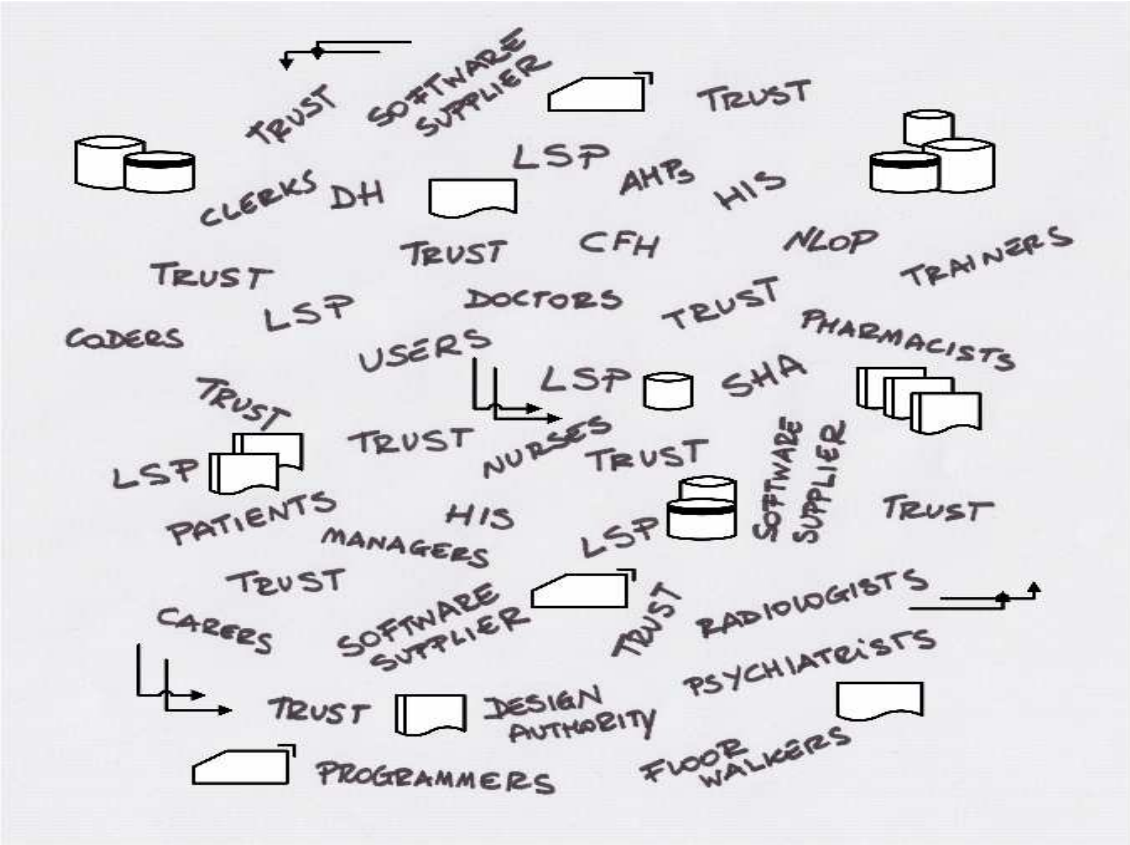
The Long and Winding Road…

An Independent Evaluation of the Implementation and Adoption of the National Health Service Care Records Service (NHS CRS) in Secondary Care in England



Final report for NHS Connecting for Health Evaluation Programme

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Foreword

This has been one of the most complex, challenging and politically sensitive evaluations that we have ever undertaken. The extensive multi-faceted fieldwork conducted in busy clinical settings was only possible thanks to the support and input of many individuals and organisations, whose support we are delighted to acknowledge on the following pages. We would here however particularly like to single out Professor Richard Lilford for having the foresight to commission this important work, Professor David Bates for his thoughtful guidance and support throughout, and also our research team who collectively have engaged with this evaluation with considerable thought, determination and skill. We hope that the summary of our work presented in the pages that follow will provide important food for thought on the future implementation plans for the National Health Service Care Records Service and also for future evaluations of the introduction of major information technology interventions into health systems.

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This large scale evaluation would not have been possible without the help of a number of people who we here take great pleasure in acknowledging. First and foremost, we thank the participating NHS Trusts and individual participants for their time and support.

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We had the welcome opportunity to discuss our research plans and present our interim findings at our Project Advisory Board meetings, at which we received helpful feedback, which both helped refine our original research plans and, more recently, our interpretation of findings. We are pleased therefore to record our gratitude to the members of this Board: Dr Gifford Batstone, Philip Brown, Lorraine Catwell, June Davis, Professor Dipak Kalra, Kathy Mason, Yvonne Pettigrew, Lee Priest and Dr Marlene Winfield. Our thanks are also due to the anonymous peer-reviewers of an earlier draft of this report for their constructive feedback and suggestions for improvement. To all of these individuals, who so generously gave us their time, we wish to record our most sincere thanks.

Our interim results and methods have been published in the BMJ and can be accessed under: http://www.bmj.com/content/341/bmj.c4564.

Abstract

Background: In 2002, the National Health Service (NHS) in England embarked on a major technology-based transformation of healthcare. Central to this National Programme for Information Technology (NPfIT) was the creation of a comprehensive "cradle-to-grave" electronic health record (EHR) – the NHS Care Records Service (NHS CRS) – that could be shared across a range of NHS providers for all 50 million residents of England.

Aims: To undertake an evaluation of the implementation and adoption of the NHS CRS in secondary care sites in England, across the three clusters: North-Midlands and East; South; and London.

Methods: A mixed methods case study-based longitudinal evaluation undertaken in 12 'early adopter' sites across the three geographical implementation clusters. Sites were opportunistically sampled according to their current or planned stage of implementation, and to provide a variety with respect to: location, size, type of care provided, Foundation and teaching status, and NHS CRS software system. Fieldwork was undertaken in six complimentary work-packages in which we sought to understand how the participating trusts made the NHS CRS work (or not) in their organisations; to identify local consequences of implementing the new systems, the costs incurred and to assess whether the new systems resulted in a reduction in missing information in outpatient clinics.

Main findings: Implementation of the NHS CRS software systems has proceeded much more slowly and with, as yet, substantially less functionality than was originally planned. The delays have related, at least in part, to ambitious expectations about: the nature of EHR systems; the time needed to build, configure and customise the software; the work needed to ensure that these systems were supporting rather than hindering care provision; and the training and support needs of end-users. Other factors affecting the rate of implementation included: the constantly changing milieu of NHS policy and priorities; the different stages of development of the different NHS CRS systems; and a complex and multilayered communication process between organisational structures, along with contractual arrangements which largely excluded NHS providers and were perceived by users as a major source of frustration that slowed implementation. As a result of commercial and other sensitivities about cost and consequences of implementation a full economic analysis could not be undertaken; however we have identified the main cost categories that need to be considered in the context of implementing complex EHR systems. At one site, in which a NHS CRS system of limited functionality had been implemented, there was no improvement in the amount of missing patient information in outpatient clinics. More broadly, however, there was some evidence that these early experiences of deploying the NHS CRS have

resulted in important organisational learning and development of relevant competencies within and amongst NHS Trusts and NHS Connecting for Health (NHS CFH).

Conclusions: This evaluation has found that implementation of the selected NHS CRS software packages has proved time consuming and challenging, with limited discernible short-term benefits for clinicians or patients, although we began to see the application of new approaches to managing information at some sites as systems matured. These findings do not preclude the possibility of longer-term benefits, which have been achieved in some hospitals in other countries, but these do often take years to realise. Nonetheless, there remains considerable buy-in into the vision and potential offered by the NHS CRS. In a future in which hospitals may have to function as business entities in order to survive, there is very likely to be a need to capture and quantify many aspects of business processes using some form of the NHS CRS. The recent move away from a centralised top-down delivery model to one in which there is greater local autonomy and choice is an overall welcome development. However, this needs to be accompanied by NHS-wide standards and incentive setting mechanisms in order to ensure continuing progress both locally and nationally, towards integrated, joined-up care systems.

Executive summary

Introduction

1. Health systems globally face common challenges. These result from many sources and include: increasing population size; demographic transitions and the growth of older, frailer sections of the population many of whom live with one or more long-term conditions; the ever-increasing array of new and expensive treatment options; and increasing public expectations.
2. Against this background, there is rising international interest in the potential of information technology (IT)-based systems for improving the safety, quality and efficiency of healthcare. Electronic health records (EHRs) usually represent the backbone of these service redesign initiatives.
3. Most of the evidence to support such initiatives and on the effectiveness of EHRs and associated systems originates in small-scale implementations of software systems that have been extensively customised to suit local needs. Even these small-scale and often well-resourced implementations are however not without problems; particularly when care processes are appreciably changed, leading to restructuring of work and innovation in organisational processes.
4. In the light of the anticipated (but as noted above unproven) benefits associated with the use of EHRs, international efforts are now focusing on larger scale EHR initiatives. Issues known to be encountered in small-scale implementations may however be exacerbated in these more ambitious transformative ventures.
5. England's National Programme for Information Technology (NPfIT) is such a large scale EHR implementation attempting to introduce, amongst other things, national EHRs across NHS specialist care providers throughout England. It has been distinguished by its (national) scale, centrally driven delivery model and extremely ambitious timeline. It is one of the few sustained attempts to implement EHRs nationally in a centralised way.

Aims and objectives

6. We were commissioned by the NHS Connecting for Health Evaluation Programme (NHS CFHEP) to conduct both a formative and summative evaluation of the implementation and adoption of the National Health Service Care Records Service (NHS CRS), and specifically the Detailed Care Record (DCR), in NHS secondary

care sites across England. In doing so, we were asked to inform the implementation and adoption of the NHS CRS, and to generate insights to inform future local and national strategic implementation decisions.

7. During the conduct of this research, some of our aims, objectives and methods had to be adapted. This was due to a combination of changes in strategic direction of the implementation, e.g. from top-down phased implementation of nationally procured systems towards an increasing emphasis on local choice in relation to a range of systems, and the severe and persistent delays within the Programme. In addition, the envisaged scope of the chosen software continued to change over the course of the study period and only limited clinical functionalities were deployed.
8. We were thus not, as anticipated at the time of writing the proposal, in a position to investigate the implementation and adoption processes, and the worked out consequences of fully implemented and function-rich NHS CRS software, but instead had to assess the NHS CRS software in the context of early implementations of often limited functionality.
9. Despite the challenges we pursued our original research plans as far as possible and appropriate, seeking to undertake a theoretically grounded, empirical, longitudinal investigation into the implementation and adoption of the NHS CRS in English secondary care.

Methods

10. We conducted a mixed-methods real time evaluation of the introduction of the NHS CRS in secondary care settings during the period September 2008 (with data collection beginning in February 2009) to January 2011. In doing so, we collected a broad range of qualitative and quantitative data from 12 'early adopter' Trusts committed to use one of the three core NHS CRS software systems (i.e. Lorenzo Regional Care, RiO and Cerner Millennium). We conceptualised each participating Trust as a case study site to reflect the importance of local contingencies, whilst attempting to make general inferences transferable to other contexts and facilitate organisational learning.
11. Our evaluation drew on sociotechnical principles and was informed by Cornford and colleagues' evaluation framework.
12. We organised the work into the following six complementary work-packages (WPs) investigating different dimensions:
    - Implementation, deployment and organisational learning (WP1)
    - Stakeholder attitudes, expectations, engagement and satisfaction (WP2)

- Organisational consequences: organisational workflow, professional role and data quality transformations (WP3)
- Assessment of costs of NHS CRS implementation (WP4)
- Assessing error, safety and quality of care (WP5)
- Organisational consequences and implications for future IT deployments and evaluations (WP6).

13. The majority of our data collection activity was qualitative in nature, primarily consisting of interviews with a range of key stakeholders, including local implementation teams, users, and a range of governmental and commercial stakeholders. This was complemented by researchers' field notes as well as observational and documentary data from Trusts, meetings with governmental stakeholders, conferences, and national documents.
14. Quantitative data consisted of an assessment of the local costs of implementation and an assessment of the impact of the new system on the availability and completeness of outpatient clinical records (WP 4 and 5).
15. We also developed a survey tool to investigate the use and usability of EHRs and related clinical systems, and the user experience with these, including attitudes and opinions.
16. Our complete dataset comprised:
    - 431 semi-structured interviews
    - 590 hours of observations
    - 234 sets of notes from observations, researcher field notes and conferences
    - 809 documents
    - 58 national and regional documents
    - 130 questionnaires on users' use and views of clinical systems
    - 4,684 questionnaires on case note availability.
17. Data in individual Trusts were collected by a designated lead researcher who also took the lead in analysis for their particular case study; regular analysis workshops with the wider team helped us to validate individual case study findings and to integrate multiple case studies to draw out more transferable findings.
18. Throughout the study, emerging findings were fed back to individual participating Trusts, NHS CFH, NHS CFHEP; the feedback received informed subsequent data collection.

Main findings

The main findings relating to each individual WP are outlined below.

Local consequences (WPs 1-3)

19. Implementing new technology-based clinical systems is never a straightforward activity, particularly when this involves replacing existing systems that are perceived as functioning well locally. It is hard and takes time, especially in the light of the complexity of implementing NHS CRS systems within and across Trusts, which will probably consist of thousands of staff with different requirements and expectations. Clinical, administrative and technical staff has to learn to work-out the consequences of such systems day-by-day and continue to make them work for as long as they are in use. This task should not be underestimated.
20. There was not a common vision or understanding of the intended purpose of the NHS CRS. Different stakeholders expressed different accounts of its intended purpose. These ranged from the data-centric (data storage and sharing), to business-centric (business process change) to policy-centric views (modernisation, shift to patient focus).
21. A variety of approaches was taken to prepare for implementation and a number of external and internal factors shaped differences in implementation strategies, the types of software, and stakeholder expectations. These included concurrent changes occurring in Trusts (e.g. working to achieve Foundation Trust status), in the NPfIT and in NHS policies and targets, adding further uncertainties and delays to the process.
22. Relationships between Trusts, Local Service Providers (LSPs), software suppliers and NHS CFH, often characterised by commercial relations, often resulted in a lack of focus on teamwork and productive processes (other positive developments that it might ensure and how the realisation of these might be facilitated). Instead different parties often worked in silos attempting to achieve what was in their own best interest. For example, Trusts often lacked budgetary control, information about contractual arrangements, the ability to configure the software or engage in direct communication with the service supplier. This led to a sense of detachment from the process for Trusts. The communication between customer and developer was often fragmented, and the potential for intelligent problem solving clashed with the structured approach characterising software contracts.
23. All Trusts adopting NHS CRS software system faced trade-offs between standardisation and localisation. Administrative, technical and clinical users interviewed were often aware of the tensions between standardisation and localisation and a need to provide a balance reflecting the needs of individual organisation and the NHS more generally. Assumptions inscribed into NHS CRS

systems as to how the English NHS operated were often challenged. The complex supply chains added bottlenecks in resolving such issues and in resolving configuration and customisation issues.

24. We also found that the NHS CRS was usually portrayed as a set of clinical systems for primarily clinical users, but the direct users of the software systems we studied were frequently allied health professionals and administrative staff. Their interests and concerns, however, seemed less likely to be captured or acted on as implementations went forward.
25. Technology for EHR has to be “fit for purpose”, with acceptable levels of reliability and utility in the clinical setting. Yet NHS CRS systems often failed such basic tests, e.g. presenting usability problems that could become critical, not least in reducing user commitment to the systems.
26. We found that NHS CRS systems had at times significant influences on users’ professional identity, which in turn impacted on attitudes towards these systems.
27. As expected, the introduction of NHS CRS systems influenced changes in work practices for a variety of clinical and non-clinical stakeholders. Data entry work was often redistributed, e.g. from administrative staff to clinicians, from nurses to doctors and vice versa. Work practices did not become “paperless”: note-taking while with the patient was still most often done on paper, with data entry in NHS CRS systems done retrospectively.
28. Enhanced availability of data and data management tools were perceived as benefits when information was legible, available in “real time”, more easily searchable and retrievable, and accessible “any time” and “anywhere” by multiple concurrent users. Electronic transmission of referrals, requests, reports, etc, was reported as making some workflows faster overall, although individual stages of these workflows could become more or less time-consuming than the work system that was previously operational, with a range of consequences for the different staff involved.
29. To make the most of these data sharing and transactional benefits, a critical mass of users and data were needed. This required time and a continuation of faith in the system while numbers of users and the volume of data built up; this in turn allowed data quality issues to be addressed and relevant new practices to become established.
30. The availability of digital data could facilitate sharing information across teams or services within a Trust, or even across Trust boundaries. However, designing digital support for integrated multi-disciplinary clinical pathways was revealed as a complex process, still only in its infancy.

31. Our data, drawn from multiple user communities across Trusts, suggests that significant organisational learning has taken place. At the individual and team level, within professional groupings and in particular within and across Trusts, the potential to respect, enhance and benefit from such learning is clear, if not always yet realised. By taking such a route, real longer-term benefit of the NHS CRS may indeed be found.

