



Centre for Health Informatics Challenge Paper

Author: Professor John Chelsom

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Executive Summary

The NHS is just emerging from a decade of wasted opportunity in the development of clinical information systems, particularly Electronic Health Records.

The National Programme for IT was a centralised approach to information sharing that has failed on a number of levels. This has delayed the introduction of new systems, weakened the commercial supplier base and disheartened many IT professionals in the service. The NHS needs a fresh approach to clinical IT.

Some have called for the use of more open source software, and it is true that open source and open standards can go some way towards providing long term solutions for the NHS.

Putting good quality toolkits into the hands of developers at the grass roots of informatics in the NHS could help to harness the enthusiasm of local clinicians and developers, channelling their solutions towards interoperable, extensible systems built using open standards and open source.

But just introducing open source software risks repeating many of the mistakes that have dogged the National Programme - lack of involvement of practitioners, protection of the vested interests of product vendors, reliance on large-scale service providers and over-complicated solutions to immediate and very practical problems.

The concept of Open Health Informatics, outlined here, introduces two new dimensions to the open standards / open source landscape. Firstly, the use of open interfaces so that every component of a solution can be plugged in and out at will, enabling a 'best of breed' approach to open source and eliminating, once and for all, the product-centric culture that has held back the NHS.

Secondly, the use of open development processes - agile development that involves users and other stakeholders at every step of the way. Agile, open processes also eliminate the pretence that users know exactly what they want at the start of development, or that the solution provider knows exactly how to deliver it.

Whilst using open source and open standards can solve some of the problems in the delivery of information systems for the NHS; also using open interfaces and open development processes can ensure that the next generation of systems delivers the effective solutions that service users will demand.

Introduction

Over the last six years the National Programme for IT (NPfIT) in England has, quite rightly, attracted criticism from academics for its technical foundation^{[5] [6]} and more recently for its lack of vision, purpose and progress^[8] It's always easy to criticise, but not so easy to put forward constructive proposals for how to make things better.

At a time when the NHS is facing radical change^[1] and is seeking opinions on how to push back on the centralised approach to IT that has been adopted since 2003^{[2] [3]}, this Challenge Paper is designed as a proposal for a fresh approach to NHS IT. We welcome responses, or indeed counter-challenges, to its content.

Background

The NPfIT is not just a failing programme^{[9][10]}, it is the most obvious symptom of a decade of wasted opportunity for information technology in the NHS in England, which is also evident to a lesser extent in Scotland and Wales. Behind the headlines of programmes failing to deliver, lies a deeper malaise – a severely weakened commercial supplier base, stifled innovation and an informatics profession which has lost its zest^[4].

During a decade of unprecedented advances in information technology, that have transformed everyday lives and have had a major impact in most other industry sectors, the NHS has struggled to progress.

Encouraged by political initiatives on open source software at both national level in the UK^[19] and within the EU^[15] research started last year at the Centre for Health Informatics at City University London on a specialism of Medical Informatics^[18] dubbed as Open Health Informatics.

Informatics is the science of information, the practice of information processing, and the engineering of information systems^[17]; Health Informatics is the application of Informatics in healthcare.

Open Health Informatics combines four key elements which have the potential to bring a fresh approach to the way clinical information systems are delivered in the NHS:

- open source software
- open standards
- open systems interfaces
- open development processes

None of these elements is revolutionary in themselves, but perhaps the time has come for a change in our perceptions, motivation and commitment to their combined strength in Open Health Informatics.

Open standards and open source

The use of open standards^[22] and open source software^[14] has quite a long history in healthcare. And with recent political initiatives calling for more widespread adoption of open source technology^{[20][21]} the question has to be raised as to why the combination of open standards and open source hasn't been more effective in delivering healthcare systems in the past.

This can be explained, in part, by some common misconceptions that persist about the robustness of open source software, including: the myth that it's mainly programmed by hackers; the legal implications of its licensing models; and the degree to which open source implementations can be supported and maintained^[11].

Whilst all of these reservations may have had some substance five years ago, times have most certainly changed – the current landscape for open source software is now quite different. Much of the best open source software is now created and maintained by commercial organisations, whose business model is based around satisfaction of customer needs on an ongoing basis, rather than one-off sales of licenses for proprietary software products.

The 'copyleft' requirements of the original free software licensing models inhibited commercial development that built on existing open source software, since any modifications or enhancements had to be passed on for free use by all. Much of today's open source software is released under more flexible licenses that allow derivative works to be packaged for almost any purpose, including commercial gain^[23].

