participation of NHS employees in this way may lower the cost of producing the intelligence, and increase the buy-in required by staff to use the information to improve services. We see transparency as the most important underpinning principle for the system, and a basis for building trust with local communities over uses of their healthcare records. We suggest that at critical mass of trust and participation – such an environment constitutes the professional information hub of a *digital* health economy.

6. REFERENCES

- [1] Bowman, M., Debray, S. K., and Peterson, L. L. 1993. Reasoning about naming systems. *ACM Trans. Program. Lang. Syst.* 15, 5 (Nov. 1993), 795-825. DOI=<http://doi.acm.org/10.1145/161468.16147>.
- [2] Lagoze, C., VandeSompel, H., Johnston, P., Nelson, M., Sanderson, R., Warner, S.: Open Archives Initiative Object Reuse and Exchange (OAI-ORE). Technical report, Open Archives Initiative. Available at: <http://www.openarchives.org/ore/0.1/toc> (2007)
- [3] Ainsworth, J., I. Buchan, “e-Labs and Work Objects: Towards Digital Health Economies”, In *Proceedings of The First International ICST Conference on Communications Infrastructure, Systems and Applications in Europe (EuropeComm 2009)*, LNICTS, Springer, London, UK, August 2009.

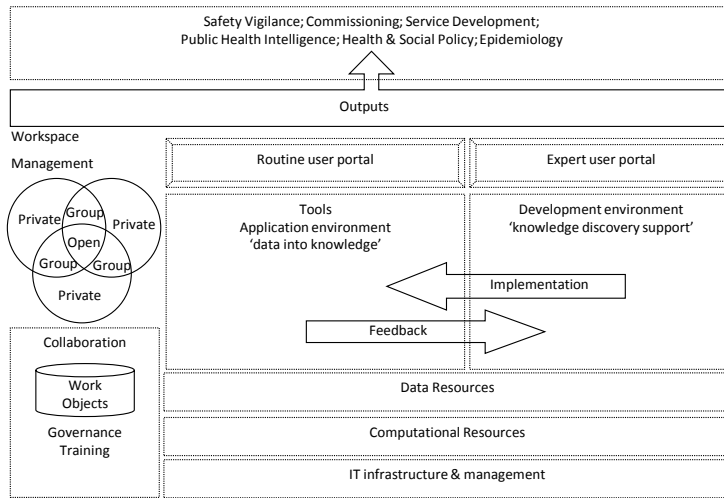


Figure 1: Functional Architecture of Northwest e-Health NHS e-Lab

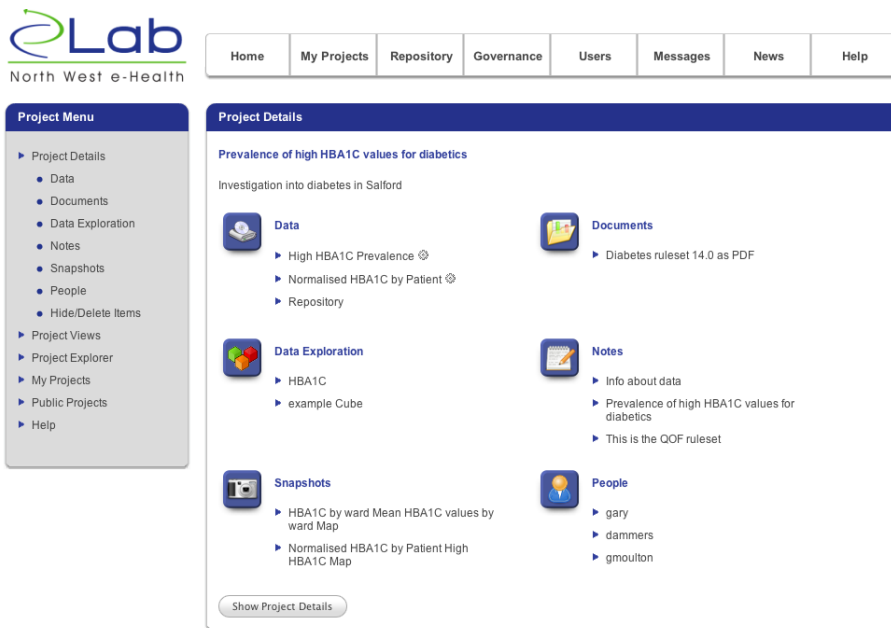


Figure 2: Interface of the Northwest e-Health NHS e-Lab prototype (R0.8)

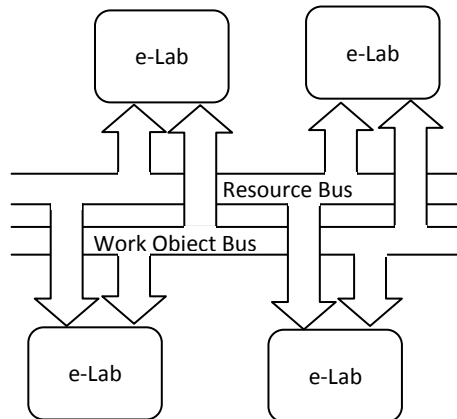


Figure 3: Buses for federating e-Labs