Assessment of costs of NHS CRS implementation (WP4)

32. Total costs varied depending on the system being implemented and the number of upgrades: higher functionality increased start-up costs, and up-front 'big-bang' implementations were larger in scale than the smaller more phased implementations, with knock-on implications in relation to costs.
33. We developed a cost framework, which successfully captured all the relevant cost categories for Trusts deploying different systems, different sets of functionality, and commencing from different starting-points. Using microeconomic production models, we identified domains of inputs that could be affected by broad-reaching technological change initiatives such as the introduction of EHRs into secondary care settings. Financial, planning and other resource-use documents obtained from hospital Trusts were assessed in order to specify inputs within those domains and estimate their values.
34. Within the cost framework, infrastructure costs (degree of IT maturity/penetration; EHR products already on the market; IT hardware budget at the Trust; requirements of the IT application; and the physical requirements of the operational space) and personnel costs (data migration; network; testing; training; and support) were the most significant sources of expenditure. Personnel costs exceeded infrastructure cost by a factor of two- to three-fold in some sites. This could be because license costs were borne by NHS CFH. However, it has to be noted that after 2015, these will be renegotiated and are likely to be borne by Trusts.
35. One of the main outputs of this evaluation is the creation of a Minimum Data Set, which can be used by Trusts planning to implement the NHS CRS to ensure that they have a robust costing model. It can also be used as an evaluation tool to collect the minimum sufficient information (at hospital Trust level) to contribute to future cost-effectiveness and cost-benefit studies of IT.
36. From the limited cost information obtained at Trust level, 'early adopters' reported that they were exposed to approximately 50% of the overall implementation costs. However, this exposure varied between Trusts depending on their negotiating powers.

Assessing error, safety and quality of care (WP5)

37. We initially undertook a cross-sectional survey in the outpatient departments of four NHS Trusts to determine the proportion of outpatient encounters for which at least one, clinically important item of information was missing. The results from an analysis of 2,897 encounters showed that:
    - One in seven patient encounters had at least one item of information missing.
    - There were substantial variations in the availability of information across the sites.
38. We then undertook a before-and-after study in one of these sites that had implemented an outpatient software module and compared this to a control site that had yet to implement this module (i.e. a controlled before-and-after study): this showed that the introduction of the NHS CRS did not result in any reduction in the proportion of missing information.

Wider contextual considerations and suggestions for future deployments/research (WP6)

39. Contracts between NHS CFH and a limited number of LSPs were seen at the outset of NPfIT as central to the successful delivery of the NHS CRS – embodying its ethos of tough contractual negotiations and "ruthless standardisation", but with regional variations. However, our research indicated that multiple restrictions imposed by long-term, central contracts was a significant inhibitor of Trusts' adoption of the NHS CRS systems
40. We found scepticism about realising the benefits associated with secondary uses of data; this is at least in part because it is unclear what will be collected nationally and how data from different NHS CRS applications might be consolidated.
41. Many stakeholders felt that the press had contributed considerably to a negative public perception of the Programme as a whole by an unremitting focus on negative aspects such as delays, costs and problems occurring during implementations.
42. Generally, participants' accounts were characterised by uncertainty and anxiety about what would happen to the Programme in the light of the evolving political and economic landscape.

Conclusions and future research priorities

43. Despite relative successes in some other aspects of the Programme as a whole (such as the implementations of N3 and the Picture Archiving and Communications System), the implementation of the NHS CRS in secondary care settings has been

considerably more complex and challenging than was originally anticipated by many stakeholders.

44. As of December 2010, 8/219 Trusts (4%) were live with limited Lorenzo functionality in the North Midlands and Eastern (NME) area; in the South 17/45 (38%) Community and Mental Health Trusts were live with RiO and 9/40 Acute Trusts (23%) were live with Millennium; and in London 6/32 Acute Trusts (19%) were live with Millennium software, whilst RiO was being used by 8/10 (80%) Mental Health Trusts and 30/31 Primary Care Trusts (97%). There are, in addition, a number of other software functionalities being implemented in Trusts, which are not part of the NPfIT.
45. The relatively **limited number of secondary care sites where implementation has taken place**, in combination with the **limited ability to share (clinical data in particular) across care settings**, has led many to doubt the overall success of the Programme. This is because the implementation of EHRs, as part of the NHS CRS, is usually viewed as the most fundamental transformational element of the NPfIT. The limited progress to date has been in large part due to the difficulty encountered integrating relatively **inflexible nationally procured software systems into NHS organisations in which local needs vary** – or are locally perceived to vary – and where paper-based systems are still seen as an essential part of everyday organisational functioning.
46. Despite these difficulties, most NHS and other **stakeholders remain committed to the overall vision of shared EHRs**; continuation of such widespread support may, however, be contingent on offering more opportunity for Trusts and their staff to contribute to local and national policy development.
47. The top-down and politically driven nature of the Programme has, from its inception, whilst ensuring necessary high level leadership and support, contributed to a **lack of organisational and user involvement in decision making** and, in particular, in system selection. One consequence has been that two of the three NHS CRS software systems we studied have had difficulty fulfilling organisational and user needs in 'early adopter' sites. This has had a knock-on effect on professional and public perceptions of the Programme and led to hesitation amongst other Trusts to adopt national solutions and adopting Trusts to consider alternatives.
48. Policy makers have already started to shift the focus of efforts to develop and implement EHRs, set within broader proposed changes to the NHS in England and reflecting the current economic climate. In developing this policy, and drawing on our research, we propose the following points:
    - The next decade will see many innovations in technology, reforms of public services and new models for healthcare organisation and delivery. **Any**

health informatics policy needs to reflect this dynamic environment and be flexible in nature so as to enable the NHS and its different constituent organisations to respond to evolving needs. For example, the creation of Foundation Trusts as competing businesses has the potential to reduce the capacity for learning between Trusts, to the detriment of the NHS as a whole.

- Short-term **effort should remain focused on making NHS CRS software systems work in the sites in which implementation has already begun**. Sites must be actively supported in charting and taking their next steps which may or may not be in line with the historic NPfIT strategy.
- Funding for this stream of the Programme needs to be continued for the sake of the Trusts committed to NHS CRS software systems but, equally important, in order to retain and build on the substantial and **hard won knowledge, skills and capability that are now available in parts of the NHS**.
- The considerable work by Trusts and NHS CFH in informing the design of the Lorenzo NHS CRS system should be seen as, at least in part, the intellectual property of the NHS from which the NHS as a whole should benefit. This work should not be lost, but will require **careful consideration of intellectual property rights in relation to future developments**.
- We advocate a **governance structure that will encompass the input of NHS-wide, public, accountable, bodies** (including Monitor and the newly established NHS Commissioning Board) **while giving a primary role to local NHS organisations in decision-making and implementation strategies**. The exact role of this governance structure will need to be negotiated, but we envisage the role for one or more NHS-wide bodies to include coordinating and facilitating development of common and open technical standards (including support for some aspects of software certification), setting quality benchmarks which Trusts can use (e.g. for usability and safety), creating incentives for inter- and intra-organisational learning, liaising with supplier communities, and developing expertise and drawing together specialists.
- In future policy, whatever the role of central or NHS-wide bodies, **implementation activity needs to be far more locally owned and driven**. In particular, organisations should not be incentivised to replace existing systems that are working for them; development of EHR should rather stem from Trusts' perceived needs and a well articulated and understood case for change within the local health economy. **This, however, should be in the context of nationally agreed standards** that will allow, in the longer-term, a

joined up healthcare delivery model and deliver the overall vision underpinning NHS CRS. We recognise however that this balance is likely to prove extremely challenging to achieve.

- A consequence of **this should be a move away from technology-driven models of "implementation"** (putting computers on trolleys and desks), and reflect increased attention to Trusts' operational needs and business priorities, their work practices, and the potential for beneficial change in work process. The findings from this evaluation suggest the need to refocus attention on "adoption", which should not be seen as a discreet period of change driven by the arrival of a new technical system, but rather as an on-going "working-out" of accommodations between staff and technology, and in which the technology is seen as an enabler of improved care processes, rather than an end in itself.
- There is also an opportunity to work to align the strategies of the NHS and a wider variety of commercial software suppliers and service providers. A **stronger and more transparent commercial architecture** could be of great benefit to all parties, but must not repeat the customer–supplier disjunction of the NPfIT.
- We **expect to see such a market emerge with a larger range of software systems and service providers and working through smaller contracts**. This market would require providers to demonstrate compliance with agreed **interoperability standards that have been built bottom-up, but have achieved a minimum level (benchmark) of usability, clinical safety and validity as well as service quality measures** in relation to pragmatic clinical practices and business processes; such systems are likely to require less customisation for individual Trusts.

49. We already have published our interim findings and developed a dissemination strategy, which will allow a more detailed exploration of the complex issues emerging from our research. Our main audience here will be national and international health informatics and information systems perspectives.
50. A range of implications for future research can be drawn from this evaluation. Most importantly, there is a **need for more longitudinal evaluations of IT initiatives** to allow tracking of implementation efforts and organisational responses over periods of time. Such studies generate insights into how technologies become embedded (or not) and are made to work in and across organisations. Similarly, detailed studies of Trusts (and sites in other countries) where EHR systems have become established and are in everyday use could inform future policy and delivery strategies.

51. Future studies should also examine the transformative power of EHR in changing (or not) clinical practices and healthcare professionals' roles and corresponding consequences for patients' experiences, expectations and roles.
52. Research is also needed into the often neglected processes of transition from paper to electronic records, or from one generation of electronic systems to another. As in this study, this turns attention to the extended processes of change (changing) and the ways in which the active users of new systems work-out how to appropriate the various affordances of any given technology into their work practices and processes of patient care.
53. A focus on international comparisons in research into technology innovation, implementation and adoption processes, and overall visions, could help inform future developments in England. In particular, **international experiences could inform the complex choices and trade-offs faced in EHR implementations** between, for instance: records' confidentiality and their accessibility; small-scale and large-scale data sharing; standardisation and interoperability standards. The English context is distinctive, but this does not mean that important lessons cannot be learned from studies of other healthcare systems.
54. There is currently a lack of academic and public debate on the long-term management and maintenance of data recorded in electronic health record systems, including disposal and security arrangements. The whole lifecycle of electronic information requires to be considered by policy makers.
55. Future research is also needed on the **ethical and legal controversies arising from research into EHRs**, including potential consequences when evaluating commercial products such as libel suits. Ethical and legal issues are also likely to become increasingly important in relation to electronically stored data e.g. if patients are harmed by illegitimate access or misuse of sensitive information.
56. Introducing technologies into healthcare environments clearly requires relationship building and good lines of communications between suppliers, patients and carers, clinical and administrative users, Trusts' managers, professional bodies and healthcare commissioners. This has so far received limited attention and is an area that could benefit from specific research and from learning lessons from other industries.
57. We emphasise that EHR-based innovation in healthcare should not be conceived of as essentially technically driven (i.e. founded on the inherent properties of EHRs or any other technology), but should be characterised by new ways of working with appropriate technologies and seek new ways of delivering better care. Detailed work process mapping and user centred design combined with exploring options for

innovation in the way care is delivered, should be central to future investigations. Fundamental to this view is the understanding that automation without redesigning services will simply magnify existing problems.

Table of Contents

Abbreviations

A&E	Accident and Emergency
AHP	Allied Health Professional
ASCC	Additional Supply Capability and Capacity
ATP	Approval to Proceed
BT	British Telecom
CCMDA	Critical Care Minimum Dataset
CCN	Change Control Notice
CDC	Clinical Documentation
CEO	Chief Executive Officer
CI	Confidence Interval
COO	Chief Operation Officer
COWs	Computers on Wheels
CSC	Computer Sciences Corporation
CSE	Customer Satisfaction Every time
DBS	Database System
DCR	Detailed Care Record
DIF	Deployment Incentive Fund
DH	Department of Health
DVP	Deployment Verification Period
EHR	Electronic Health Record
EPS	Electronic Prescription Service
GP	General Practitioner
HDM	High level Data Model
ICP	Integrated Clinical Pathway
IMP	Issue Management Process
iPM	iSOFT Patient Manager (interim PAS solution developed by iSOFT)
IT	Information technology
LC1	London Configuration 1
LC2	London Configuration 2
LE	Lorenzo Enterprises
LEAP	Lorenzo Early Adopter Programme
LPfIT	London Programme for IT
LSP	Local Service Provider
LTC	Long-term Condition
MDS	Minimum Data Set

NHS	National Health Service
NHS CFH	NHS Connecting for Health
NHS CFHEP	NHS Connecting for Health Evaluation Programme
NHS CRS	NHS Care Records Service
NLOP	National Local Ownership Programme
NME	North, Midlands and East (Programme for IT)
NPfIT	National Programme for Information Technology
OBS	Output Based Specifications
OR	Odds Ratio
PAC	Public Accounts Committee
PACS	Picture Archiving and Communication System
PAS	Patient Administration System
PCT	Primary Care Trust
PDS	Personal Demographics Service
PID	Project initiation document
R1	Release 1
R1.9	Release 1.9
R2	Release 2
R3	Release 3
R4	Release 4
RAM	Random Access Memory
RBAC	Role based access control
RiO	CSE Servalec RiO
SCR	Summary Care Record
SHA	Strategic Health Authority
SIBL	Single Instance Board for Lorenzo
SUS	Secondary Uses Service
TTO	To-Take-Out medication
UCD	User Centred Design
VPN	Virtual Private Network
WES	Warranted Environment Specifications
WP	Work-package

Chapter 1: Background

Internationally, there is keen interest in implementing modern, digital information technologies to support the organisation and delivery of healthcare. As one of the first and most ambitious, nationwide healthcare reforms to be attempted, England's National Programme for Information Technology (NPfIT) has attracted particular attention. The Programme includes the multi-faceted National Health Service Care Records Service (NHS CRS), which was intended to create a single, "cradle to grave" electronic health record (EHR) for every NHS patient in England by 2010. This chapter sets the scene for our research, giving key background information relevant to our evaluation of the implementation and adoption of NHS CRS software systems in England. It provides an overview of developments in the NPfIT and of the NHS CRS within it; describes the commissioning arrangements for the evaluation; considers approaches to evaluating large scale EHR implementations more widely; and, finally, outlines the structure of the detailed report of our evaluation which then follows.

1.1 Electronic health record systems

Using computer technology to store and share individuals' health and healthcare information is widely viewed as an essential underpinning for safer, high quality and sustainable, modern healthcare systems. Many countries throughout the world are now seeking to replace paper-based patient records with life-long, digital records that can be shared across healthcare organisations and accessed as and when required by all healthcare professionals involved in a patient's care. With demographic shifts towards more elderly populations and the increased prevalence of long-term health conditions, countries in North America, Europe, the Middle East and Australasia are pursuing EHR implementations in an attempt to address some of the challenges facing their national healthcare systems.(1;2)

This widespread interest – and in some cases, substantial government investment – in EHRs reflects the belief that a range of benefits will accrue as a result of implementing these new systems. In addition to expected economic benefits of modernised service organisation and care delivery, the theorised benefits of EHRs with clinical alerts and decision support tools include: greater accuracy and legibility in documenting and communicating patients' healthcare information; time saving, for example, by avoiding duplicated patient history taking; reduced clinical errors, and greater safety for patients; no lost records; enhanced integration of patient care across different times and settings; increased patient satisfaction;

improved data quality for clinical audit and research; and the availability of administrative data for financial and other management purposes (see Box 1.1). EHRs might also provide patients with more readily accessible information from their own records, and thereby support patients who seek a more active partnership with healthcare professionals and enhance self-care.

Aim	How?	Expected benefits?
1. To improve patient safety	By providing clinicians with rapid access to information about a patient's: • Allergies • Adverse reactions • Medications • Significant diagnoses and problems	Clinician benefits • Immediate access to accurate list of medications • Definitive list of allergies and adverse reactions • Less time spent piecing together clinical history • Reduced risk of error e.g. dosage and generic/branding confusion Patient benefits • Less likely to be harmed • Assurance that the right information for diagnosis, treatment and care planning is available where and when it is needed • Corroboration of clinical/medication history rather than interrogation Service benefits • Reduction in hospital admissions • Reduction in length of stay • Reduction in litigation costs
2. To improve access and responsiveness by:	By providing key clinical information (allergies, adverse reactions,	Clinician benefits • Improved appropriateness of clinical care

A. Supporting clinical assessment of patient's with urgent and emergency care needs	medications and significant diagnoses and problems) to: • Ambulance service • Emergency departments / Accident and Emergency (A&E) • Walk-in centres • Minor injuries units • Out-of-hours service • NHS Direct	• Faster recognition of critical clinical need • An end to "flying blind" – access to medical history for confused or non-verbalising patients Patient benefits • Treated faster, in most convenient setting • Care provided closer to home • No need to repeat clinical history Service benefits • Reduction in emergency admissions • Reduction in A&E attendances • Speed up decision to treat/admit/ discharge in A&E • Reduction in face-to-face contacts in out-of-hours services • Reduction in ambulances dispatched • Reduced emergency journeys to A&E
B. Supporting delivery of high quality care where patient communication/ language is a barrier	By making basic contact information and key clinical information available when people cannot give e.g. because of disabilities or first language other than English By recording preferred language and other care	Clinician benefits • Knowledge of medical history, language issues: saves time • Know which language and communication aid is needed: reduces frustration Patient benefits • Language/communication needs

	preferences	instantly known to care professionals Service benefits • Speed up care processes - cost and time savings from increased efficiencies
3. To improve clinical and cost effectiveness through A. Communication of key data that will support integrated planning and delivery of care plans across different providers of care - particularly patients with long-term conditions (LTCs)	Availability of key clinical information across different healthcare organisations Using General Practitioner (GP) contribution to include additional condition specific information e.g. conditions, what teams are looking after/coordinating care, what to do in a crisis, patient preferences	Clinician benefits • Significant reduction in time and effort when treating acute exacerbation of known LTCs • Minimal disruption to long-term care when patient seen in unscheduled environment Patient benefits • Experience more joined-up care: increased confidence in care given Service benefits • Reduction in emergency admissions • Reduction in GP visits
B. Better Medicines Management	Ability to view current medications (known to GP)	Clinician benefits • Reduces need to prescribe from scratch Patient benefits • Patients less likely to receive inappropriate or sub-optimal prescribing Service benefits • Reduced waste

		• Reduced prescribing costs
4. To improve the patient focus by A. Providing safer care through the reduction in medication errors and adverse drug reactions (ADRs)	By providing clinicians with rapid access to information about a patient's : • Allergies • Adverse reactions • Medications • Significant diagnoses and problems	Clinician benefits • Immediate access to accurate list of medications • Definitive list of allergies and adverse reactions • Less time spent piecing together clinical history • Reduced risk of error e.g. dosage and generic/branding confusion Patient benefits • Less likely to be harmed • Assurance that the right information for diagnosis, treatment and care planning is available where and when it is needed • Corroboration of clinical/medication history rather than interrogation Service benefits • Reduction in hospital admissions • Reduction in length of stay • Reduction in litigation costs
B. Facilitating patients to become partners in their care	Patient can access their Summary Care Record via HealthSpace Patient choice over whether to have a SCR, the content of the SCR and whether the info should be shared	Clinician benefits • Higher compliance rates with treatment • Better outcomes Patient benefits • Patients able to see and determine what information is held and shared

		– greater confidence in treatment • Patients become more "engaged" in their own health- better outcomes Service benefits • General health improvement: supports shift from sickness service to a genuine health service
C. Ensuring patients' experience is more integrated, joined-up care	Different providers of care have access to the same information	Clinician benefits • Less frustration for clinicians themselves and on behalf of their patients • Better overall care planning • Better outcomes Patient benefits • More confident about care given – clinicians know what has happened to patient in different healthcare settings • Patients don't have to repeat basic information about clinical history – corroboration rather than interrogation Service benefits • Speed up care processes – cost and time savings from increased efficiencies
D. Ensuring confidentiality is better protected	Patients able to choose whether to have a SCR or not and whether it can be shared Role-based access	Clinician benefits • Fewer faxes, telephone calls etc seeking patient information in unsecured manner - such requests become "extra-ordinary"

	controls Legitimate relationships – must be declared by healthcare professional before accessing SCR	Patient benefits • In control for first time over what information is stored and shared between organisations

Box 1.1: The anticipated benefits of electronic health record systems (3)

Such positive consequences remain to be clearly demonstrated in practice; a review of the literature reported that robust, empirical evidence was thus far lacking for many of these anticipated benefits.(4) It is also recognised in the literature that implementing EHR systems can potentially introduce harmful consequences. Important potential risks relate to the accuracy and completeness of the information entered into the electronic record, and to the security of digital data. Further, the disruptive nature of introducing new technologies into healthcare organisation and care delivery means that unforeseen consequences, harmful or positive, are also possible following the implementation and adoption of healthcare information technology (IT) systems.

