NIHR ePRESCRIBING RESEARCH PROGRAMME

INFRASTRUCTURE, INTERFACING AND INTEGRATION

Roundtable Discussion Report

Roundtable Discussion Report

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Executive Summary

The report is the outcome of a roundtable event on the infrastructure, interfacing and integration of ePrescribing systems in hospitals. Organised as part of the National Institute for Health Research funded programme of work on ePrescribing, the one-day event brought together clinicians, implementation teams, policy makers and suppliers who together explored key aspects of the roll-out and longer term optimisation of ePrescribing systems. The discussions from the day have provided critical insights into stakeholders' experiences, and have been used to outline the building blocks and main considerations relating to the infrastructure and interoperability of ePrescribing systems. Key findings summarised here are described in more detail throughout the report.

Summary of key findings

- Hard and soft infrastructures are needed to support the roll-out and longer term adoption of ePrescribing. A sound hard infrastructure requires suitable end-user devices, resilient networks and good connectivity, storage and backup servers, as well as continuous power supply.
- Soft infrastructures must provide appropriate training and support, project management and leadership, engagement, whilst ensuring accountability and risk management.
- While usability and end-user satisfaction were improved with specialist systems deployed in a single area of clinical practice, the interfacing of multiple systems within a hospital was found to present technical challenges in ensuring reliability, accuracy, consistency and sufficient flexibility in the exchange and retrieval of data.
- Integrated systems were seen as too monolithic in terms of their suitability across specialities, and could lead to inefficiencies and insufficient flexibility, especially at times of upgrades to a single part of an integrated system. Upgrades from one integrated system to another was seen as high risk and extremely demanding in terms of resource requirements.
- A blended approach, where bespoke systems could complement integrated systems may offer a better way forward.
- An appropriate policy and regulatory framework is needed to improve transparency in decision-making as well as collaboration between suppliers, such as through national standards for joining up systems.

1. Introduction

The report summarises findings from a roundtable discussion on the challenges in relation to infrastructure provision, interfacing and integration for the successful implementation of ePrescribing systems in National Health Service (NHS) hospitals. The day-long event, held on 23 September 2013 in Liverpool, UK, was organised as part of the National Institute for Health Research (NIHR) funded ePrescribing Research Programme[1], a mixed methods national evaluation of the implementation, adoption and effectiveness of ePrescribing systems in hospitals in England. The aim of the day was to bring together different perspectives on the barriers, challenges and lessons learnt in the adoption and use of ePrescribing systems in NHS hospitals, focusing in particular on

[1] See http://www.cphs.mvm.ed.ac.uk/projects/eprescribing/

infrastructure requirements for deployment and the benefits and limitations of interfacing and integrated systems. The roundtable discussion included participants from NHS Trusts at different stages in the planning, deployment and use of ePrescribing systems as well as suppliers. This report documents the main foci of discussion and key conclusions drawn during the event in order to provide a useful record and resource for providers needing to make major decisions in relation to hospital ePrescribing systems.

2. Methods

Twenty-two delegates external to the research team and one member of the ePrescribing research programme's Public and Patient Involvement (PPI) Group took part in the roundtable discussion. The external delegates included clinicians, hospital Information Technology (IT) managers and ePrescribing implementation team leads, representatives from supplier companies (i.e. Cerner, JAC and TPP), as well as policy and research specialists. The twenty-three participants were split into two groups for four topic-based breakout sessions which ran in parallel (see Appendix A). Each group was led by a moderator from the research team (Ms Ann Slee and Prof. Robin Williams) and sought to explore as a group:

- The "hard" and "soft" infrastructures that need to be in place to successfully deploy and use ePrescribing systems in acute care settings
- What differentiates interfacing systems (i.e. systems that allow information to be shared across multiple suppliers) from integration (also known as single vendor complex systems encompassing multiple applications)
- The main challenges in interfacing and integrated systems

Groups were brought back together to present a summary of their discussions to delegates in the other group, once at the end of the morning sessions and then again at the end of the afternoon sessions. All sessions were audio-recorded with the participants' consent and anonymised transcripts of the discussions were subsequently produced. The data were then coded and organised thematically in QSR NVivo 9 Qualitative Software to explore the key themes and areas of interest, which are reported and discussed below.