A new generation of commercial enterprises is emerging which will support and maintain open source software developed by third parties, safe in the knowledge that future use of the software can continue with or without the parties originally involved in the open source development.

Open standards have been cited as the magic bullet in delivering improved IT services to the NHS, including the early promises of 'ruthless standardisation' in NPfIT^[7].

However, the top-down imposition of standards can create as many problems as it solves^[42], and is open to exploitation by those focussed primarily on commercial gain, rather than the best IT solutions. Both Office Open^[41] (the Microsoft XML formats for MS Office) and PDF^[40] (Adobe's Portable Document Format) are now international standards, yet they meet few of the most common criteria for being 'open'^[22]. The Health Level 7 (HL7) standard is not entirely open^[43] and its adoption by NHS Connecting for Health has led to some of the chronic over-engineering of systems that has blighted the NPfIT.

The slow take-up of the open standards/open source combination is further explained by the lack of focus on the other two elements of Open Health Informatics – the use of open systems interfaces and open development processes.

Open systems interfaces

Too often, the use of open standards and open source has been used to further the commercial or ideological aims of the organisations delivering them. This precludes one of the great benefits of open standards/open source, which is to focus on the needs of the customer and the delivery of solutions to customer problems, rather than creating solutions that serve the best interests of a particular product vendor or open standards community.

This barrier can be broken by the use of open systems interfaces, the most recent incarnation of which has been systems developed using a 'Service Oriented Architecture'^[24].

Ideally, every representation of data in a system, and every system function, should be accessible through an open interface, so that any software that processes the data, or implements the functions, can be changed. Open standards should allow for the free interchange of data – this must include changing to use different, more effective standards as these become available, since locking standards inside systems, rather than exposing all data through open interfaces, also locks the system into the use of a particular set of standards.

Similarly, the use of monolithic open source 'products' that attempt to supply all of the functions required in a system can expose the customer to many of the same limitations associated with proprietary products, as the solution is focused on the capabilities of the product, not the specific requirements of the customer.

With this in mind, the best open source implementations should expose all functionality through open interfaces, so that any component of the software can be changed without impact on the rest of the system. This approach encourages the use of 'best of breed' open source software components, rather than single open source products.

So, whilst this does not preclude using the best components of well known open source health products such as OpenVista^[25], Tolven^[27] or OpenEMR^[28], it also opens the door to more general open source components such as the Mirth integration engine^[29], the Orbeon XForms platform^[30] and the eXist native XML database^[31].

Using interchangeable, best of breed open source components has two main benefits for healthcare systems. Firstly, it breaks, once and for all, the undue influence of a single technology supplier, be that a software product vendor, an open source development community or an open standards body. Secondly, it means that healthcare systems can use general open source software, not just open source designed specifically to meet healthcare requirements. The basic building blocks of functionality in healthcare systems are similar to those of any other system – data entry, data visualisation, workflow, ordering, scheduling, booking, reporting, etc. And most of the basic requirements for data storage, data exchange, security and access control are not unique to healthcare either.

As such, the ultimate goal in using open system interfaces is to allow the combination of open source software from multiple suppliers, with continuous objective evaluation of the best software to use for any particular function. The open source components can be designed for general application, or specifically for healthcare, and can be small components that implement just a few functions, or larger modules implementing a whole block of features.

Open development processes

The final piece of the Open Health Informatics jigsaw is the use of open development processes. Open source software is most usually constructed using an agile software development process^[32] with continuous builds, automated testing and open issue logs. There is nowhere to hide in such a development process – what you see is, quite literally, what you get and if you want something different you can either contribute through the existing development community, or do it yourself. Such an approach at least ensures that there can be no repeat of what must surely rank as the world's most spectacular purchase of 'vapourware', perpetrated on behalf of the British taxpayer in the NPfIT (almost seven years after NHS Connecting for Health heralded the end of vapourware^[44], the iSoft Lorenzo product which it purchased was still struggling to deliver its first operational systems^{[12][13]}).

But open development processes, as embodied by agile methodologies such as Scrum^[33] can deliver more than just software products. They can deliver solutions on time and within budget, through a true partnership between customer and supplier. The failure to achieve such a partnership is probably the single biggest failure of the NPfIT, and the root cause of many of its other problems. The stand-off between customer and supplier was baked into the original procurement process and the subsequent contracts – it became impossible for suppliers to meet their commercial objectives without hiding large parts of the development process (and its problems) from the NHS.