For the UK government, introducing nationwide EHRs was a core component of larger, ambitious, multi-faceted initiative for IT-enabled modernisation of the NHS in England. The creation of a national IT infrastructure and the central procurement and implementation of new, standardised computer systems was planned with the aim of raising service quality, improving patient safety and satisfaction, and enhancing the future sustainability of England's universally available, publicly funded NHS. The strategy to deliver the proposed, ambitious transformation of the NHS in England was named the NPfIT.

1.2 The National Programme for Information Technology

The NPfIT became the focus of domestic and international attention as the world's most ambitious and expensive government programme for IT-enabled health system reform. A series of government publications had prepared the way for its launch in 2002. The Department of Health (DH) had made a commitment to creating life-long electronic records for NHS patients four years earlier.(5) Subsequent government publications supported the strategic goals of improving NHS information systems and of developing more "patient-centred" service organisation and care delivery.(6-8) In 2002, the Wanless Report recommended doubling the amount of protected expenditure for NHS IT. Later that same

year, *Delivering 21st Century IT Support for the NHS – A National Strategic Programme* was published – and the New Labour Government, led by the Rt. Hon. Tony Blair, launched NPfIT for England (other devolved nations, that together with England make up UK, have their own national NHS organisations).(9)

Many hundreds of different IT systems were used by NHS staff at the time of the Programme's launch. These were usually small-scale systems that had been locally developed or procured, often for use in a single setting. Different NHS organisations varied widely in their commitment to adopting new technologies and in the levels IT expertise that were locally available. There were no secure means of exchanging confidential healthcare information to support the continuous care of patients who received treatment at different NHS settings. At the outset, the scope of the centrally managed NPfIT was to create a national electronic infrastructure – a broadband network to serve all NHS organisations in England (N3) – to deliver electronic prescription (Electronic Prescription Service) and electronic appointment booking services (Choose and Book), and to build a life-long, EHR service for patients in England through the use of a limited range of standard software systems.

After 2002, the scope and costs increased significantly. In addition to delivering the four, originally scoped projects, over time the remit of the Programme expanded to include delivery of a further six, main projects (see Box 1.2), plus a range of activities designed to support NHS staff in making organisational and clinical changes in parallel with implementing new IT systems. A 2009 report by the parliamentary Public Accounts Committee (PAC) estimated that the costs of delivering the whole Programme, as it was then envisaged, had risen by ~50% to £12.7 billion.(10)

Aspects of delivering the Programme are now generally acknowledged to be successful, such as building the high-speed broadband network (N3), and the implementation and adoption of Picture Archiving and Communications Systems (PACS) throughout England's hospitals. Others, such as the core NHS CRS, have aroused more controversy and attracted adverse criticisms. Some of these latter issues are explored in later chapters of this report, where findings from our evaluation are presented.

1.2.1. Overview of the Programme's governance and leadership history

At the outset, the Programme was managed directly by the DH. In 2004, following a review of its "arms length bodies", the DH announced it would establish a new government agency,

NHS Connecting for Health (NHS CFH). The new agency would combine carrying responsibility for delivering the Programme with taking over some of the functions previously carried out by the former NHS Information Authority. NHS CFH was created in 2005. Under the leadership of Mr. Richard Granger, the agency employed staff with healthcare, IT and management experience, who were drawn from the NHS, academia, the civil service and from the private sector. NHS CFH underwent a series of organisational and leadership changes in the course of its existence. A 2007 restructuring saw the introduction of the National Programme for IT Local Ownership Programme (NLOP). The main changes it brought were devolving responsibility for local delivery of the Programme from NHS CFH to groupings of England's 10 Strategic Health Authorities (SHAs), which were organised to reflect each of the three, remaining Local Service Providers (LSPs) geographical areas i.e. the North, Midlands and Eastern (NME), London and the South. NHS CFH then focused on commercial and legal aspects of the Programme. In a wider reorganisation in 2010, NHS CFH was brought under the direct management of the DH's Informatics Directorate.

Under the NHS CFH, a five-year programme of research was set up in 2006. The NHS CFH Evaluation Programme (NHS CFHEP) is led by the University of Birmingham, which commissions independent, academic research to evaluate various aspects of the Programme. These evaluations are intended to inform future NHS IT deployments and more generally to generate: "…insights into the lessons learned through such large scale projects".(11) The evaluation reported here, NHS CFHEP 005, is one of the portfolio of independent studies commissioned under the NHS CFHEP scheme.

1.2.2 The current state of play in the Programme

Our research was undertaken against the backdrop of an evolving Programme, shifting NHS strategies and directives (for instance, for maximum time-to-treat targets) and changing government policies for the NHS in England, which have continued into 2011. The current UK Coalition Government took office in May 2010. A Government White Paper lays out new plans for further, substantial restructuring of the NHS in England.(12) The plans include fundamental changes to the way in which the services of NHS organisations are to be commissioned, with purchasing powers being taken away from Primary Care Trusts (PCTs), where they currently reside, and passed to consortia of General Practitioners (GPs). It is also envisaged that all of England's acute and mental health hospital Trusts will become Foundation Trusts. Foundation Trusts have greater financial autonomy and independence from DH control. Since 2004, when the government introduced Foundation Trust status,

some 53% of acute hospital Trusts and 70% of mental health Trusts have made successful applications under the existing regulations.

More recently, significant changes are following the 2010 Coalition Government review of the Programme. The DH review concluded that: *"… a centralised, national approach is no longer required"*.(13) This statement marked the abandonment of the original, top-down approach to achieving nationwide healthcare information exchange through deploying new, standardised IT systems, and the official move to adopting a "connect all'' approach. Embracing greater local choice for NHS organisations and the opening up of NHS IT markets to multiple systems suppliers are likely to be accompanied by a substantially reduced Programme scope. The national infrastructure delivered through the Programme is to be retained, while applications common to all NHS organisations, such the electronic appointment booking service, Choose and Book, are to become services under the control of the NHS. Simultaneously, the centrally negotiated and managed contracts to deploy NHS CRS systems in all of England's NHS hospital Trusts are being pared back. Under the reduced contracts, the Programme aims to deliver a smaller number of more limited hospital EHR implementations between now and when the contracts end in 2015.

Finally, at the time of writing, a public consultation on future NHS IT policy – for an "information revolution" – has just closed, with an announcement on the consultation outcome expected later this year.(14) The "vision" for an information revolution, in keeping with the policy document, *Equity and Excellence: Liberating the NHS*, simply alludes to people having: "… an accurate record of their care, available to them electronically".(12) This may be contrasted with the originally planned NHS CRS, which it was hoped the Programme would deliver.

1.3 The NHS Care Records Service

1.3.1 The originally envisioned NHS CRS

The original plan for the NHS CRS was to deploy a few, centrally selected and procured NHS CRS applications for hospitals (and to an extent for the community). This was predicated on achieving national connectivity through rigorous systems standardisation at the regional level. The applications would enable the creation of detailed, longitudinal EHRs that would be set up, stored and updated locally during each episode of routine care. Every patient would also have an electronic Summary Care Record (SCR) created for him or her to hold brief, clinical information that could be accessed from anywhere in the country, at any

time of day or night, to support appropriate care giving in emergencies. The SCR would be centrally stored on the NHS Spine, a national database and messaging application, and together with the local, detailed electronic record, would create each individual's NHS CRS.

1.3.2 The Programme's NHS CRS delivery strategy

The DH first divided England into five, geographical, implementation "clusters". Tenders were then invited for a LSP to implement new or replacement IT systems to build into the NHS CRS in each of these. In 2003/4, 10-year LSP contacts were awarded to: Computer Sciences Corporation (CSC) to deliver the NHS CRS in the then North West and West Midlands cluster; British Telecom (BT) Capital Care Alliance for the London cluster; Fujitsu for the Southern England cluster; and Accenture for both the North East and the Eastern England clusters.

Accenture withdrew from its contact after three years (in 2006). Its former areas were taken over by CSC, leaving three LSPs in the Programme. These three LSPs were subsequently reduced to two; legal negotiations between the DH and Fujitsu to revise the original contract for the South of England stalled in 2007/8, and the LSP contract with Fujitsu was terminated in May 2008. This placed the South of England area in an anomalous position in the Programme. It now had no LSP to deploy a single, regional solution for EHRs in secondary care.

By the end of the year in which the evaluation reported here began – 2008 – the delivery strategy was for hospital Trusts in the South to choose to take NHS CRS solutions from either of the two remaining LSPs (BT in London, and CSC in the rest of England) or to deploy new IT systems using other suppliers approved in an Additional Supply Capability and Capacity (ASCC) list (see Figure 1.1). The National Audit Office noted that the Programme's deployment plans were four years behind schedule.(15)

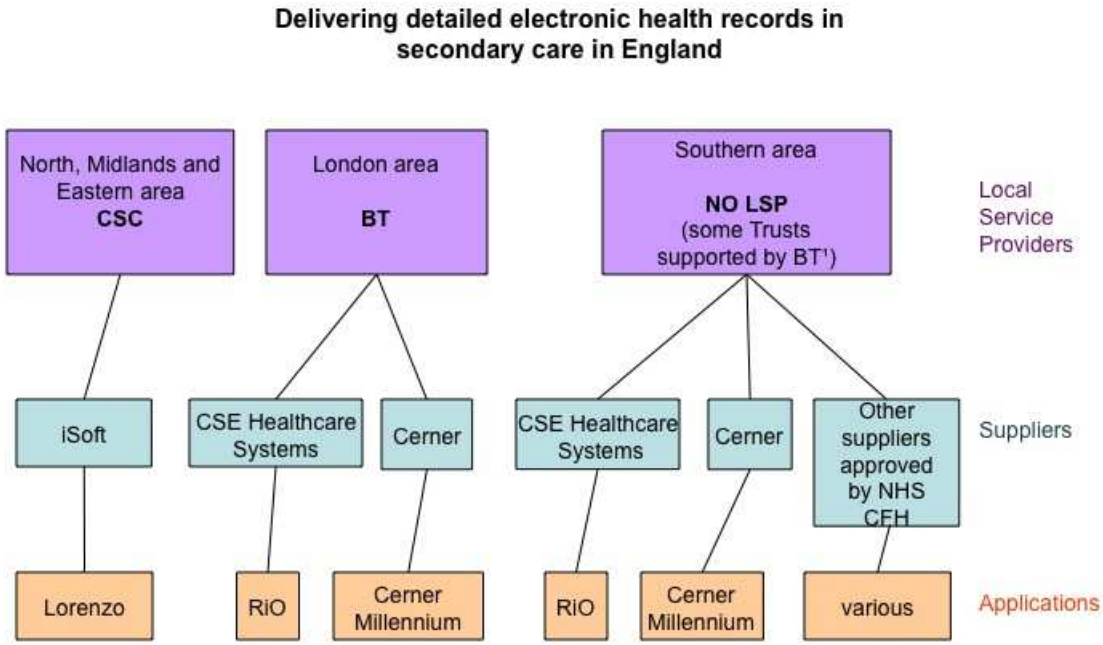


Figure 1.1: The delivery structure for implementing the NHS CRS (16)

1.3.3 The NHS CRS suppliers and applications

Initially, the LSPs' chosen solutions were to be introduced to all hospital and selected community Trusts in a Programme cluster, with a scheduled timeline of deployment "slots". The plan was designed to allow LSPs to deliver incremental releases in the functionalities of the NHS CRS applications to hospitals. The bundled releases planned for BT's solution for acute hospitals, Cerner Millennium (hereafter referred to as Millennium), are shown in Figure 1.2. Those for Lorenzo Regional Care (hereafter referred to as Lorenzo), the CSC solution, are given in Figure 1.3.

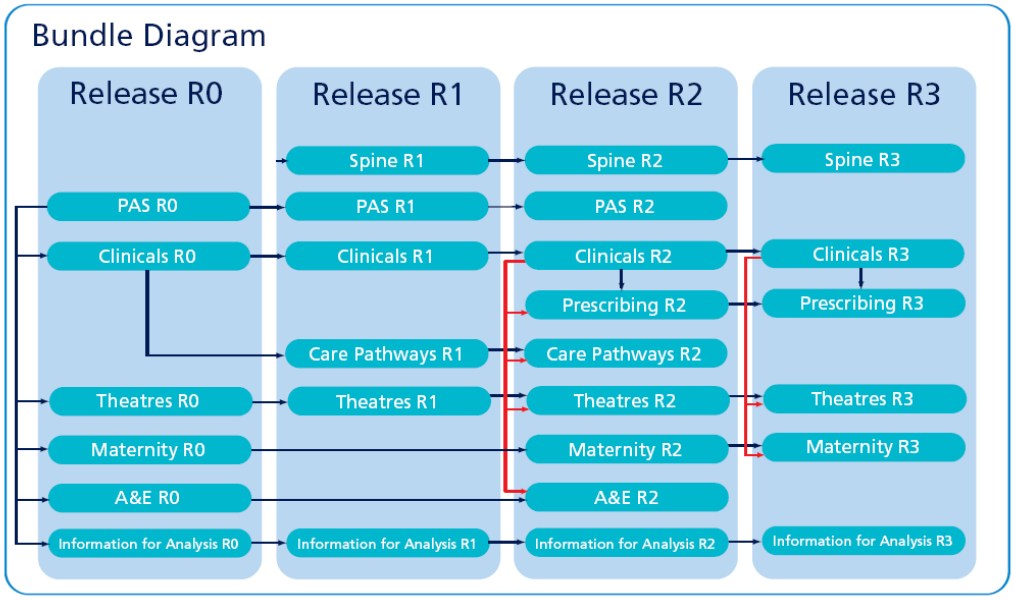


Figure 1.2: The intended phased implementation of Millennium Software in London (17) (permission to reproduce in the process of being applied for)

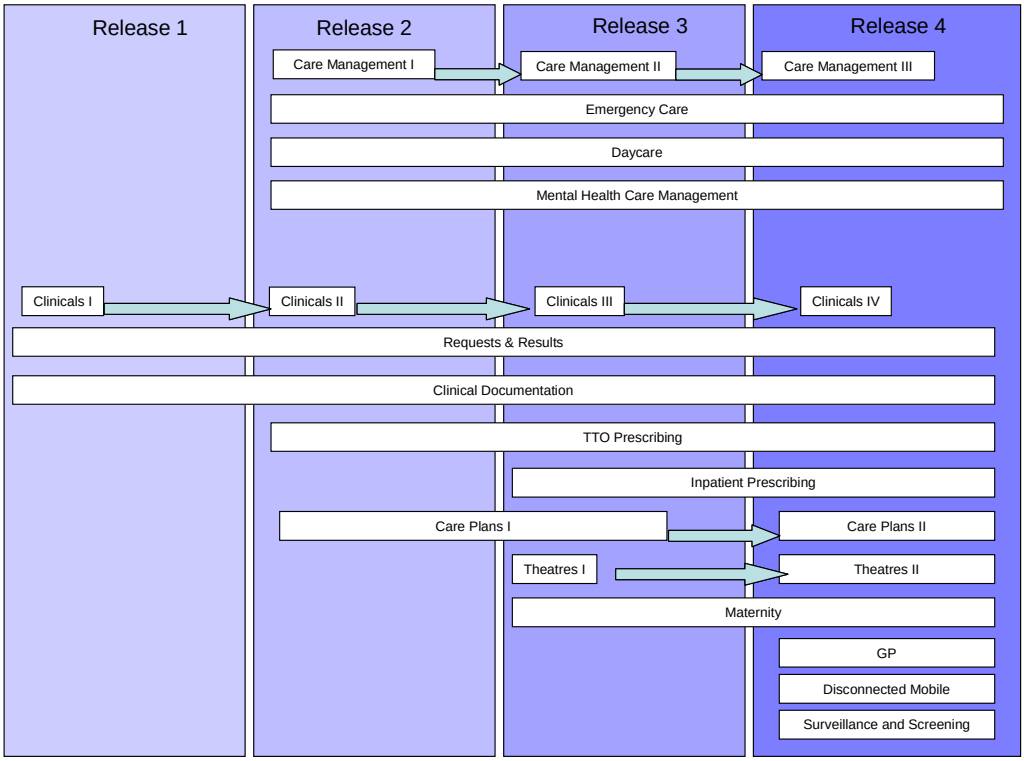


Figure 1.3: The intended phased implementation of Lorenzo software (18) (permission to reproduce in the process of being applied for)

Each LSP was given responsibility for choosing and sub-contracting a software supplier. CSC chose iSOFT and, with them, planned to develop, build and deploy a new NHS CRS

application, Lorenzo. Cerner is the supplier sub-contracted by the LSP, BT, to provide Millennium, which was already an established healthcare IT system in the USA. However, Millennium was only adopted as the strategic solution for acute hospitals in London after an initial arrangement for a different, single, London-wide solution had fallen behind schedule: a contract re-set in 2005 first saw "interim solutions" for London – Millennium, and the CSE-Servelec (subsequently CSE Healthcare) web-based application, RiO, for community and mental health Trusts. Initially in 2004, BT had chosen an IDX solution for both acute and mental health Trusts in London, mirroring Fujitsu's decision to sub-contract IDX for its NHS CRS solution in the South. Fujitsu subsequently replaced IDX with Cerner.