3. Summary of Discussions

3.1 Hard Infrastructures

Discussions began by considering the infrastructures that need to be in place. Infrastructures were defined as *"tangible things that need to be in place to support the implementation"* (Group 1) and "*taken-for granted"*, quasi-invisible elements that *"don't get noticed until they go wrong"* (Group 2). The initial focus was on 'hard infrastructures' – which were of four main types, reflecting how data are entered, retrieved and stored in ePrescribing systems. Table 1 below summarises these four categories of infrastructure and how they are typified by events and contexts of use. Associated considerations that span across all four categories of infrastructure are also noted.

Table 1 Categories of hard infrastructure, associated events and overarching framework

Category of Infrastructure	Associated Use, Events and Considerations	Overarching Framework
End-user devices and associated equipment (e.g. computers, tablets and printers)	- Mobility - Portability - Location: space constraints, accessibility	○ Safety – patient ○ Security – theft, damage/loss of equipment or data ○ Policy and standards ○ Costs
Network and connectivity	- Wireless coverage - Bandwidth use	
Servers	- Data storage and backup - Disaster recovery - Down time management	
Power supply	- Charging equipment - Battery life - Generators	

3.1.1 End-User Devices

End-user devices were seen as fundamental to the adoption of ePrescribing systems, yet knowing what equipment would be needed in practice was far from straightforward. One participant from a Trust where an ePrescribing system had been implemented described the methodology that they had employed to establish what devices were needed; despite careful planning, it was acknowledged that much of their learning had taken place along the way. Their approach followed a number of successive steps:

1. Learning from other sites that had implemented a similar system.
2. Establishing who the equipment was for and what the purpose of the device(s) would be (i.e. would the device be used solely for ePrescribing or would other healthcare systems and/or additional IT applications, such as email or web browsing be accessed via it too?).
3. Considering security risks (e.g. theft) and where devices would be stored when not in use.
4. Reviewing usability issues, such as screen size, which was considered especially relevant for high mobility devices.

As a result of this assessment, the Trust found that despite the convenience of highly mobile and portable devices, 'prescribing trollies' where a laptop was bolted onto a cart would offer the best solution in their site, as this could be used alongside new nursing trollies that could allow medicines to be securely stored and transported.

Participants agreed that understanding the needs of individual groups of end-users and the multiplicity of form factors or device types that may be needed in any given area were vital aspects of the planning and deployment, and needed careful consideration prior to the procurement of the equipment. This meant that different staff groups might require different devices, and that these may vary from ward to ward depending on the space available, network coverage or power supply.

It was recognised that involving end-users in the decision making process was key, and examples of strategies employed by Trusts to do this were provided, such as "Device Roadshows" where feedback could be obtained from end-users. The selection of equipment thus needed to be part of an open dialogue and collaborative process between end-users and implementation teams to find hardware that could meet both technical and clinical needs. One participant described some of the unrealistic expectations and inappropriate choices made by clinicians, opting for devices that may be popular consumer rather than clinical products:

"So the business change is really important because you do have to take the ideas on board of what they want - they won't use it if they don't like it but as I said you're quite limited on the equipment that's out there that would work as well because the handhelds, everyone wants an iPad and not everything runs on the iPad or they're not secure enough because people do go walkies with iPads as well, so those are kind of decisions you'll have to take into account as well." (Participant 5, Group 1)

Involving end-users in the choice of devices may be an effective way of engaging staff. However care must be taken in managing expectations and considering available resources otherwise the exercise may end up alienating staff who find they cannot get their preferred solution. Compromises may need to be made, as exemplified by this extract from one of the discussion groups:

Participant 4: *I mean we couldn't give them iPads and that was the main gripe.*

Participant 13: *Yeah, that's the trouble everybody wants something trendy don't they?*

Participant 4: *But I mean if you drop one of those, I know you can get cases for them but I personally don't think they're suitable for clinical areas.*

Participant 5: *I think they've accepted that now though.*

Participant 4: *Yeah and I mean they're not Windows so that again hinders you slightly.*

Participant 13: *I think it's probably more about how you get them on board. If they're a vocal group then we need to win them over somehow.*

Participant 4: *We use a motion C5[2] device which sort of looks like an etch a sketch, they're pretty robust. (…) we've had complaints but at the end of the day what we've done with the anaesthetists we had a device roadshow, we brought people in, we looked at all other devices and this was the device, albeit it may have had a small screen but looking at other factors considered this was the best suited device for the area.*