So how can agile methodologies deliver openness in the process of systems development and solution delivery? For a start, agile methodologies don't pretend from the outset that customers know what they want, and that suppliers know how deliver it. This may sound fairly fundamental, but current practice in public sector procurement encourages each side to commit to these pretences far too early in the overall development process. The NPfIT was a classic example of this, where the initial contracts committed the NHS to requirements that hadn't been investigated widely enough and suppliers to solutions for which they had neither the track record nor the know-how to deliver.

IT project managers often make reference to the Project Triangle^[34] combining the three variables of resources (equating to timescale and cost), scope and quality. It is commonly accepted that it's possible to fix any two of these, but almost impossible to

fix all three i.e. to deliver a system that works reliably, does everything originally required and costs what was originally budgeted.

With agile development, there is constant reappraisal of both the requirements and the scope of the solution, which allows the budget and quality to remain fixed – it's almost guaranteed that a working system can be delivered within the timescale and budget originally agreed, but it's just not possible to say at the outset exactly what the system will do! On first consideration this may sound a mistake, but, in fact, it addresses two of the most common causes of failure in IT systems development, namely the failure to accommodate change and to manage risk.

In an agile project, working software is delivered very early in the process. It is then reviewed by users, extended by developers and tested by quality assurance specialists on a repetitive basis (usually in one month cycles) until the end of the project. Progress is measured by the number of features completed to the satisfaction of users, not by ticking off tasks on a project plan. Customer and supplier share all of the same information about the project on a continuous basis: which features are on the backlog to be developed; which are currently being implemented; how quickly features are completed; whether the software builds successfully and can be run by a user; how many tests have been run (usually on a continuous, daily basis with the latest build of the software); and how many defects there are.

This process fosters a genuine understanding from all parties of the challenges faced in any software development project. It allows users to change their minds about what they need, and developers to learn new ways of meeting those needs.

Bottom-up development

The use of agile implementation processes, aided by open source toolkits that help users to define data sets, input forms, care pathways, customised reports and views, can also break the dependence of the NHS on external systems integrators.

There are many examples of locally developed, clinician-led systems which have successfully met local needs^[38]. What many of these systems have lacked is the means to transfer to other specialties or care providers, to integrate with other Trust systems or national services, and to be maintained as part of the mainstream IT infrastructure once the original developers have moved on.

The emergence of the NHS Interoperability Toolkit^[35] could help to bring such local systems into the mainstream, provided that it does not become another mechanism for promoting top-down, over engineered solutions developed primarily by technologist rather than end-users.

The future for open source/open standards in NHS IT may well lie in the use of open toolkits^{[36][37]} to implement systems using a user-led, bottom-up approach; the application of the four principles of Open Health Informatics can help make these systems affordable, repeatable and sustainable.

Conclusion

The application of Open Health Informatics can provide a fresh approach for information technology in the NHS, embracing not just open standards and open source software, but also addressing some of the systemic issues that have plagued the NPfIT, by using open system interfaces and open development practices.

The opportunity is emerging for open source software and practical open standards to play an important role in promoting a new bottom-up, clinician-led approach to systems implementation.

As the top-down influence of NPfIT starts to fade, the health informatics community in the UK should also take the opportunity to reassess the value of the HL7 standards in delivering effective, functional systems.

Putting good quality toolkits into the hands of developers at the grass roots of informatics in the NHS could help to harness the enthusiasm of local clinicians and developers, channelling their solutions towards interoperable, extensible systems built using open standards and open source. However, promotion of the wrong tools could also help perpetuate the top down imposition of unworkable solutions.

Ensuring that software is developed with truly open interfaces between components and key service (functionality), at every level of the architecture, can open the doors to the use of best of breed open source components - some healthcare specific, some more general - and thus shift the focus onto the development of the best solutions, rather than fitting solutions to the capabilities of products (whether proprietary or open source).

And using agile development processes will ensure that solutions are developed openly, iteratively and with the full involvement of all major stakeholders.

Using open source and open standards can solve some of the problems in the delivery of information systems for the NHS; also using open interfaces and open development processes can ensure that the next generation of systems delivers the effective solutions that service users will demand.

About the author

Professor John Chelsom leads the Open Health Informatics research programme at the Centre for Health Informatics, City University London, and is a founding partner of the consultancy firm Eleven Informatics LLP.

He was formerly the founder and Managing Director of CSW Group, a pioneer of web-based Electronic Health Records systems in the NHS and a key supplier in the early stages of the NPfIT and Informing Healthcare in Wales.

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