In London, both RiO and Millennium were adopted as the strategic solutions after a further contract re-set in 2006, which moved BT away from aiming for a single supplier (IDX) for London and endorsed the LSP's use of multiple suppliers in a "best of breed" approach. The history leading up to the current LSPs' NHS CRS-related solutions for secondary care is given in Box 1.2 and the present position illustrated in Figure 1.1.

1998 • NHS Executive commits to detailed EHRs
2002 • National Programme for IT for England (the Programme) starts • Richard Granger appointed NHS Information Technology Director
2003/4 • BT awarded contract for the central database and messaging service, the NHS Spine • LSP 10-year contracts awarded: CSC - North West and West Midland cluster; BT Capital Care Alliance – London cluster; Fujitsu - Southern cluster; Accenture - North East and Eastern England clusters • CSC plans to work with subcontracted supplier, iSOFT, to develop a new application, Lorenzo; BT and Fujitsu plan to work with subcontracted supplier, IDX Corporation, to implement the application, Carecast • BT awarded N3 (NHS broadband network) contract
2005 • NHS CFH set up to deliver the Programme • BT contract re-set 1 for "interim solutions" in London (until Carecast strategic solution becomes available) • Fujitsu replaces IDX as its supplier and subcontracts instead to Cerner to supply Millennium in

the Southern cluster
2006 • Accenture withdraws as LSP; CSC awarded 9-year contract for Accenture's former clusters • BT drops Carecast as a London-wide solution and appoints Cerner as its main subcontractor for acute hospitals in London • "New Route Map" for London proposals include: o "best of breed" approach, i.e., three main subcontracted suppliers instead of one – to supply Millennium for acute Trusts; RiO for community and mental health; and INPS Vision for general practice o London-wide integration engine, connected to the NHS Spine, proposed to enable London Shared Patient Records
2007 • NLOP introduced (devolved responsibility for local delivery of the Programme from NHS CFH to groupings of Strategic Health Authorities; replaces original, 5 clusters with 3 Programme areas - Southern (LSP, Fujitsu), London (LSP, BT) and NME (LSP, CSC) • BT contract re-set 2 for "best of breed" London solutions
2008 • Fujitsu LSP contract in Southern area terminated, leaving no LSP in Southern area • BT contract re-set 3 negotiations for New Delivery Model in London (to permit London Trusts – limited – opportunities for local configuration and build of Millennium and mixing components from originally planned Release Bundles (see Figure 1.2)) • Richard Granger, head of NHS CFH, leaves in January; Gordon Hextall, acting head, leaves in April; Christine Connelly and Martin Bellamy appointed to jointly lead NHS CFH in September
2009 • BT awarded additional contract to take over 8, formerly Fujitsu/Millennium Trusts (7 following merger of 2 Trusts), plus 25 Trusts for RiO and 4 additional, acute Trusts in Southern area • Other Southern Trusts given choice of LSP solution from BT or CSC or from various suppliers in ASCC • Martin Bellamy, Director of Programmes and Systems Delivery, NHS CFH, resigns • NHS CFH, headed by Christine Connelly, Chief Information Officer for Health at the DH, is integrated with DH Informatics Directorate • Parliamentary announcement of contract renegotiations with BT and CSC/seeking NPfIT cost savings
2010/11 • May: UK General Election: New Labour Government replaced by a Conservative-Liberal

Democrat Coalition Government

- New Memorandum of Agreement signed between BT and NHS CFH for reduced number of NHS CRS deployments in London; also negotiations to pare back LSP contract with CSC
- London-wide integration engine plan dropped
- Government review of the Programme confirms that the original, standardised "replace all" approach is to be replaced with a (standards and interoperability-based) "connect all" approach; NHS IT markets opened up to multiple suppliers
- Outcome of a Department of Health Public Consultation on NHS IT expected in 2011

Box 1.2: History of the National Programme for IT and its Local Service Providers and suppliers for the NHS Care Records Service

1.4 Evaluating electronic health record systems

In planning this evaluation, we reviewed the expanding body of literature on the evaluation of EHR implementations in individual hospital settings and of small-scale or focused IT implementations.(19-23) Given that there was very limited experience with implementing large-scale, national IT systems in healthcare until recently, there is limited, directly relevant evidence available that could be drawn on to guide our evaluation and, as has become apparent through subsequent publications, the best evaluation methods are contested.(24-26)

More generally, it is apparent that the wider field of health information systems evaluation has over the last two decades broadened from a narrow focus on understanding the "economic benefits" of EHRs to a wider set of interests and concerns, including assessing their "impact" on the quality, safety and efficiency of patient care – the term "impact" implying a strong, temporally focused and unidirectional causality at the heart of the evaluation practice.(27) This concern with assessing impact has led to calls from some quarters for the greater use of randomised controlled trial (RCT) designs.(28) These calls have however been countered by arguments that, despite their apparent robustness, RCTs are impractical due to the impossibility often of randomising parts of a hospital or hospital system, and by more fundamental concerns regarding attempts to "control" for potentially important effect mediators and the difficulties of measuring the effects of a generic health service innovation on a diverse array of outcomes.(24) One response to such concerns has been the argument for more "quasi-experimental" or "observational" studies evaluating EHRs in practice.(29)

More recently, it has become common to find the implementation of EHR systems described as complex change management interventions that require a well-articulated vision and

strategy, strong leadership, appropriate resources, good project management, an enabling organisational culture, effective communication and attention to human resource issues.(23;30) The importance of four key components – technical, human, project management, and "organisational and cultural" change – has been emphasised as necessary for ensuring a successful process of adopting EHRs.(2;31;32) These components and their interconnections highlight the need for multi-faceted methods to reflect far more complex challenges than those that relate solely to the technology. Thus evaluation is moving towards an approach that can encompass the complex environment in which the technology is introduced and used.(33-35) This has catalysed a shift towards using multi-method approaches that allow exploration and contextualisation as part of evaluation.(29;36-38) This view assumes that EHRs are not simple IT projects amenable to management control, but are interrelated with organisational and social dimensions.(39) It is also now increasingly accepted that evaluation activities need to be formative and multi-faceted so as to capture the experiences of implementation as perceived by diverse stakeholders in complex healthcare settings.(25;36;40-42) Such approaches seek to integrate quantitative and qualitative components ("methodological pluralism") in order to assess not only the outcomes and consequences of EHRs but also to explain how they come to work (or conversely how and why they fail to work).(43-46) Imaginative approaches to evaluation in this spirit are able to bypass assessing progress against predefined criteria and milestones, and give researchers the opportunity to 'tell the story'.(47)

1.5 The structure of this report

After this introductory chapter, Chapter 2 gives the aims and objectives of our evaluation of the NHS CRS in secondary care, and this is followed by an overview of the research strategy and methods that were employed in our evaluation (Chapter 3). The more detailed objectives, methods and main findings of the various facets of our evaluation are then presented (Chapters 4-7), beginning with themes derived from qualitative data from multiple case studies (Chapter 4). Chapter 5 details related investigations to try to understand the local costs in NHS CRS-related implementations. The report then presents quantitative work undertaken in hospital outpatient clinics, which aimed to assess the consequences of IT implementations for patient safety through a cross-sectional and controlled, before-after study of the completeness of information available in clinics (Chapter 6). These findings are drawn together and expanded in Chapter 7, where the content attempts to provide a broader context for the evaluation and begin to tease out the implications of this work. Finally, Chapter 8 summarises the findings from the overall evaluation and presents the conclusions and policy recommendations that may be drawn from this research. Relevant supporting

material is presented in the Appendices. Recognising that some readers may only read certain chapters, all abbreviations are spelt out in full with the first usage in each chapter. Key terms are also explained in the glossary.

We are currently working on a number of more academic presentations and publications that will draw on and develop further the themes covered in this report.

Chapter 2: Aims and over-arching objectives

2.1 Aims

We sought to undertake a formative and summative evaluation of the implementation and adoption of the National Health Service Care Records Service (NHS CRS) with a view to informing local and national strategic implementation decisions on the implementation and adoption of the NHS CRS. In doing so, our aims were to:

- Investigate the early releases of NHS CRS systems (i.e. Lorenzo, Millennium and RiO) across a variety of dimensions that are reflected in our six work-packages (WPs).
- Liaise with NHS Connecting for Health (NHS CFH) throughout the evaluation in order to inform both local implementation and plans for the national roll-out of the NHS CRS.

2.2 Objectives

Our main over-arching objectives were to:

- Explore different implementation processes of the NHS CRS within their wider organisational, political and economic contexts.
- Explore the attitudes, experiences and expectations of the various stakeholder groups over time.
- Investigate the evolving organisational consequences expected, for example, in relation to organisational workflows, professional role and data quality transformations.
- Assess and understand the costs of NHS CRS implementation.
- Investigate whether the introduction of the NHS CRS resulted in improvement in the quality of care.
- Summarise and integrate the findings with wider contextual considerations and make suggestions for future deployments and research.

Research activities were organised into six complementary WPs that were approached as methodologically closely related and, where appropriate, as sharing theoretical approaches, field work activities in data collection, and analytical themes. Each WP had its own more specific objectives (see Chapters 4-7).

Whilst our core aims and objectives remained, we, for several reasons beyond our control, needed to rethink some of the premises underpinning the commissioning brief and our response to this, and, with the support of the funders and guidance of our Independent Project Steering Committee, realign the focus of this work and revise some of our more detailed objectives. The main reason for this realignment was the very limited deployments of the NHS CRS and, even in instances where systems had been deployed, the limited clinical functionality of these systems. This therefore led us to focus more on the formative local component of our work. Furthermore, the fact that ePrescribing functionality had not been deployed rendered it impractical to conduct our planned quasi-experimental evaluations in relation to assessing the impact of the NHS CRS on this important safety indicator. There was also a strategic shift from a top-down deployment of a limited number of standardised software systems to an increasing emphasis on local choice in relation to the system functionalities that were to be implemented, hence our move to a case study-based approach (see Chapter 3). This shift towards a more locally tailored approach was accelerated following the May 2010 election and the associated change in government. We also (in keeping with national bodies such as the Audit Office and Public Accounts Committee) faced challenges in accessing relevant financial information on the costs of deployment, these being explained by reference to confidentiality clauses and concerns about the releases of commercially sensitive data, which also necessitated a change in emphasis in relation to some aspects of our economic work (48;49). Although some revisions to our research plans were necessary we remained, as far as possible and appropriate to do so, true to our original detailed research objectives. We have, in the interests of transparency, detailed our original research objectives in Appendix 1 and detail our revised objectives in relevant chapters focusing on individual WPs in detail (see Chapters 4-7).

Chapter 3: Overview of methodology

3.1 Introduction

We conducted a prospective multi-faceted mixed methods evaluation of the implementation and adoption of the NHS Care Records Service (NHS CRS) in order to generate insights that could support the implementation of the NHS CRS in 'early adopter' sites (formative assessment) and the future roll-out of the NHS CRS to other settings (summative assessment). The research was classed as a service evaluation by the NHS Research Ethics Committee (ref. 08/H0703/112; see Appendices 2 and 3 for details on approval documentation). This Chapter provides an overview of the overall methodology employed in this evaluation; more details of our methods in relation to individual work-packages (WPs) are provided in Chapters 4-7.

Our plan was to track developments over time in a number of NHS Trusts across England, undertaking a series of before-during-after assessments. Although commissioned to begin our research well after the start of the Programme, because of the delays in implementation, we still began our evaluation before any substantial implementations of the NHS CRS had taken place. These delays however continued well into our evaluation period, which made it impossible for us to pursue the original plan of assessing these software systems once they had had an opportunity to embed within NHS sites. Our evaluation was also hampered by the fact that the implementations that did begin tended to involve limited deployment of clinical functionality, which impacted on our ability to study the proposed safety and quality indicators. Also of relevance was that there was a discernible move away from "standard" solutions to more customised deployments in which NHS sites not only had a degree of choice in the particular safety modules to be deployed, but also in the approach to implementation. These changes forced us to reconsider aspects of our plans, moving to a predominantly qualitative case study-based approach. Quantitative aspects of our original research approach were however maintained in as far as it was still appropriate to do so.

3.2 Theoretical background and approach

Our original proposed theoretical approach was informed by a "realistic evaluation" perspective,(46) which sought to understand what works and for whom and in which contexts. However, because of the changing landscape and our evolving appreciation of the nature of the NHS CRS, and its various manifestations, we shifted towards a more focused

sociotechnical approach drawing primarily on Cornford et al.'s (1994) sociotechnical framework to help shape and frame data collection and analysis (this will be explained in more detail in Chapter 4).(50)

Our initial plan was also to study quantitatively the effectiveness of the NHS CRS in improving safety outcomes relating to prescribing indicators, the quality of information provided on discharge and missing information in outpatients departments using a quasi-experimental design. The proposed stepped-wedge design would have allowed us, we envisaged, to undertake a series of controlled before-after evaluations as deployments of the NHS CRS proceeded (see Chapter 6).(51) However, it became clear that, in the light of our emerging understanding of the implementation landscape, this approach was no longer appropriate for a variety of reasons, these including:(52)

- The original assumption underpinning the research call and our proposal was that the different software systems that constituted the NHS CRS (see Chapters 1 and 4) would all provide broadly comparable functionality such that it was possible to make an overriding assessment of the effects of the NHS CRS; shortly after beginning our fieldwork, it however became clear to us that this was more aspirational rather than reflecting the reality on the ground.
- There were furthermore major regional changes, such as the withdrawal of a Local Service Provider (LSP) in the South and contract renegotiations in the North, Midlands and Eastern (NME) and London regions, which needed to be accounted for in our evaluation.
- Considerable delays in the implementations in all regions resulting, for example, from delays in release of software updates.
- The limited clinical functionality being deployed.
- Trusts developing their own local deployment strategies by prioritising and working on the functionalities they were most interested in, resulting in difficulties in making any meaningful comparisons between sites with their varying software and implementation processes.

In view of the above initial insights, it became clear that we needed to focus less on the NHS CRS as a discrete entity and more on how the NHS CRS comes into being (is formed) through people's understanding and actions, i.e. how it is "performed".(53) This led to shifts in our approach; the focus was now directed, not so much on evaluating and thus making implicit judgments as to what was ultimately achieved, but more to *understanding* and *narrating* the stories of the *NHS CRS in-the-making* through the lens of a sociotechnically framed and performative, rather than a deterministic and linear ontology.(44;54) Case

studies allowed us to acquire insights into the implementation and adoption strategies of 'early adopter' sites by enabling us to understand how *they* understand the NHS CRS, the processes of change it triggers, the reasons for adopting particular strategies, as against others, and the expectations relating to these implementations.

Our case studies were in-depth and longitudinal; their purpose was to understand how each site perceived and performed the implementation and adoption of the NHS CRS from inside,(55-57) and how this varied over time. We spent considerable time in the settings we investigated, interviewed the range of people who were affected by these implementations, observed their practices (whenever this was possible) and read through a variety of documents that provided contextual insights.(58) In doing so, we gained rich insights into the complexities associated with individual sites.

We defined a case study as a NHS organisation (Site) which planned to and/or commenced implementation of one of the three core NHS CRS software systems (i.e. Millennium, Lorenzo or RiO) as part of the National Programme for Information Technology (NPfIT), in which we undertook qualitative or quantitative field work. Our field work was undertaken predominantly in those sites that ultimately satisfied this definition, but some field work was also undertaken in a broader range of sites from which case study sites were ultimately selected. Appendix 4 gives a summary of each individual case study in this evaluation.