A delicate balancing act needed to be struck in the decision making process and compromises reached. Such compromises needed to remain aligned to budgetary constraints, local requirements, such as ensuring that sufficient numbers of devices could be procured and used, that the applications as either dedicated ePrescribing or multiple use devices[3] were well understood, that security and durability issues had been taken into account, and that they did not impinge on safety,

[2] Tablet computers specifically designed for clinical environments, see http://www.motioncomputing.com/us/products/rugged-tablets/c5te

[3] It is worth pointing out that multiple use devices may include non-clinical systems. One Trust explained how use of the patient bedside TVs were being explored as way to provide a good screen size to clinicians at every patient's bedside.

whether this was because of screen size, infection control, or loss of data. Indeed, selecting the wrong kind of device would have meant that some of the safety benefits of ePrescribing over paper may not be realised. For instance, it was pointed out by one participant that wards where insufficient or unsuitable devices were provided often led to 'retrospective prescribing', whereby prescribing did not occur at the time of the staff-patient interaction, missing out on the benefits of decision-support in prescribing and potentially leading to errors. Although this case may reflect a failure to agree changes in working practices needed for effective utilisation of ePrescribing, it demonstrated also how a poorly designed or selected device would do little to help manage change.

3.1.2 Network and Connectivity

The loss of connectivity exemplified how hard infrastructures may become particularly visible when not working properly. One participant explained how once they had decided on the type of devices that were to be used they carried out an extensive survey of the wireless coverage, which led to upgrading every ward's wireless access:

"If you're going to run a system wirelessly and treat patients by their bedside with the mobile carts, it's imperative that this needs to be stringently checked beforehand. We've done surveys six weeks before in all the areas to make sure that everything was spot on because at the end of the day we don't want to hinder the clinicians doing their job." (Participant 4, Group 1)

The mechanism by which a survey could be carried out was described as relatively straightforward and involved an engineer walking around the wards to identify any 'black-spots'. However, connectivity was explained to be dependent on usage demand and bandwidth requirements from ePrescribing and other systems. This means that coverage during a testing phase does not necessarily ensure good connectivity when the system is being used in a real-life situation. This was for one Trust "one of the lessons learnt", as roll-out had to be halted until funds could be found to upgrade the entire wireless network. Ensuring good connectivity is essential to maintain staff engagement too, as a poorly functioning system had led in one hospital to frustration and resentment from end-users.

3.1.3 Servers

Server type and backup plans were also discussed in relation to connectivity and importantly too for disaster recovery in the event of the system going down temporarily, whether as part of planned or unplanned downtime. A key distinction was made between box servers and cloud servers, the first occupying a physical space, the other being a virtual server. Participants on the whole agreed that risks were lower with virtual servers as these could be located off-site, had less downtime, offered greater flexibility for upgrades, increased storage capacity, and were more cost effective. One of the suppliers present explained that servers can also be managed off-site by the supplier company. Some participants questioned the cost-effectiveness of this type of service however, and also explained how this could lead to tensions if a third party had control of the data.

Backup plans needed to be carefully considered too, and acceptable disaster recovery plans endorsed by all parties affected are required. This needs to take place as part of a close consultation

between the IT team and clinicians to assess the physical dangers to the server and the impact of any backup strategy which could lead to data loss, and/or temporary inaccessibility, in order to establish the frequency of backups and acceptable levels of data loss.

3.1.4 Power Supply

The supply of power to support use of the system is perhaps one of the most taken for granted hard infrastructures, yet it remains essential to plan for continuous power availability. As most devices were mobile, ensuring good battery life and easy ways to recharge devices were critical, as were sufficient and appropriately positioned sockets and generators in the event of power failures. Training had itself become part of this infrastructure, as it was explained that failing to recharge devices could lead to end-users being locked out of the system. However, it was also explained that even when plans had been made to deal with a power failure, these did not always go far enough: one participant recalled a major incident, soon after their go-live, during a big power failure outside the hospital when even the generators failed to start.

3.2 Soft Infrastructures

Soft infrastructures were defined by the moderators leading the sessions as sitting "around the hardware", and included "people" or "processes" that support the hard infrastructures. The discussions that followed revolved around four key areas: training and support; project management; engagement; and risk management/accountability.