3.3 Sampling

The general rationale for sampling case study sites and interviewees was adopted from Patton:

> "*Qualitative sampling designs specify minimum samples based on expected reasonable coverage of the phenomenon given the purpose of the study and stakeholder interests"* (59)

We considered the importance of broadly considering Patton's phrase "stakeholder interests" to select participants using purposive sampling to identify diverse Trusts (teaching versus non-teaching hospital, Foundation versus non-Foundation, and acute versus mental health settings) across the Programme's geographical implementation areas (i.e. London, NME and Southern England) and to include sites implementing all three, centrally procured hospital applications (Lorenzo and Millennium for acute hospitals and RiO for mental health).(59) We sought to have a sample of 'early adopter' sites at which NHS CRS-related activity was

taking place and from where the breadth and, more importantly, the depth of enquiry could generate potentially transferable lessons.(60;61)

Within each of the case studies, we aimed to recruit a diverse range of interviewees, actively seeking different perspectives.(62) We used a purposive sampling strategy to identify relevant individuals at the Trust level, and if appropriate beyond, using snowball or chain sampling.(63) Trust interviewees from case studies included hospital and community mental health managers, implementation team members and IT staff, doctors, nurses, allied health professionals, administrative staff and, where appropriate, patients and carers. In addition, we purposively sampled knowledgeable individuals who were not NHS Trust staff and who offered additional perspectives on implementing the NHS CRS. Interviewees here came from NHS Connecting for Health (NHS CFH), Strategic Health Authorities (SHAs), LSPs, and system developers.

3.4 Methods

In keeping with the aims and objectives of our study, multiple methods were used to collect data in this evaluation. Qualitative data collected at each case study site consisted of Trust documents, transcripts of semi-structured, face-to-face, telephone and email interviews, on-site observations and accompanying field notes (see Table 3.1 for our complete dataset) and surveys and questionnaires for quantitative assessments. We also reviewed specialist IT publications, national media reports and publications by parliamentary and professional bodies to track the wider context, or macro-environment, in which implementation took place (see Chapter 7). Where possible and relevant, data collection at each site took place in two phases, namely Time 1 (T1) and Time 2 (T2), attempting to consider a six to nine months gap between the two phases. T1 data collection finished at each of the case study sites when the research team judged that saturation had been achieved, i.e., no new, rich, diverse data relevant to the evaluation were being acquired. This was in part influenced by setting factors, such as the scale of the deployment at the site (e.g., limited to a ward or hospital-wide) and type of functionalities being introduced (e.g., ordering tests or clinical notes). Data collection periods varied by site (see Table 3.1); all of the data reported here were collected between February 2009 and January 2011. Where possible, we revisited sites at T2 in order to understand how implementation had progressed.

Total number of interviews (by Work Package)	Hours of on-site observations; no. of sets of field notes	Total number of documents collected	Quantitative data collected (surveys)
Total: 431 interviews (WPs1-3: 301 WP4: 37 WP5: 58 WP6: 35)	590 hours of observations; 234 sets of field notes	809	130 CLICS surveys; 4,684 outpatient surveys

Table 3.1: Overview of our complete dataset

Our research was conceptually divided into six inter-related work-packages (WPs), reflecting the various qualitative and quantitative aspects of interest. Figure 3.1 below presents a diagrammatic overview of these WPs and their inter-relationships.

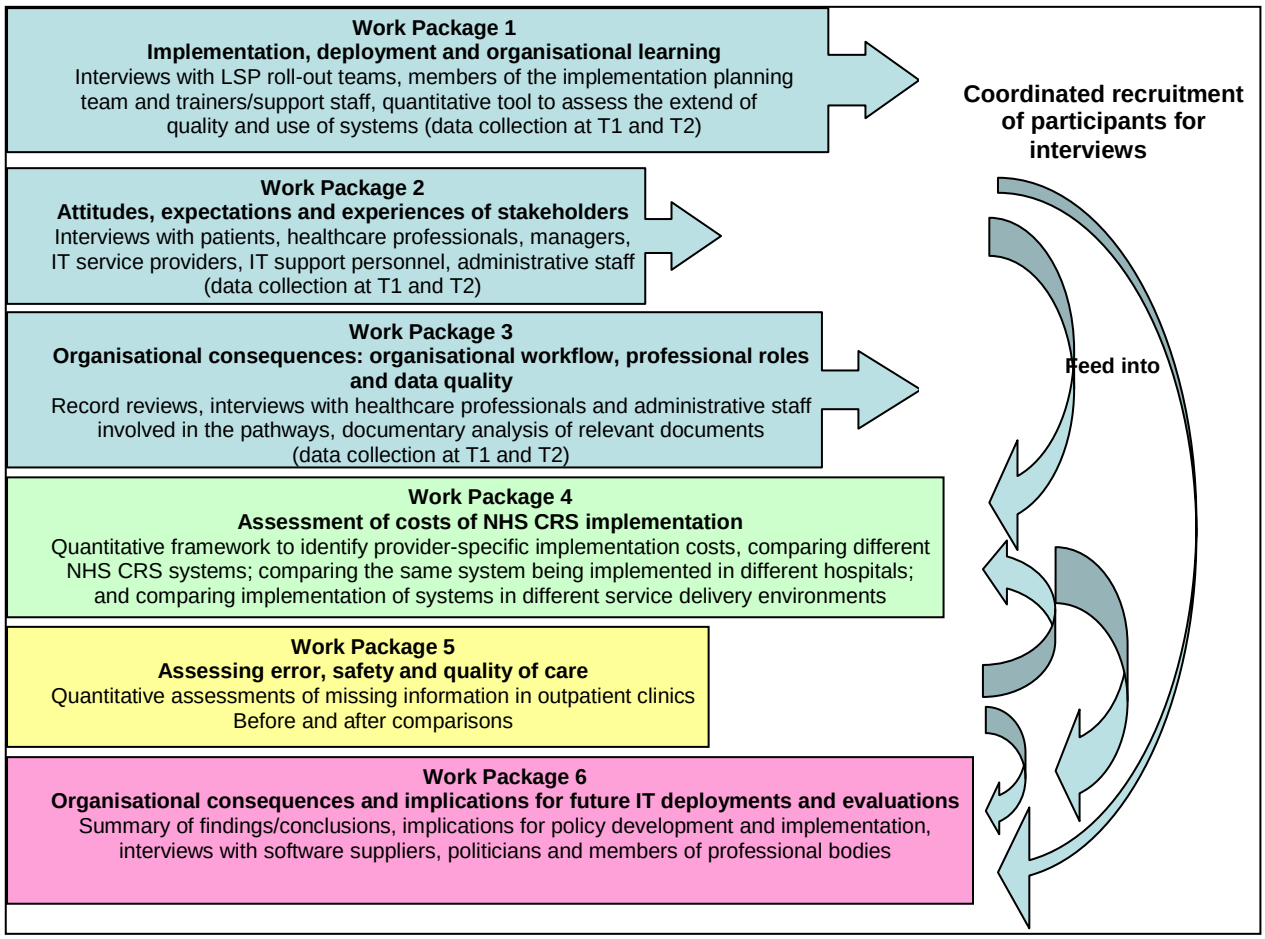


Figure 3.1: Diagrammatic overview of our research

In the following paragraphs, we provide a broad overview of the qualitative and quantitative

methods employed in our work. More detailed methods in relation to individual WPs can be found in Chapters 4-7.

3.4.1 Our qualitative work: interviews, observations and documentary data

Semi-structured interviews

Interviews were the main method of data collection for the qualitative parts of this evaluation. We explored perceptions, meanings, attitudes, past experiences, definition of situations, and constructions of a reality in relation to the NHS CRS.(59) We used a generic guide adapted to particular groups of interviewees (see Appendices 5-10). These consisted of a combination of open-ended core questions and more in-depth probes.(64) Specific questions emerged as the interviews unfolded, and the wording of those depended very much on the directions the interviews took.(65) Interviewers tried to be open-minded, to introduce divergent questions at the times, and also to take into account any new concepts and frameworks proposed by the interviewees.(66)

In addition to an explanation of evaluation and interviewees' rights, interviewees were, where possible, provided with an information sheet containing a summary of the study, expectations from the interviews, their rights, their potential contribution to the study, ethical considerations like data confidentiality, and the lead researcher's profile and contact information at least several weeks in advance. This was however not always possible as some interviews were conducted more opportunistically. Most interviews were digitally audio-recorded (with the interviewees' verbal consent). For some interviews, participants requested not to be recorded, in which case the researcher took notes. The recording was checked after each interview, the interview process critically reviewed, and the interview schedule amended if necessary. Professional transcribers transcribed the interviews verbatim, with the interviewers then checking the transcripts for accuracy. Copies of the transcripts were, wherever possible, made available to interviewees, although only a minority requested to see these. Occasionally, some direct attributable quotes were also checked with interviewees.

Observations

To complement the interviews, some researchers observed the changes in actual practices in hospitals and some affiliated community centres across the recruited Trusts and took notes relating to these observations. The approaches adopted varied including use of a simple checklist for observing various NHS CRS applications in use, computers, facilities,

practices, and how staff used the NHS CRS in their day-to-day practices. Where possible, some researchers also sat with staff to observe different NHS CRS applications and the ways in which these interfaced with, for example, the Spine, the way they used their SmartCards, the log-in, and the way they put notes on the NHS CRS application. Some researchers were given a personal informal presentation of the NHS CRS application in use, usually by a member of the implementation team. Our study team also had in vitro presentations of the major systems of interest (i.e. Lorenzo, Millennium and RiO), these being arranged with the support of NHS CFH. In addition, some Trusts invited the lead researchers to sit in NHS CRS Board meetings and user group meetings as an observer, which was a useful and informative means to update the latest status of deployment in details and to identify potential interviewees for our ongoing evaluation.

Documentary data

Documents including public papers, agenda papers, internal documents, minutes of various meetings, correspondence, bills and legislations, annual reports (official and unofficial), reports on evaluation of practitioners' performance, magazines, newspapers, emails, etc, were a rich source of data in this evaluation (see Appendix 11 for a sample list of documents collected).(64) Given the early stages of NHS CRS implementation, documents were the only source of data for some particular aspects allowing access to a set of events and processes that was otherwise unavailable.(67) Information derived from documents was utilised either straightforwardly or interpretively, to produce primary research findings or for verification purposes.(59) Documents were also used as supplementary sources of data to validate other data.(65) We further used documents to enhance our understanding of the NHS CRS, its history, the measures to materialise its deployment, understanding the strategy for implementing the NHS CRS as well as to provide some quantitative data.

We used a range of documents published by government bodies, particularly the Department of Health (DH), NHS CFH, the National Programme for Information Technology (NPfIT) and the London Programme for Information Technology (LPfIT), the Public Accounts Committee (PAC), and a substantial number of documents from participating Trusts. We also treated contents of some specific websites such as media articles and NHS CFH as "documents" to help us keep abreast with key developments. We in particular selected documents that:

- Explained the history of development of the NHS CRS

- Reported the progress of implementation and adoption of the NHS CRS and challenges ahead
- Described the policy, its benefits, prospective outcomes, etc
- Expressed business plans, expenditure, scenarios for deployment, risks and benefits; lessons learned
- Explained progress of implementation, stakeholders' attitude and decisions made to address such concerns, and organisational correspondences
- Prepared to educate various groups of practitioners and public regarding the NHS CRS applications and their revisions.

Examples of specific documents collected from Trusts included: copies of the Trust's organisational structure; NHS CRS deployment timelines; Project Initiation Documents (PIDs); Business Cases; Risk Registers; minutes from NHS CRS-related board meetings; lessons learned documents; training strategy documents; and annual reports. Additional relevant local documents, such as work process maps, were collected where these were accessible. A comprehensive list of the documents that were obtained and studied is available on request.

Data analysis

In most qualitative research, analysis begins during data collection; this has the advantage that any early and developing insights can shape further data collection.(59) Adopting this sequential or iterative analysis had the advantage of enabling us to go back and refine questions, develop hypotheses, and pursue emerging avenues of inquiry in later interviews and observations.(68;69)

Designated lead researchers undertook both the data collection and led the analysis of individual case studies. Researchers combined deductive, thematic coding guided by a matrix of sociotechnical factors and inductive coding that allowed themes to emerge from the data without prior theoretical categorisation.(50;60;61) This involved immersion in the data, which was achieved by repeated reading of interview transcripts, discussion amongst team members, development of provisional analytic categories/themes through comparisons with our theoretical lens and other secondary studies, and iterative refinement of these categories using the constant comparative method (comparing our analysis to date with new data as these emerged).(70) Comparison of findings across and between case studies was achieved through qualitative workshops which allowed individuals to present and share their case

study findings and then reflect collectively on the interpretation of these in the light of other ongoing case studies.

Documents were analysed in a similar way by following an inductive thematic analysis. During analysis emphasis was placed not only on the content of the documents, but also on the context they were describing and within which they were produced.(71) Document analysis intermingled with the analysis of transcripts and observation notes in order to produce an integrated account of the cases under study.

3.4.2 Our quantitative work: undertaking a cost analysis and quality, safety and error assessments

As already noted, we needed to reconsider aspects of our quantitative work. The changes made are outlined below, with a more detailed discussion in Chapters 5 and 6.

For the economic work (WP4), we set out to assess implementation costs and develop a framework for costing that could be rolled-out to Trusts as the NHS CRS was implemented. We faced a number of challenges in achieving this goal, these including: the widely acknowledged delays in implementing different NHS CRS systems; difficulties in making meaningful comparison across sites because of varying functionalities in different releases; and, most importantly, a reluctance to provide documents containing cost information at a Trust level – perhaps even more so following the election of an austerity focused Coalition Government.(72) These challenges substantially limited access to relevant quantitative data – particularly financial data – that we could obtain. These difficulties were regularly communicated to NHS CFH and the NHS Connecting for Health Evaluation Programme (NHS CFHEP), but they too appeared powerless to provide such data.

In light of these challenges, we aimed to construct a generalisable model of implementation costs at the Trust level based upon their individual experiences. We used a combination of available cost data, additional available documentary evidence and a number of semi-structured interviews with, amongst others, finance managers and IT implementation leads, the purposes of which were to:

- Identify the costs involved in implementing electronic health record (EHR) systems into NHS secondary care sites
- Derive cost categories and explore the factors that impact on the amount of resource spent by Trusts in each of these cost categories.

Our other quantitative WP aimed to assess the error, safety and quality of care (WP5), with a focus on those outcomes that were most likely to be influenced by the early releases of the NHS CRS. Significant health outcomes were unlikely to be detectable within the study timeframe, and thus indicative process measures were chosen. Four measures were planned: medication errors; medicines reconciliation on hospital admission; completeness of information provided at hospital discharge; and availability of key information in medical records in hospital outpatient clinics. However, as our work progressed, it became apparent that the repeatedly "revised" (delayed) timescales for NHS CRS implementation would no longer marry with our evaluation timeline. The clinical functionality, which would influence the first three process measures, was unlikely to be in place during the evaluation period. Consequently, although data collection tools for all four measures were developed and piloted, only the availability of medical records was actually pursued.

3.5 General methodological considerations

Prior, informed consent to join the evaluation was obtained from participating NHS Trusts, and researchers complied with local requirements for approvals on a case-by-case basis. Informed consent was also obtained from participating individuals. We have, as far as possible, sought to protect the anonymity of participating sites and individual participants by removing identifying information from the data.

Despite traditional attention to the content of the policy implementation rather than the process, this evaluation concentrated much on the processes contingent on developing and implementing change and the context within which the policy was developed.(73) This was necessary to avoid diverting attention from understanding why desired policy outcomes failed to emerge. We therefore focused on process rather than on the outcomes or impact of the NHS CRS, acknowledging Reich's (1994) argument that policy reform is a profoundly political process, affecting the origins, formulation and implementation of policy.(74) In addition to difficulties in assessing outcomes only months after start of deployment of the NHS CRS, evaluating process brought advantages over outcomes. First, comparisons were not essential in studying the implementation process. Second, direct study of processes helped identify the obstacles and deficiencies of implementation which needed to be remedied,(75) which was in line with formative element of our evaluation. Finally, there were some examples of failure in the process which were likely to lead to poor outcomes.

The evaluation also aimed to identify and explain why the NHS CRS on paper was widely different from what was executed. It was essential therefore to get at the narrative behind the NHS CRS process, to explore the phenomenon from the perspective of those involved, and to analyse their views, opinions, and actions. It needed immersion in the policy debates that took place to identify ideas that were held and influences that held sway.

One of the issues in evaluations such as this is researchers' views and position, their institutional base, perceived legitimacy, and prior involvement in policy communities.(76) This is critical to researcher's ability to access the policy setting and conduct a meaningful analysis. This is arguably more important if the analysis requires engaging with policy elites,(77) and when investigating sensitive issues of "high politics",(76) very much the case in our evaluation.

We used a range of approaches to validate data quality and credibility, including checking for face validity, looking for disconfirming evidence, data triangulation by data source and seeking informant feedback.(59) The collaborative composition of our research team enabled researchers to approach the data analysis more critically, corroborate relevant themes to pursue, read and re-read the data to identify supplementary themes worthy of exploration. Researchers tried to remain reflexive during the entire process of the research, and explicit within the analysis.(78) Emerging findings were shared with participating Trusts for their feedback. Transcripts, codes, emerging findings and their interpretations were presented and discussed by research colleagues at each stage of the analysis process in regular team meetings and in multi-disciplinary data analysis workshops and Steering Group and Independent Project Steering Committee meetings. Discussions and feedback supported researcher reflexivity and confirmed the interim results' trustworthiness and credibility.(79;80)

3.6 Chapter summary

This chapter has sought to provide an overview of the approach we planned to and eventually ended up pursuing, explaining our rationale for the changes that were made. Despite these changes, we were however able to maintain key aspects of our evaluation, namely the multi-faceted longitudinal nature of the enquiry, which sought to understand the broad range of consequences associated with and resulting from these deployments, with a focus on the depth of enquiry as a result of which it is we believe possible to generate a number of important potentially transferable lessons. The details of the methods employed

together with the findings from the various WPs are considered in more detail in the following three chapters.

Chapter 4: Understanding local consequences

4.1 Introduction

The first three research work-packages (WPs) and their themes *'Implementation, deployment and organisational learning'* (WP1), *'Attitudes, expectations and experiences of stakeholders'* (WP2) and *'Organisational consequences'* (WP3) were closely interconnected and could not meaningfully be investigated in isolation. Implementation strategies were strongly tied to stakeholders' expectations; individual and collective experiences were shaped by changing organisational work-practices; and organisational learning was both a means and an outcome of individuals' experience of National Health Service Care Records Service (NHS CRS) implementation. This chapter thus presents the findings from these first three WPs in an integrated manner. We start by briefly reflecting on the contexts of implementation and adoption at regional (cluster) level and on the different visions of the NHS CRS as described by different stakeholders. We then report and discuss the different experiences and strategies of implementations, and the negotiated (clinical, technical, institutional and professional) locus and focus of change found in the various healthcare organisations studied. The analysis continues with a focus on the processes of changing, adopting and adapting to the NHS CRS and the manifestation of these processes in work-processes, use of technology and information for clinical and administrative needs and data quality. The chapter concludes with a reflection on processes of organisational learning.

4.2 Aims and objectives

Our aims were to explore past, current and projected NHS CRS implementations and their organisational implications. More specifically, we sought to:

<u>Implementation, deployment and organisational learning (WP1)</u>

- Explore the rationales and strategies of implementation
- Identify the range of stakeholders involved in the implementation process (intra- and inter- organisational), explore their relationships and their modes of working
- Study how the wider context (organisational, economic, political) influenced implementation processes
- Investigate examples of organisational learning and the development of new competencies

- Feedback all the above to support the continuing roll-out of the NHS CRS.

Stakeholder attitudes, expectations, engagement and satisfaction (WP2)

- Explore key stakeholders' (i.e. including patients/carers, healthcare professionals and managers) attitudes and expectations of the NHS CRS
- Explore stakeholders' experiences of the NHS CRS at both early and later stages, where possible and applicable
- Feedback all the above to support the continuing roll-out of the NHS CRS.

Organisational consequences: organisational workflow, professional role and data quality transformations (WP3)

- Explore how the NHS CRS influenced professional roles
- Explore transformations in workflows and work practices
- Investigate the role of IT literacy in the implementation of the NHS CRS
- Investigate data quality changes after the introduction of the NHS CRS.

4.3 Methods

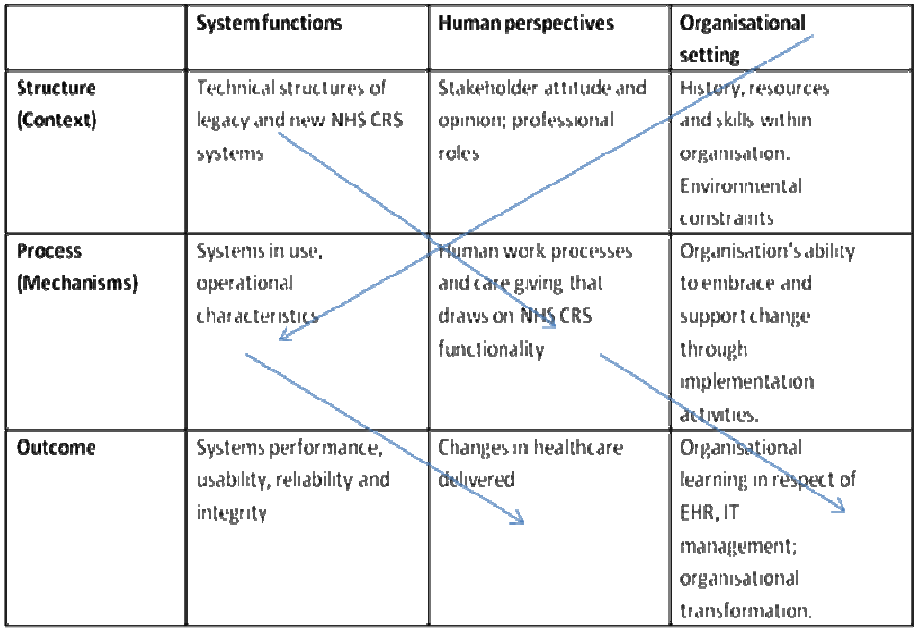
4.3.1 Conceptual framework

We took a sociotechnical approach to evaluating the implementation and adoption of the NHS CRS. In this we were drawn to consider three distinct, but fundamentally intertwined domains: of technology; of people; and of the organisational settings they work within. The world that we studied is one where these three elements, each individually of great complexity, come together and we took it as axiomatic that to understand any one implies and requires understanding of the other two. There is then no "technical" NHS CRS separate from the people using it and the organisations that they participate in (see also Box 4.1).

Implementation versus Adoption	In the context of information technology (IT), the term implementation has always been ambiguous, for instance referring in the structured waterfall model to either the 'building'/'coding' stage (coming after requirements elicitation/high level design, and before integration/testing) or to the stage of 'preparing the system for use' (installation, configuration, data migration, user training, etc.).(81) In the context of the NHS CRS, we use the term to refer to the latter – i.e. from the decision to 'purchase the software package' to the strategies and activities for 'preparing the system for use'. However, in the case of Lorenzo, the design of the system took place during or after its 'implementation' (and this term therefore includes strategies and activities belonging to the stages of requirements elicitation, design, coding, integration, testing). While implementation brings the software system in the workplace, adoption refers to the process by which people within the organisation make it (or not) part of their work practice. The term adoption (and its negative 'non adoption') often implies and/or conveys a view of 'static outcome' of implementation (the software system is either adopted or not) and it is usually seen as synonym of 'use' (or 'non use') of the software. However, adoption as a process could manifest itself in 'use' as originally intended, or in different forms and degrees of 'use' (or 'non use'), potentially constantly evolving.
Customisation versus Configuration	Both configuration and customisation of a software system aim at making an existing off-the-shelf software package (its interface, or its front-end or back-end functionalities) suitable for organisations' context or their technical requirements (e.g. compatibility with legacy systems and infrastructures). However, with configuration we refer to the 'fine-tuning' of the system by using pre-existing software options (e.g. re-programming the software with existing code), while with customisation we refer to the process of changing the software by introducing design/software code especially created for the organisation.
"Working-out"	The expression 'Working-out' signifies a dynamic process of adjustment, adaptation, improvisations and making of meaning that takes place when the new technology is introduced to the workplace. It is a sociotechnical process involving not only individuals in relation to the new technology, but the ensemble of people, existing and emerging work practices and tools, individuals and organisational beliefs, assumptions, and expectations.

Box 4.1: Key definitions

From the initial proposal the research has been based on a sociotechnical model that combined these three domains with the process, structure and outcome framing of Donabedian (see Figure 4.1). This framing was intended to do two specific things. First to ensure that in data collection we considered and collected data relating to each element, second to support data analysis that emphasised the connections between the elements. We need to emphasise that this model is not intended as a means to separate out the three sociotechnical domains, or the structure from process and outcome, and thus to allow some tokenistic and disconnected findings on "social issues". We always remember that the real world of healthcare is not placed into such boxes, but is a layered and complex assemblage of all three domains simultaneously in all three states.



	System functions	Human perspectives	Organisational setting
Structure (Context)	Technical structures of legacy and new NHS CRS systems	Stakeholder attitude and opinion; professional roles	History, resources and skills within organisation. Environmental constraints
Process (Mechanisms)	Systems in use, operational characteristics	Human work processes and care giving that draws on NHS CRS functionality	Organisation's ability to embrace and support change through implementation activities.
Outcome	Systems performance, usability, reliability and integrity	Changes in healthcare delivered	Organisational learning in respect of EHR, IT management; organisational transformation.

Figure 4.1: Cornford et al.'s sociotechnical evaluation framework[1] (50)

The fusion of the three domains was found in particular and *in ultimo* in people's work practices – the time and place where people (individually and in teams or groups) appropriate technology as they perform tasks – tasks that contribute to and sustain the organisation. But, while the ultimate sociotechnical NHS CRS emerged in work practices,

[1] The arrows that cut across cells intend to illustrate how context, processes and outcomes may be conceptualised as co-constituting each other. Reprinted from: Cornford T, Doukidis GI, Forster D. Experience with a structure, process and outcome framework for evaluating and information system. Omega, International Journal of Management Science 1994; 22(5):491-504 with permission from Elsevier.

when and as it is used, along the way (during the period of “implementation”) we could see this combining occurring in the implementation strategies and practices used. This was the main focus of this research. It thus adopted a process-based perspective that considered the sociotechnical working out of new ways of working with new technologies. The inherent and situated combinations this implied is in some contrast to approaches that privileges one aspect and ignore others, for example, privileging the technology and endowing it with essential characteristics of, for example, efficiency or safety, or prioritising managerial interests of control or resource allocation, or prioritising the interests of people (or some dominant sub-group) for stability and cultural continuity.

Sociotechnical approaches are traditionally and historically associated with a particular philosophy of systems design in which individual user groups’ interests are strongly represented, for example through participative processes, and in which the final shape of a technological solution is able to be negotiated at the time of design and in this way to represent some reconciliation of diverse interests including those of managers, users or customers. The primary focus in this tradition is on work teams and groups.(82;83) A strong echo of this perspective is found in much of the literature around the National Programme for Information Technology (NPfIT) (and health informatics in general) that calls for more “clinical engagement” to support electronic health record (EHR) and other initiatives.(84)

The sociotechnical perspective has, however, a broader importance and utility than just as a means to inform activities of technological or organisational design. It also allows policy makers, managers, engaged professionals or independent evaluators to balance a concern with technology’s potential and functionality *per se*, with the ways such functionality might be introduced to the organisation, be adopted by groups of users and work teams, and the cumulative and integrated consequences that emerge as new sociotechnical systems of work are initiated, established and stabilised.(37;85)

In other words, it is not just the system as designed or the system in use that is essentially sociotechnical, but also the processes that brings systems into use – the processes of implementation and of adoption. These two processes might be seen conceptually as distinct and separable – represented as interrelated processes by which design and construction is linked to use through implementation and adoption (see Figure 4.2).

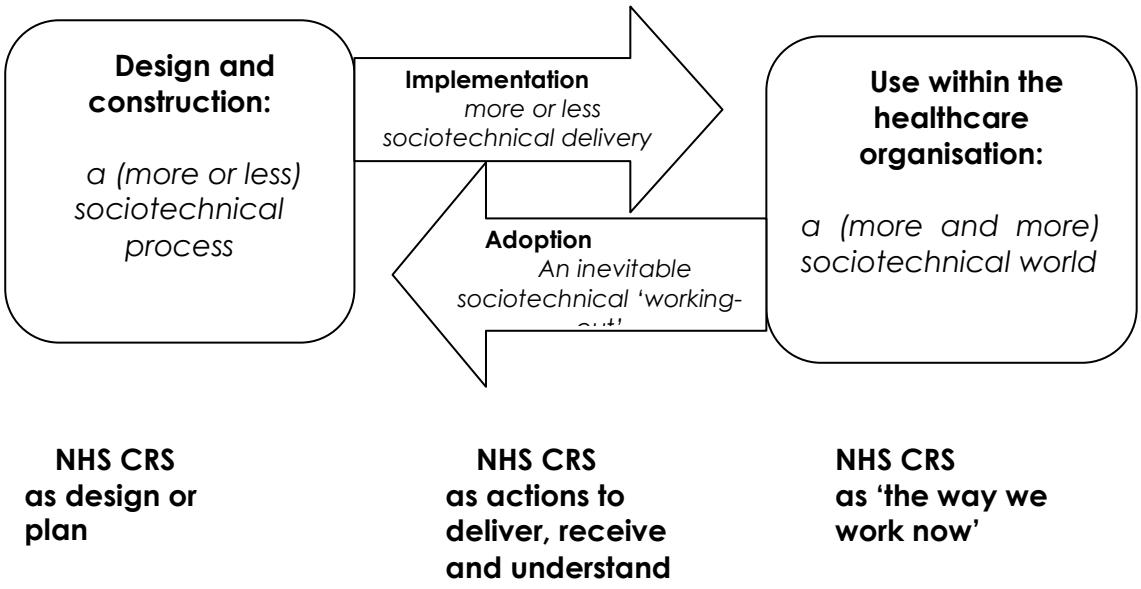


Figure 4.2: Implementation and adoption as two inter-related processes

We should note here, how we understand the two words implementation and adoption (see also Box 4.1). Implementation is the moving of new things and ideas into the organisation or work place – done to a large degree by others/outsiders – who we may call implementers. Adoption is the countervailing process by which people within the organisation accommodate (or not) the new systems or ideas and make them part of their work practice. In the extreme case technical functionality may be present (implemented – a working computer at the nurses' station) but not recognised, considered or used – not adopted and not appropriated into day-to-day work. More significantly the designed system may be there, but be used in ways or to degrees that the designer/sponsor/implementer did not foresee, with unexpected or unpredictable positive or negative organisational consequences.(86)

Both sets of actors – the implementer with their new technology to offer and the users with their work to do (plus invariably some existing already "adopted" technology often referred to as legacy systems), have a role in influencing how things turn out in the end, but more significantly how they are worked out in their duration. In this Chapter we placed particular emphasis on the sociotechnical processes of "working things out" (Box 4.1), seeing it as central to developing an understanding of the NHS CRS. The work was thus premised on the understanding that contemporary healthcare information systems are not essentially shaped in *ex ante* processes of analysis and design (with or without strong sociotechnical processes such as clinical engagement), nor by careful package selection or optimal implementation activities. Their consequences are thus not clearly apparent at the time of initial implementation.

Rather the sociotechnical “working out” of a technology within the work and organisational setting continues over time, perhaps many years, and might be better seen as a set of improvisations, enactments or transformations rather than as taking any ordered linear path.(87-89) And it may not be just or even principally the technology and its direct functionality that is ‘worked out’, but other aspects such as the workflow, team structures, the professional demarcations and even the organisational form itself.

On this basis, the approach to evaluation we used is to create a detailed narrative of the process of change (we refer to change as it happens as “changing”) that was initiated by and represented the NHS CRS. Studying change (before-during-after) implicitly assumes a movement from one situation to another with the major interest being on where we get to.(90) This assumption can enable comparisons of static views or “snapshots” of the context under investigation at various time points. It does not however provide a basis to explain either the process (i.e. the internal and ongoing “how”) or the reasons (i.e. the “why”) for change. Our processual perspective allowed us to start to answer such questions, and to focus on the changing that the NHS CRS brought about. This distinct perspective was also reflected in the evaluation’s shift away from only comparative studies to case-based studies.

4.3.2 Recruitment

We collected data from a total of 17 different locations. 12 of these met our inclusion criteria for case study sites. These 12 sites therefore form the main bulk of the data collected, whilst the other 5 locations have informed our analysis. Please refer to Appendix 4 for summaries of included case study sites. Please refer to Appendix 4 for summaries of case studies and to Vol. 2 for more detailed analyses and discussions of the cases. For each site, we recruited participants by following a purposive and snowball approach. Research participants differed in both number and job position such as Trust Chief Executive Officers (CEOs), IT Directors and Managers, Chief Operation Officers (COOs), human resource managers, clinical leads, junior doctors, consultants, nurses, matrons, allied health professionals, patients, ward clerks, representatives from Strategic Health Authorities (SHAs), registration authorities, software developers and Local Service Providers (LSPs) and so forth. Recruitment was largely dependent upon individuals’ availability and willingness to participate. Each individual was contacted either directly or through a site’s gatekeeper (i.e. individuals that control access to potential interviewees in the organisation).

4.3.3 Data collection

Data collection periods varied by site (Table 4.1), time frames and length. Overall, data were collected between February 2009 and January 2011. The type of data collected at sites included Trust documents, transcripts of semi-structured, face-to-face, telephone and email interviews, on-site observations and accompanying field notes, and in one site responses to a survey (Table 4.1). Interviews were conducted with the use of specifically designed interview guides in accordance with the role of each interviewee (implementation team members, healthcare professionals, patients etc). As already described in Chapter 3, we also reviewed specialist IT publications, national media reports and publications by parliamentary and professional bodies to track the wider context, or macro-environment, in which implementation took place. We tried to maintain a longitudinal element to our study by collecting data, whenever possible, at multiple times. For instance, in many cases, we collected data at two time periods (T1 and T2). The table below presents the total number of interviews, number of hours of observation, number of documents that we collected and number of responses we received from our survey for the purposes of WPs 1, 2 and 3. It represents a sub-set of Table 3.1.

Interviews	Observation (no. of hours)	No. of Documents collected	Survey (CLICS) (no. of respondents) (see Appendices 12 and 13)
301	229	720	130

Table 4.1: Data collected for the purposes of WPs 1-3

4.3.4 Data analysis

Data analysis was an iterative process and followed an inductive process. It was a two-step approach. Data were initially analysed at a case study-based level. Case study leads followed a thematic approach to analysis. Data were analysed through repeated reading of transcripts, field notes and documents and themes were developed bottom-up based on a combination of deductive and inductive approaches, which were influenced by each researcher's academic background and the sociotechnical framework described above. The process of analysis was repeated after each data collection period (e.g. T1 and T2) when this was applicable. Themes were refined after being related to each other and compared to the findings from the wider literature. The findings we present below constitute an outcome of the second stage of analysis, a meta-synthesis that drew upon the analytical themes from all case studies.

Primary findings from our data analysis processes were fed back to participating Trusts through formative feedback sessions. These were in many cases interactive sessions during which researchers would present findings and analytical remarks, with the opportunity for individuals and Trust representatives to comment on, confirm or disagree with these preliminary findings. The feedback received was taken into account in the final analysis of the case studies.

4.4 Main findings

4.4.1 The context for deployment and adoption

The software systems that embody the NHS CRS were, as explained in Chapter 1, deployed on a geographical basis, with distinct approaches and structures for each cluster[2]. As explained earlier (see Chapter 1), when our research was commissioned there were three clusters: North, Midlands and East (NME); London; and the South. However, by the time that our study began, Fujitsu, the LSP for the South had exited and there was therefore no contracted supplier for this whole region.