3.2.1 Training and Support

Training was seen as a fundamental part of an ePrescribing implementation, and which, if delivered correctly, would provide significant returns in the long run, since participants did feel that the more time and resources were put into training, the easier it would be when going live with the system. A number of key issues were noted in relation to training and support:

Content and Delivery

Participants stressed the importance of providing training sessions that were tailored and delivered separately to individual professional groups. However experience had shown this is not always possible. It was reported how being unable to segregate training sessions in this way, made it "really hard to deliver a teaching session" as information was not relevant to all those taking part in any one training session. Trainers too needed to reflect the variety of disciplines, as this helped reinforce the credibility of the system, and the training that was being offered. In some instances, it had been possible to arrange one-to-one training to address individual needs, and it was remarked how it was essential to ensure a mechanism was in place to identify and follow-up staff requiring additional training. It was also explained that training is not simply about learning about the interface of the system, but also about how processes associated with the introduction of the system are altered too. This led to further examples of the limitations of most training provided, which were not, for example, geared to addressing skills deficiencies in literacy and numeracy which only came to the

surface when some staff struggled to utilise ePrescribing systems that called for new ways of calculating dosage. At the same time, it was made clear that strategies needed to be developed to maximise attendance at training sessions and to ensure that only trained staff could access the system, for instance by only activating passwords after completion of the training. More flexible approaches to training may be needed, yet it was pointed out these had received a mixed response. For instance eLearning-based training provided at one hospital had been relatively successful with doctors, but was found to be unsatisfactory for nursing staff.

New Staff, Locums and Bank Staff

While occasionally staff arrive from a hospital where they received ePrescribing training, planning for the training needs of new or temporary staff who do not have this experience has been, as one participant put it "a long running saga". Two aspects were identified as making the training of these groups of staff especially difficult: (1) timing – when to deliver training and find sufficient time, especially if these were short term / temporary posts; and (2) cost - financial responsibility for this type of training was not clearly defined, and/or costs associated with the training were not accounted for. While untrained staff were not allowed to use the system at any of the participants' hospitals, it emerged that training had in some cases been condensed to sessions as short as 10 minutes' duration, from modules designed to take 90 minutes. This situation had arisen as a result of pressure put on by the Trust's Human Resources (HR) team, or because of competing training requirements, whereby new recruits had to receive inductions and training in a number of other areas before being allowed to work.

24/7 Support

After go-live, "hand-holding" was seen as an important part of training and the continued support offered to end-users. Examples of good practice in this area included a helpdesk acting as the main point of contact, from where requests were directed to either the IT team or an on-call ePrescribing pharmacist, depending on the nature of the issue. The queries and requests were logged to help both address and rectify specific issues within the system and its infrastructure, and importantly also to feedback into the training scripts and training modules, so end-users received better training and the need for support could be reduced.

3.2.2 Project Management: Leadership and Team Structures

As an ePrescribing implementation was frequently referred to as a "journey", it was pointed out that even two years into a deployment, there was usually little sign of 'the journey' ending soon. This was due, according to the experience of one Trust, to the need for constant upgrades to ensure the system functioned appropriately as well as changes in Health Service/Trust practices or policies. This had resulted in "project" teams remaining in place indefinitely, even though it had been expected initially that teams would be dissolved fairly soon after implementation. Participants noted how this made retention of key members of the project team critical, because of the local knowledge and the ePrescribing expertise they had gained during the course of the project. At the same time it was felt that team structures needed to change and evolve to reflect the different stages of an

implementation. A longer term deployment strategy which takes into account the continued need for upgrades was therefore a key aspect of the soft infrastructures.

The role and structure of the teams that led and shaped the project were discussed in some detail. Valuable lessons had been learnt at one of the sites, where a number of teams were involved in the project at various levels, each having a different remit:

- Level 1 - Executive Team authorising IT or financial aspects of the project.
- Level 2 - Project Team working in close collaboration with the Operational Team, which included pharmacists, doctors and nurses, responsible for the system build.
- Level 3 - Training Team, responsible for the training scripts and delivering the training, and associated Support Team operating post go-live.

A dedicated ePrescribing team supported by adequate resources to employ individuals full-time to carry forward the project was seen as an absolute requirement. The size of these teams were seen to vary according to the size of the Trust where the system was being deployed and to the implementation timelines that were being anticipated, as faster roll-outs required bigger teams and therefore increased allocation of resources. While participants agreed that faster roll-outs were preferable, their feasibility was reduced by the higher cost they incurred.