In the sections below we briefly outline the history and the specific software systems that each cluster was implementing.

For the various reasons described below, and more generally as part of the original conception of NPfIT, this cluster model provided a large natural experiment in alternative ways of approaching the establishment of software systems to underpin EHRs in secondary care, in both acute and community settings.

In particular, and as exemplified by the metaphorical section headings used below, we see contrasts between the incremental and iterative practice found in NME, where software systems for acute and community care were being written as they were being deployed (iSOFT Lorenzo), and the use in London and the South of an established and large-scale packaged software system developed outside the NHS context (Millennium).

In the former case, high degrees of customisation were potentially possible with opportunity for significant input by clinical staff in the early phases. The software provider iSOFT had a

[2] We recognise that the term “cluster” is now officially redundant within NHS CFH; however, we have retained it here as a useful phrase to indicate the three distinct deployment mechanisms and software supply chains.

substantial software base in the UK, and was a major provider of patient administration systems (PAS) with their iPM product. In contrast, Millennium was an older product, with the potential for customisation, but without an explicit offer of deep customisation in the NPfIT contract. Its main customer-base was in the USA. There was, at the time of its selection as part of NPfIT, one independent, Millennium implementation in a London organisation.

In the case of community and mental healthcare settings in both London and the South, the product chosen was RiO from Customer Satisfaction Everytime-Servelec (CSE-Servelec). This was also a mature product, but one that had been developed in the NHS context and for community care. Within the NME cluster, Lorenzo was also used in community care.

Building while using: NME Lorenzo

Lorenzo is a specific type of web-based EHR software implemented in the NME cluster of England. This cluster was previously planned to be divided into three geographical areas including the East & East Midlands, the North West & West Midlands, and the North East. When the contract with Accenture, one of the LSPs responsible for implementing NHS CRS software in the North East and East & East Midlands, was terminated in January 2007 (see also Chapter 1), responsibility for implementing NHS CRS software in these regions was transferred to the LSP of the North West & West Midlands (Computer Sciences Corporation, CSC).

CSC's strategic solution was Lorenzo software developed by iSOFT. It was originally planned to be implemented as a single integrated solution across both primary and secondary care settings. This scope, however, was subsequently reduced to exclude primary care settings because contracts were repeatedly renegotiated in order to reduce costs in an increasing climate of economic uncertainty. Another reason was the reluctance of primary care settings to implement a product that was still under development and their preference for Systems One/TPP solution. This has led many to suggest that the strategic direction should change from an initial focus on integrated care records towards interoperability of existing systems based on standards.(91)

The NME cluster was the largest of the three NPfIT clusters. It covered approximately 60% of England and included the following SHAs:

- East Midlands
- East of England
- North East

- North West
- West Midlands
- Yorkshire and Humber.

Altogether, these SHAs covered 89 Primary Care Trusts (PCTs), 87 acute Trusts, 28 mental health Trusts, five ambulance Trusts, and 10 specialist Trusts (including social and community care).

Lorenzo software was itself unique in many ways. Perhaps one of its most outstanding features, which also differentiated it from the other NHS CRS solutions, was that it did not during the course of our evaluation (and indeed still does not) exist as a fully functional product. The original intention behind its selection was to develop in collaboration with the NHS a system that is tailored to the needs of its users.

Different releases became available as soon as they were developed in Chennai in India, where most of iSOFT's engineers were based. Although releases had to be implemented consecutively, organisations were to some extent free to choose which parts of releases they wished to implement according to their needs.

In order to meet users' needs and to realise benefits, CSC delivered the iPM solution (also developed by iSOFT) to many Trusts across the NME area. iPM was an electronic PAS system with basic functionality and Spine integration, installed as a first step towards the final Lorenzo EHR solution. iPM was designed to deliver some early benefits to Trusts, but was planned to be substituted by the final solution eventually. iPM was therefore referred to as an "interim solution". It is expected that CSC will stop supporting it in 2013.

As of December 2010, Lorenzo Release 1 (R1) was used on a relatively small scale in one mental health Trust, two community Trusts, and three acute Trusts. Lorenzo Release 1.9 (R1.9) was also implemented in two acute Trusts and one community Trust. Its implementation was significantly behind schedule and implementations had been characterised by often publicly debated problems, combined with the limited scale and functionality deployed.(92) Details of Trusts and Lorenzo Releases implemented to date (at the time of writing) can be found in Table 4.2 below.

Trust	Release and go-live date
South Birmingham PCT	R1 in September 2008
Morecambe Bay Hospitals NHS Trust	R1 in November 2008 R1.9 in June 2010
Bradford Teaching Hospitals NHS Foundation Trust	R1 in April 2009
Hereford Hospitals NHS Trust	R1 in September 2009
Five Boroughs Partnership NHS Trust	R1 in October 2009
NHS Bury	R1.9 in November 2009
NHS Stockport	R1 in December 2009
Birmingham Women's Hospital NHS Foundation Trust	R1.9 in November 2010

Table 4.2: Trusts and Lorenzo Releases implemented to date

In Lorenzo Release 1 (R1), iPM and Lorenzo ran in parallel. The functionality of R1 implemented was somewhat dependent on the setting and included clinical documentation, service requests and electronic discharge functionality. Lorenzo R1 was not integrated, but interfaced with iPM. Lorenzo PAS integration (and replacement of iPM with the Lorenzo PAS) took place with the introduction of R1.9.

During the implementation of Lorenzo in NME there was a parallel running of both paper and computer systems. Lorenzo was implemented in a "soft" mode with paper systems being gradually replaced with electronic systems in selected parts of the Trust initially. Releases of Lorenzo with increasing capabilities were slowly rolled out to other settings in the organisation (although this could only to a certain extent be done with R1.9, because as a PAS replacement it needed to be implemented on a relatively large scale).

Opening the package: London

Greater London had 32 acute hospital Trusts, 10 mental health Trusts, 31 PCTs and more than 1,600 GP practices to serve an ethnically mixed population of over seven million people.

In the past, as in other areas of the country, individual NHS organisations in London developed or bought IT systems locally in ways that created healthcare *"information islands"*. Prior to the launch of the Programme in 2002, the (then) five London SHAs decided to pool resources to deliver patient-centred information systems to support the patient journey across London healthcare settings. After 2002, this vision of an integrated care records service for London was commuted into the NHS CRS. At the time of the evaluation London

had a single SHA, NHS London. The London arm of the national Programme, the London Programme for IT (LPfIT) was part of NHS London and had: *"…overall responsibility for upgrading NHS information technology to make it possible for hospitals, community services, mental health Trusts and GPs to share electronic patient records across the capital"*.(93)

When the Department of Health (DH) awarded the LSP contract for London to British Telecom (BT) in 2003, it was intended to have a single, capital-wide NHS CRS solution. An initial plan to develop a common solution for both the London and Southern clusters – from the software supplier IDX Corporation – disintegrated when the Southern cluster LSP (Fujitsu) replaced IDX with Cerner as its main subcontractor in 2004, followed by BT terminating its contract with IDX in 2006. BT's decision in 2006 to replace IDX with the American supplier company, Cerner, for acute hospital systems in London thus mirrored Fujitsu's earlier decision in the Southern cluster. Millennium was already a well-established healthcare IT system in the USA, and one, large acute Trust in London had independently chosen to implement Millennium before the start of the Programme.

By 2006, BT had already been working in partnership with Cerner and another supplier, CSE-Servelec, to give the capital's acute and mental health Trusts access to greater IT functionality until the proposed, IDX strategic solution for London became available. They were focusing on replacing PAS and hospitals' theatre and maternity systems. The difference between the interim solutions offered by BT and the awaited strategic solution was that the latter was to be a single database that was used by all of London's different NHS organisations, which would therefore support integrated care pathways in a way in which the interim solutions could not do.

The delivery of these interim solutions for London's NHS organisations had been formally negotiated with the DH in the first major re-set of the London LSP contract, known as a Change Control Notice (CCN). In a second, major re-set negotiated in 2007, it was proposed to resolve NHS uncertainties about London's interim NHS CRS-related IT systems by formally adopting the use of more than one supplier to achieve shared EHRs. It was labelled using "best of breed" solutions for the different health sectors in the city (i.e. Millennium for acute Trusts and RiO for community and mental health) (see Figure 4.3). Under CCN2, there was to be a London integration engine to route clinical messages from the multiple, clinical systems supplied through the Programme, and three, major releases of the London configured Millennium solution for acute Trusts (see Table 4.3). Thus the plan was to deploy packages ("boxes") of functionality that built on each other as each subsequent release was implemented. The second major release, London Configuration 1 (LC1), was to be the first

to be NHS Spine compliant – to access patients' demographic data from the central database – and to require SmartCard authenticated access by NHS staff.

The interim solution for mental health Trusts (and a different version of the system for community organisations) was RiO from CSE Healthcare (formerly CSE-Servelec). Unlike Millennium, RiO is a web-based application and was developed in the UK. RiO implementations started in London mental health Trusts in 2006, at which time, for the first time, London was signed up to using the same configuration of the same software in seven out of the capital's 10 mental health Trusts. Five Trusts started with an early version of RiO (version 4.0) and two received version 5.1 as their initial deployment. Version 5 of RiO has single sign-on SmartCard access and NHS Spine connectivity (see Table 4.4).

BT's first deployment of LC1 took place in a London Trust in June 2008, and that Trust's subsequent, widely publicised difficulties (particularly in relation to activity reporting, which resulted in the loss of Trust income), led to a "90 day rescue plan", during which all Millennium deployments in acute settings in London were put on hold. Similarly, difficulties encountered by a mental health Trust when it upgraded from RiO version 4 to version 5.1 led to a temporary suspension of RiO deployments in London until the problems could be identified and resolved. All deployments subsequently resumed: by 2010, eight mental health Trusts and six acute Trusts were using these new systems delivered by BT. Two further acute Trusts had implemented Millennium independently and subsequently joined the Programme. According to Mr. Kevin Jarrold, head of the LPfIT: *"While the acute sector had proved challenging, the London Programme had achieved significant success with RiO, which is now in use by all but one of the capital's 31 primary care Trusts, and eight out of ten of its mental health Trusts"*.(94)

The third set of major contract re-negotiations between BT and the DH began in 2008. The CCN3 included permitting acute Trusts greater opportunities for local configuration and build of Millennium systems delivered through the Programme. RiO could be tailored to individual mental health Trusts by BT in the same way that Millennium could for acute Trusts. The "new delivery model" proposed in the 2008 negotiations also included giving London Trusts more flexibility in when they chose to deploy the different functionalities that were potentially available to them in Millennium, so moving away from predefined, delivery packages of LSP-bundled releases and edging towards allowing (a degree of) Trust specific *"cherry picking"* between release bundles, at least for acute organisations. CCN3 was agreed and signed in 2010.

The main changes CCN3 brought about were: firstly, it confirmed the new delivery model for Millennium but this was accompanied by a reduction in the numbers of London deployments of NHS CRS software systems to acute organisations. These were now to total 15 (instead of 32 – although precise numbers are liable to change with hospital Trust mergers) by the end of this contract in 2015. There were also to be enhanced RiO functionalities made available in two, new versions of the application for mental health Trusts, then to be known as Release 1 and 2 (replacing the former versions 6 and 7). The total number of these London RiO deployments was reduced from the originally planned 10 to eight. Provision for a London-wide integration engine – along with delivery of new systems to London GPs and the London Ambulance Service – was now out of scope. The revised contract was cheaper; savings of £112 million – approximately 10% of the initial contract cost - were to be achieved by agreeing this latest contract, reflecting the DH's announcement in 2009 that £600 million had to be pared from the Programme's overall costs.

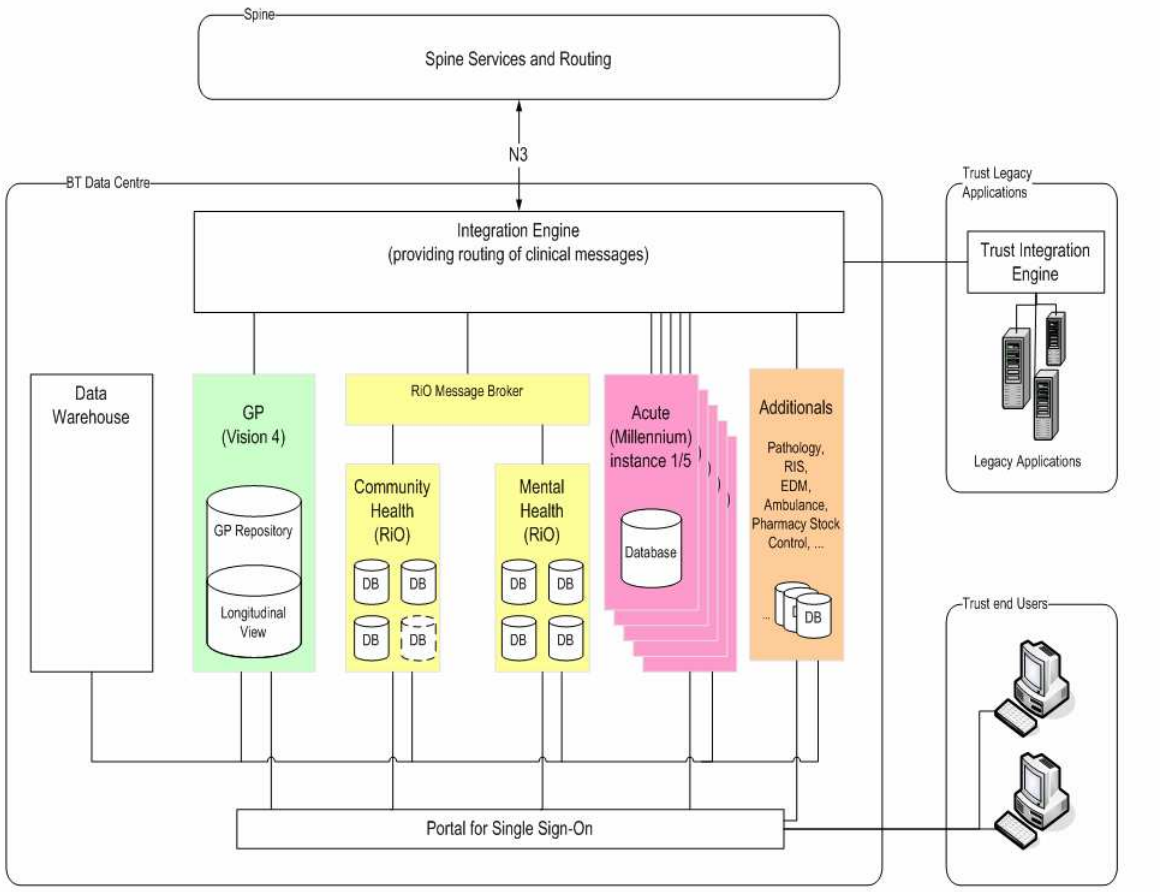


Figure 4.3: Structure and components of the London NHS Care Records Service (NHS CRS) planned for London in 2007 (93) (permission to reproduce in the process of being applied for)

Millennium London Configuration (LC0)	Millennium London Configuration (LC1)	Millennium London Configuration (LC2)
• An electronic care record for every patient • Patient registration, admission, discharge, transfer • Patient medical record tracking • Pathology / Radiology requests, results viewing and notifications • Clinical assessments and documentation • Scheduling (including theatres, clinics, beds, diaries) • Access to management information and reporting • Compatibility with Choose and Book • Maternity booking of expectant mothers and recording of delivery details	• Connection to the Spine (the national database and messaging service), providing access to patient demographic information, such as name and address • Increased security with the use of SmartCards and single sign on access to the system • Theatre case functionality, including pre and intra operative documentation, case tracking views and mandatory reporting • Clinical features include allergies, extended requests, additional clinical assessments and ability to link to scanned documents	• New functionality to support: - medication management, including requesting and administration of drugs - anaesthetics, including device integration - critical care, including bedside medical device integration and critical care data entry - advanced structured clinical documentation • Enhancements to existing functionality in the following areas: - theatres -accident and emergency - requests and results reporting - clinical documentation - patient administration - operational, clinical and management reporting • Future integration with other care settings

Table 4.3: The three major releases of Millennium for London acute Trusts, in 2007 (93) (permission to reproduce in the process of being applied for)

RiO system for mental health Trusts
• Annotated clinical diagrams • Assessments, to record new assessments and view existing ones • Bed planning and scheduling, to provide a diary-based graphical view of current and anticipated activity • Care planning • Care Programme Approach review scheduling • Case record - forms the 'front sheet' to the client's clinical record • Caseload management • Clinic management, to set up clinics and create, manage and book appointments • Diary and planning tools • Document upload - enables scanned paper assessments, referral letters and other electronic documents to be attached to the client's record • Family links, to allow clients' records to be linked, where appropriate • Help function • Mental Health Act - enables section details to be recorded in line with MHA legislation • Operational reports - include progress notes by clinical discipline, bed summary reports and caseload views. The system also produces statutory reports including the Mental Health Minimum Dataset • Progress notes, to record a client's progress, and can be added to and updated by different team members. Significant notes such as client risks can be flagged, as can those that contain third party information. Notes that have not been validated can be identified. • Referral management, to give a chronological list of current and discharged (closed) referrals

Table 4.4: Key features to be offered by the web-based application for mental health Trusts (95) (permission to reproduce in the process of being applied for)

Rapid roll-out unravels: the South

The Southern cluster presented a distinct story relative to the other two (i.e. London and NME). It made progress until deployments stalled in 2007 while Fujitsu and the DH tried unsuccessfully to agree a revised LSP contract, and uncertainties for future deployments for NHS Trusts continued when the LSP contract was terminated altogether in 2008, leaving the South with no LSP.