3.2.3 Engagement

Engagement of end-users and decision-makers was seen as essential for training, adoption and to ensure that the system was, where necessary, modified to meet requirements for longer term use. While some of this work took place as part of the decision-making and deployment team roles, it was pointed out that three areas would require special attention:

1. Managing the image of the project: this was needed to ensure that the project was not seen as either pharmacy or IT-led, but as a Trust-wide project.
2. Good communication and complaints handling: to deal with the three different phases of engagement in an implementation, which were explained as - stage one (pre-implementation) when awareness and engagement is low, especially at executive level, stage 2 when the roll-out has started, and stage 3 when "*everyone is complaining...*" .
3. Executive level engagement: this was seen as a "powerful tool" or entity that could escalate issues to the supplier.

It was suggested that having a person in place who could handle this aspect of the project would be ideal, yet might be unrealistic for many, given the additional financial resources required to allow this to happen. It is worth noting however, that a number of steps in the planning of the implementation became themselves integral to the engagement work, and that although special efforts needed to be put into it, engagement was also inevitable. For instance, process mapping often led to lengthy discussions with individual clinical teams which in itself raised awareness and knowledge of the implementation work.

3.2.4 Accountability and Risk Management

There was uncertainty as to who should be ultimately responsible for an ePrescribing deployment project and therefore who should be held accountable. Certain individuals within hospitals were formally given titles that reflected their involvement in the project, for instance "*Lead for electronic Prescribing"* within a certain discipline. This seemed nonetheless to denote their task to champion the project rather than be held accountable. It was suggested that a changing leadership model within the NHS with the appointment of Chief Clinical Information Officers (CCIOs) may help clarify the boundaries of responsibility and accountability. There were concerns that such individuals may lack in-depth understanding in specialised areas which would be especially important in relation to risk management. However, mechanisms such as safety audits, incident reports and prescribing data analyses operating within a set of national safety standards to which Trusts must comply, would ensure risks were appropriately managed, since current guidelines stipulated that clinical safety officers must be in place.

3.3 Interfacing and Integration

3.3.1 Definitions

Interfacing was defined at the start of the day as a method of communication using a standard language that allows different information systems from different vendors to share information, in contrast to integration seen as the seamless interaction of various applications from a single vendor that forms a larger and more complex system[4]. The choice between integrated systems and configurable systems revealed a number of associated costs and benefits (summarised in Table 2). However it emerged how rather than competing against one another, these strategies could usefully be brought together.

Multiple definitions of interfacing and integrated systems were offered by participants themselves, which broadly reflected two perspectives – the end-user interface and the technical system design. Integrated systems were initially seen as centralised and all-encompassing systems which distinguished them from interfacing systems:

"Integration is just pretty much to me all in one (…), within the integrated system everything should automatically do everything." (Participant 5, Group 1)

"… integrated has a central repository and interfaced where they need to interoperate is more kind of different siloed repositories." (Participant 6, Group 1)

[4] Based on the definition provided in McManus, R, Nemec, E, Ferer, D. Suggested definitions for informatics terms: Interfacing, integration, and interoperability. Am J Health-Syst Pharm. 2012; 69:1163-5

For some, this definition therefore included portals in which "best of breed" systems could be seen as integrated:

"…our organisation is going down the integrated route with open source clinical portal and best-of-breed." (Participant 1, Group 2)

Many disagreed however that a portal could be seen as an integrated system since it was simply a way of presenting data, rather than a system in which data were moved seamlessly and automatically between applications.

3.3.2 Challenges in Interfacing and Integration

The tension surrounding the most appropriate definition for interfacing and integration led participants to discuss the technical challenges of interoperability in interfacing systems, which were seen as significant. There were in their view, a number of problems in ensuring reliability, accuracy, consistency and sufficient flexibility in the exchange and retrieval of data, in which the quality of the link between systems therefore became primordial:

"Interoperability is only ever going to be as good as the link between the two systems and how sort of inclusive of information that link is really." (Participant 12, Group 1)

"My understanding of the issues for interfacing are the number of links and data flows that you're going to have to manage" (Participant 1, Group 2)

"… what information do you pass between the two systems, where's it saved, how does it get updated across the two? What if it's deleted in the first system, does it get deleted in the second system?" (Participant 11, Group 1)

"How's it presented in the back end, how's it pulled out?" (Participant 4, Group 1)

Technical issues were seen as one aspect of the challenges of interfacing as the lack of uniformity and multiple logins impacted negatively on the overall usability of systems and end-users' experience. Importantly too, the deployment of multiple systems required strong leadership and sound management to ensure that systems remained aligned to the hospital's overall IT deployment strategy.

The integration route was for its part seen as too monolithic in terms of its suitability across areas of clinical practice, which led to inefficiencies and insufficient flexibility, especially at times of upgrades to a single part of an integrated system:

"… we bought an integrated system, we've signed a five year contract and at the end of that we're almost certainly going to go with something else therefore EPMA [Electronic Prescribing and Medicines Administration] is going to have to be replaced in five years with everything else and so, well there are good and bad things with that aren't there? Perhaps one of the advantages about interoperability is that if you can get the systems interfacing OK then at least you can stick with a decent system, you can go with one that's arguably fit for purpose from the beginning." (Participant 1, Group 1)

It was also reported that rolling out an integrated system and switching from one integrated system to another was extremely laborious and entailed a high level of risk:

"…the change from one system to another is an enormous task." (Participant 13, Group 1)

"… you've got data migration issues and so there's lots and lots of challenges that go with having an integrated system." (Participant 1, Group 1)

Despite providing a seamless interoperability of multiple applications, integrated systems were seen as too deficient in their functionalities. This for some meant that "*integration is not achievable*…", in part because suppliers of integrated systems were unable to keep up with the pace of change in the way care is being delivered:

"Social care are coming now and we're sending discharges from secondary care … discharges are going out and GPs are receiving them as well. But there's no way we can have an integrated system at the moment that will do everything, social care as well. And things are changing, I mean when it first started, when I first met you we had [a] community trust didn't we, and we had secondary care. Now we've got integrated community trust and secondary care, we've got social care coming on board. The business is moving at such a fast rate that - we've got telehealth haven't we, interoperability tools and all those other things that I mentioned, I don't know how we can just go with integration." (Participant 2, Group 1)

Such changes demonstrate also how interoperability issues stretch beyond the confines of the hospital and that allowing information exchange between primary and secondary care settings, need to be taken into account too.

3.3.3 Finding a Way Forward

It was clear as the discussions progressed that participants felt that integrated and interfacing systems had both benefits and disbenefits, as summarised in Table 2. While an initial show of hands at the start of the final session of the day suggested an inclination towards integrated systems, it transpired that, despite offering a "*smoother*" solution, choosing this path was not without its drawbacks. One participant, whose Trust was soon to choose a system, clearly summarised the difficult choice that needed to be made:

"We primarily have bespoke systems, best-of-breed, within our organisation we're a best-of-breed scenario but we're still looking at those big solutions like [integrated system supplier], we recognise that there might be over-riding reasons why you would go for a whole hospital system and that there might be pressure on an organisation to go with that. We also recognise that the stand-alone systems tend to give you their highest level of functionality per se and possibly the best level of support from around that. But then there are the other disadvantages around interfacing and integration and things like that so for us it's a case of, and I don't want to get onto our next point there isn't an answer to which one is the best but for us there isn't and it's really about your own situation and connectivity and transaction volumes and all sorts of other issues." (Participant 8, Group 1)

Participants agreed that a compromise would always need to be made when choosing between integrated and interfacing systems. This was especially pronounced in a hospital setting which sought to address the needs of such a varied user-base:

"You've also got multiple users as well, what I want out of a system is not what, you know, anybody, what the clinicians want out of the system or what the nurses want out of the system so it's always going to be a compromise. " (Participant 9, Group 1)

"There's always likes and dislikes based on what your needs are really and if it meets everyone's needs." (Participant 5, Group 1)

It emerged that rather than favouring one over the other, participants felt that a combination of approaches might be necessary to allow for what was described as a blended approach, where bespoke systems could complement integrated systems:

"I think (…) even the integrated systems need to be interoperable in a sort of blended approach for the both of them." (Participant 4, Group 1)

"Integrated systems with like a health information exchange on top that does sort of pass information between all these different organisations might be the way to go." (Participant 6, Group 1)

Table 2 Benefits and Disbenefits of Integrated and Interfacing ePrescribing Systems

	Benefits	**Disbenefits**
Integrated	• Consistency • Efficiency • Integrated records and improved workflow • Ease of use • Training • Costs more predictable/ lower maintenance costs	• Limited scope for change/limited customisation • Locked into one supplier • Long development timescales • Downtime management problems • High one off cost • Scale of change management
Interfacing	• Bespoke • More mature products, and better support • Best of breed • Easier to make changes/smaller system • Cost, lower and one element at a time	• Developed by individual clinical teams, cannot be supported by IT/ isolated expertise • Multiple contracts with a number of suppliers • Managing multiple supplier relationships • Data retrieval • More training required when interacting with several systems • Difficulty of getting suppliers to collaborate • Lack of standards

The blended approach is perhaps also well suited to what was described as an immature market and product offering in the UK:

"What I'm learning is that I don't think there's any system who is fully offering any of those things and all systems are half-way houses." (Participant 5, Group 1)

"… and if a system comes along and it gives you electronic prescribing (…) I think if that system offers you electronic prescribing and then they say actually we also do bed management and we can do results reporting and you gradually buy other modules that would change your reflection because you may say OK we'll take that at the moment but then we might switch that on later, you don't have to, you can integrate or you can, you can be integrated or you can be interoperable, interface with other systems so that might change if a system comes along and you can actually just choose well I'm going to have those modules." (Participant 13, Group 1)

Participants explained that they were keen to deploy systems that were adaptable to changing situations and requirements, so that specifications could be continually and easily managed, rather than defined at the point of inception of the project as they may have become irrelevant or unworkable by the time the system was rolled-out.

A culture shift on the suppliers' side needed to happen according to some, as too often products on offer were trying to define clinical needs, rather than responding to individual site requirements and national guidelines. It was argued that Trusts needed to pay closer attention at the time of procurement to contractual arrangements, to make sure that these allowed for the right kind of changes to be made at the later stages of the project, including clauses relating to system interfacing, so that hospitals retained some control over the implementation and optimisation of the system. This could also be complemented by a supportive policy and regulatory structure that would allow decisions to be made on a clinical rather than financial and technical basis. For instance, it was highlighted that poor communication and collaboration between suppliers as well as lack of national standards for joining up systems limited opportunities to select bespoke systems suited to individual specialities. Addressing this may therefore help meet users' needs, since it was stated that having access to systems that carried low risks in terms of deployment and use, and offered seamless switching between functionalities, were high priorities.

Conclusions

The discussions have provided a rich understanding of the issues facing hospitals in the planning, deployment and longer term use of ePrescribing systems. Lack of experience and knowledge, local risk factors, misaligned visions of clinicians, IT and implementation teams, and suppliers, together with financial pressures, inadequate training and leadership appear to be significant factors impinging on the deployment of ePrescribing systems. Particular requirements that needed to already be in place - hard and soft infrastructures - were clearly articulated during the discussions, and despite their generalisability, they remain deeply embedded in local contexts of use. It was clear that taking a long term view of a deployment and realising the prolonged nature of an ePrescribing project, including the continuous need for system optimisation, are fundamental to ensuring that

the right project management and financial strategies are adopted. Compromise and flexibility, supported by an appropriate policy and regulatory framework which improves transparency in decision-making as well as collaboration between suppliers, such as through national standards for joining up systems, may offer some promise in helping progress to be made in the deployment of ePrescribing systems, and particularly in unlocking the potential offered by interfacing bespoke systems.

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Appendix A: Roundtable Discussion -Agenda

Infrastructure, Interfacing and Integration

Monday 23rd September 2013, Foresight Centre, University of Liverpool

9.30 -10.00	Arrival and coffee
10.00 -10.15	Welcome, overview and aims of the day, & introduction of toolkit by *Prof Munir Pirmohamed and Dr Jamie Coleman*
10.15 -10.30	Introductions

PART 1: Getting your infrastructure right (in two groups)

Moderators: Ann Slee and Prof Robin Williams

Topic 1: What are the main hard infrastructures that need to be in place?

11.15 -11.30	Coffee break and networking

Topic 2: What are the main soft infrastructures that need to be in place?

12.15-12.30	Summary feedback from each group discussion
12.30-1.30	Lunch and networking

PART 2: Interfacing and integration (in two groups)

Moderators: Ann Slee and Prof Robin Williams

Topic 3: Where is the difference between interfacing and integration?

2.15-2.30	Coffee break and networking

Topic 4: What are the main challenges involved in interfacing and integration?

3.15-3.30	Summary feedback from each group discussion
3.30	Evaluation and depart

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