At the outset of NPfIT, the Southern cluster was the largest and perhaps the most unwieldy of the proposed clusters.(96) In 2006, the three SHAs in the region – South West SHA, South Central SHA and South East Coast SHA – covered 93 NHS organisations: 31 PCTs, five Ambulance Trusts, 43 acute Trusts (including 25 Foundation Trusts), 13 mental health

Trusts, and one care Trust (a limited number of NHS Trusts in England, called care Trusts, provide both health and social care services).

The contract for the LSP for the South was won by Fujitsu in 2004 and it has been suggested that this was in part due to their offering a very competitive price.(96) Initially, Fujitsu was in alliance with the supplier IDX Systems Corporation but early in the contract, in 2005, Fujitsu changed its main software supplier from IDX to Cerner and Millennium software. This was the start of an ambitious implementation plan in the South, aiming for a rapid roll-out of a basic version of Millennium (R0) to deliver PAS replacements and other, limited functionality (initial clinicals, theatres, maternity and A&E), - and then offering increments of clinical functionality in subsequent releases. The consecutive release, R1, was to deliver NHS Spine connectivity for Southern Trusts.

Cerner was contracted in part because of the experience of Homerton Hospital in London with installing Millennium, ahead of NPfIT.(97) However, in this site the software proved to require significant modification, for example with lost appointment details (see Chapter 6). Thus delays were caused as significant revisions and amendments had to be made, for example, to allow new clinical codes and to allow support for Choose and Book (see Chapter 1). This extra work took time out of the release plan and led to Trusts in the South hesitating and then declining go-live dates

Fujitsu had by July 2007 installed Millennium R0 in eight (approximately 20%) of NHS acute Trusts in the South; these became known as the ‘Live8’ (see Box 4.2). Progress stalled, however, as problems with the deployed Millennium systems became more apparent. In May 2008, following lengthy contract negotiations that had aimed to reset the system’s development and delivery plans – and thereby better meet local NHS organisations’ perceived needs – the DH terminated the Fujitsu LSP contract.(98)

1. Nuffield Orthopaedic Centre NHS Trust
2. Taunton and Somerset NHS Foundation Trust
3. Winchester and Eastleigh Healthcare NHS Trust
4. Surrey and Sussex Healthcare NHS Trust (99)
5. Weston Area Health NHS Trust
6. Milton Keynes Hospital NHS Foundation Trust
7. Worthing and Southlands Hospitals NHS Trust (subsequently withdrew) (100)
8. Buckinghamshire Hospitals NHS Trust

Box 4.2: The 'Live8' Trusts that have installed Millennium software

Giving evidence to the Public Accounts Committee (PAC) on why Fujitsu had withdrawn, Peter Hutchinson, Fujitsu's group director for UK public services said, *"We had tried for a very long period of time to re-set the contract to match what everybody agreed was what the NHS really needed in terms of the contractual format. In the end the terms the NHS were willing to agree to we could not have afforded. … There was a limit beyond which we could not go".*(101) Andrew Rollerson, a Fujitsu executive, giving evidence to the House of Commons PAC said something a little more blunt: *"What we are trying to do is run an enormous programme with the techniques that we are absolutely familiar with for running small projects. And it isn't working. And it isn't going to work".*(49)

After the exit of Fujitsu, NHS CFH negotiated with BT (already implementing Millennium systems in London as the London LSP) to take over support of the Live8 sites. It was reported in the media that the price of the contract, and details of how BT would move sites from the Fujitsu data centre to its own without causing disruption, were critical issues in these negotiations.(102) Meanwhile Fujitsu was continuing to provide the Live8 sites with support for the existing implementations.

By 2009, BT was able to take over responsibility for supporting the then seven Trusts with Millennium in the South (one of the eight had by then withdrawn following its merger with another NHS organisation).(103) The £500m contract awarded to BT was for a relatively limited package of work, which included taking over the Live8 Trusts, deploying Millennium in four additional acute Trusts in the South and delivering RiO to 25 community and mental health sites.(104;105)

Outside of this contract, acute Trusts in the South were then offered the choice of taking either Cerner or iSOFT systems, delivered by BT or CSC respectively, or they could choose

a different supplier selected from the NHS CFH Additional Supply Capability and Capacity (ASCC) list.(106)

In 2010, under the BT deal, the DH gave the go ahead for a Millennium upgrade across the South of England (this had previously stalled over data security concerns with the planned data transfer from the UK to the US).(107) The Trusts to receive the upgrade were Buckinghamshire Hospitals NHS Trust, Milton Keynes Hospital NHS Foundation Trust, Nuffield Orthopaedic Centre NHS Trust, Surrey and Sussex, Taunton and Somerset NHS Foundation Trust, Weston Area Health NHS Trust Healthcare NHS Trust, and Winchester and East Leigh Healthcare NHS Trust; local testing of the first technical upgrade stage was reported as complete in August 2010.(106) Progress had also been made with BT deployments of RiO in the South. Seventeen out of the 25 sites were live with RiO 5.4 by August 2010.(106)

4.4.2 What is the NHS CRS?

Our findings have indicated that the NHS CRS was not only the generic name given to a range of software systems (i.e. Lorenzo, Millennium and RiO), but also a multi-faceted concept. Different research participants (i.e. managers, healthcare professionals, administrative staff and patients) attributed a different meaning to the nature and role of the NHS CRS in secondary healthcare settings. This indicates the lack of a single vision behind the NHS CRS and the development of multiple interpretations revolving around what the NHS CRS was perceived to be, what it ended up being and how it could become in the future. This section outlines these different interpretations (also summarised in Table 4.5) and argues that the NHS CRS embodies at least three visions: data-centric, process-centric and policy centric, each with its own aspects.

Visions of the NHS CRS		
Data-centric	**Business-centric**	**Policy-centric**
Digital container of information	Computerisation & Standardisation	Means and outcome of modernisation
Database that joins-up healthcare delivery	Business change	Means to reinforce existing policies
Administrative tool	Electronic monitoring and control	Political agenda
Recording device and Auditor	Business opportunity	Patient-centric tool

Table 4.5: Visions of the NHS CRS

The NHS CRS was conceptualised by participants as a means for digitalising health-related information, such as patient notes and clinical letters, which was previously held on paper. In this case, it was envisioned as an electronic container of information that stores, maintains, updates and disseminates information.(47) In doing so, it was thought to render clinical information knowable and transferable and to improve the delivery of healthcare to patients: *"Such a fantastic idea to have access to useful clinical information…at the touch of a few buttons"* (Interview, Healthcare Professional, Site R).

Further, interviewees described the NHS CRS as an enabler for sharing information across temporal and spatial boundaries (this is a long standing aspiration for IT systems, see for example (108)): *"you could go between Leeds and London and not be repeating your same clinical history was the ultimate goal"* (Interview, Local Service Provider). In the view of clinicians this implied the possibility to exchange information both in an asynchronous and in an indirect way. Clinicians would then be able to get the necessary information independently of where they are located. At the same time, they argued that instant access and transfer of information across hospitals and between general practices and hospitals would facilitate more "joined-up" processes of healthcare delivery. Electronic joining-up of healthcare meant for patients that they were no longer responsible for transferring information across healthcare organisations and between professionals. For clinicians it meant it would help to improve clinical decision-making by making them less reliant on patients' memory and more on accurate and updated facts.

In contrast to this, some participants saw the NHS CRS as a mere administrative tool that provided demographic information and the possibility to track patients, but had limited clinical importance: *"it's just a demographic database that doesn't give me any clinical details"*

(Interview, Healthcare Professional, Site D). In this case, the interviewee identified the NHS CRS, as a vision, with the system deployed in this particular site.

The NHS CRS was also envisioned by some healthcare professionals as a recording device and an auditor of clinical outputs. It was thought to constitute, at least in theory, "*a very good audit trail"* (Interview, Healthcare Professional, Site C) that made outputs visible,(44) tractable and amenable to analysis and a means *"for monitoring and for reporting and for performance measures"* (Interview, Healthcare Professional, Site M). Clinicians said that this was not possible before the implementation of NHS CRS systems because data were not consistently recorded. Yet, participants from Site M argued that although the potential for monitoring and auditing was there, the functionality was not tailored to their needs.

Also, some participants saw the NHS CRS as a means for computerising and standardising clinical work practices and processes. Computerisation would render healthcare professionals' work paperless: *"…if you can get to a paperless system, that is a real selling point for us"* (Interview, Healthcare Professional, Site D) or, paper-light because *"there are some things you have to have on paper, for example, there are things I ask the patient to draw on like a clock face"* (Interview, Healthcare Professional, Site M). Further, clinicians argued that computerisation would render the delivery of healthcare less reliant on healthcare professionals (e.g. by populating data) by eliminating errors and data duplication: *"simply by deploying CRS we eliminate all those errors"* (Interview, IT Manager, Site D). Clinicians assumed that computerisation would then allow them to spend more time with patients. Some patients however expressed their concerns that computerisation, defined from their perspective as the implication of technology in consultation, would depersonalise their relationship with doctors.

Some interviewees also perceived the NHS CRS as being a way to eliminate differentiation of clinical and administrative work practices across Trusts, to standardise the processes of healthcare delivery and the conduct of healthcare professionals and to regulate the way in which healthcare professionals interact with patients: *"…their ideal is that the NHS will become standardised, so the way in which we interact with computers and the way in which we interact with patients will become standardised'* (Interview, IT Manager, Site C). Other participants welcomed standardisation because they saw it as an opportunity to work in a *"smarter more efficient way"* (Interview, Healthcare Professional, Site F).

Apart from computerising and standardising, the NHS CRS was perceived as a means to initiate business change and improve healthcare service (also found in (44)): *"I don't think*

we are deploying Cerner here, I think what we are doing is reviewing and improving our services…The core of what we are doing is as a change management programme" (Interview, IT Manager, Site D).

Further, participants described the NHS CRS as being a means for electronic surveillance and monitoring of Trusts and healthcare professionals.(109) As they said, the NHS CRS has the potential (at least in theory) to centralise information about the performance of each Trust across the country. For instance, through the Spine the DH could potentially have aggregated information about various performance indicators such as costs, outputs or performance profiles of each Trust. Centralised information could then be used, according to participants, as a way to compare the results and performance of healthcare organisations and as a basis to make decisions. According to one project manager, such comparisons engendered financial risks and raised fears of job insecurity: *"It might give you some transparencies. It might give you some aggregated understanding. You might find that one hospital cost profiles are completely different to another. You might start to look at why and people might be nervous of their jobs, even"* (Interview, IT Manager, Site C). In relation to its electronic monitoring effects and in the context of it holding genetic information, patients described the NHS CRS as a means for electronic identification of citizens.

The NHS CRS was also presented as an indication of modernisation, a necessity and *"a way of the future"* (Interview, Patient, Site H). This was not only because of the availability of advanced technology, but also because of its potential to improve the old-fashioned ways in which the NHS works: *"I just think the day of paper notes is probably gone when there's so much technology around…If you think about it's a very ancient way of doing things to write everything down when there's so much technology out there…"* (Interview, Healthcare Professional, Site H). Through the creation of EHRs, the NHS would be able, according to a clinician, to respond to the demands of the new generation of patients for instant healthcare-related information and services: *"The new generation wants things now. So waiting for medical results does not fit with the new generation. In the future patients will expect immediate results"* (Interview, Healthcare Professional, Site F).

In contrast to this, participants from Site M perceived the NHS CRS not as a means to change, but as a way to reinforce already existing policies: "*You had a policy that you should have done this. Now, we are just going to reinforce it. That's what RiO really did. … it does reinforce the existing policies, which a lot of Trust users don't follow"* (Interview, IT Manager, Site M).

Also, because the NHS CRS was implemented during a period of economic and political turmoil, some participants associated it with an overtly political agenda. This indicated that the meaning, and more importantly, the existence of the NHS CRS was in flux because it was shaped by whichever government was in power: *"I've got a concern that if one of those two parties come into power and it seems highly likely that they will, that the National Programme might be closed and Lorenzo might be shut down and what then happens, do we get left and do we then go back to where we were two years ago, just seems a really painful situation and do they close the whole of the National Programme in which case, do we go back to where we were eight years ago?"* (Interview, IT Manager, Site C).

Moreover, some participants saw the NHS CRS as being a way for a more patient-centric healthcare.(110) Through the NHS CRS patients were thought to be uniquely identified across healthcare organisations: *"a patient-centric view looking at it as—one point of identification single NHS number"* (Interview, Healthcare Professional, Site D). Participants also thought that the NHS CRS gave patients ownership over their record, rendered them knowledgeable about the information that is included in it and thereby also responsible for its correctness and completeness: *"…it's the patients that hold the record and the patient should control who has access to it. …Give the patient the record and give the patient the key to unlock it. They are partly responsible for the record themselves…"* (Interview, Healthcare Professional, Site R). Also, according to another participant, the NHS CRS would enable patients to be able not only to access personal health-related information and thus to participate in clinical decision-making, but also to share this information in other patient networks.

Patients were however more critical about the assumed patient centricity that lied behind the NHS CRS. For many, the NHS CRS was primarily a technology-led rather than a patient-led project. Also, patients expressed their indifference towards computerisation of their records by arguing that priority should be the quality of treatment they receive rather than the medium that carries their clinical information: "*I am here to get well. I don't know about what they do [about records] here and I don't want to know. It's their job to look after me*" (Interview, Patient, Site A).

Finally, a healthcare professional envisioned the NHS CRS as a threshold that will attract more commercial organisations to enter into the NHS. The prerequisite to this was that clinical processes, pathways and practices become protocolised, represented to the technology and thus made transferable to other NHS and non-NHS organisations.

Three points need to be made in relation to the different visions of the NHS CRS. Firstly, participants dissociated the NHS CRS, as a vision, from the product that was supposed to embody and deliver this vision. This was despite their concerns about the appropriateness of the product to achieve benefits in the near future: *"Good vision, but whether this system [Lorenzo] could do it I don't know"* (Interview, Healthcare Professional, Site H).

Secondly, some participants linked the vision with the implementation process of the NHS CRS. They argued that gradual implementation of the NHS CRS would fade away and weaken the vision: *"…small step changes along the way rather than having a vision of what they wanted to achieve in the longer-term, so that's constrained I think, you know, what's been achieved"* (Interview, IT Manager, Site H).

Thirdly, some participants' viewpoint that the NHS CRS constituted an administrative rather than clinical tool may be associated with the limited functionality of NHS CRS software deployed in many Trusts at the time of our evaluation.

4.4.3 The arrival of the NHS CRS in institutional settings

This section reports on the ways in which sites prepared themselves for the arrival of the NHS CRS. Specifically, it describes the strategies that were set in place in order to embed NHS CRS systems, and their inscribed assumptions about clinical work and routines,(111) in the organisations. The process of rendering the NHS CRS a "taken for granted" part of an institution, i.e. its institutionalisation, was complex and longitudinal.(112;113) As our findings below demonstrate, it required a clear *rationale* that was commonly understood and shared by members across the organisation and robust *management and governance structures* that led and oversaw implementation,(113) set milestones and controlled progress. Further, the institutionalisation of the NHS CRS required a sound technological infrastructure for NHS CRS systems to work and interface with other systems as well as a clear *implementation strategy* for deploying system functionalities. Finally, important aspects of the institutionalisation of NHS CRS systems were provision of training and security and availability of resources. Our findings suggest that sites did not manage to fully institutionalise the NHS CRS but were in different stages of its institutionalisation. The last sub-section outlines a number of (external and internal) factors that explain why this was the case.

Rationale for being 'early adopter'/implementer of the NHS CRS

As discussed in Chapter 1, at the time of the inception of the NPfIT, all the NHS Trusts were expected to implement (within specified timelines) the recommended software systems.(9) A number of Trusts volunteered to become 'early adopters' of NHS CRS applications. Arguably, all the Sites discussed in our report were 'early adopters'. However, the specific term 'early adopter' was only given to some Trusts and was linked to extra funds provided by the LSPs. These were the Trusts that piloted NHS CRS software in a clinical environment and worked with the LSP and the developers to make it fit for clinical use by feeding back any arising problems. (Refer to Glossary for a more detailed definition). Those Trusts were promised to receive the Deployment Incentive Fund (DIF), set at different rates, i.e. for secondary organisations this was £1 million in NME and £300,000 in London. Other Trusts that were classified as 'fast followers' (later referred to as 'early implementers') did not receive DIF (e.g. Site Q). In this report we use the term 'early adopter' in a broader sense to refer to organisations that were amongst the first to implement the NHS CRS systems as part of the NPfIT.

Although the Sites which volunteered to be 'early adopters' had different characteristics and varied histories (e.g. experiences with IT), the reasons given by the interviewees for being an 'early adopter' were often similar.

Our interviews indicate that an important reason for the Sites to adopt NHS CRS software systems early was the wish to upgrade their technology without making a considerable investment. Their existing systems were often seen as lacking some functionalities and as supporting little integration and communication of data across the Sites and beyond and, thus, as not fit for the purposes of the NHS CRS. For some, it was a question of comparing costs of renewing licences for existing systems and the costs of implementing NHS CRS systems, for which the licence costs did not have to be met by the Trust. The Sites were also afraid that the support for their legacy systems might be withdrawn by the suppliers in the near future. For example, one IT Manager in Site C described the NHS CRS as being *"an IT project that's nice to have"* and as an opportunity that *"…gets you to a better place with your IT systems"* (Interview, IT Manager, Site C). This view was echoed by an IT Manager in Site D: *"…having the National Programme funded for us and all the complexities of integration was obviously a big financial bonus for us"* (Interview, IT Manager, Site D).

It appeared that for Site B one of the decisive factors was the DIF: *"I've got a director of finance who looks at the bottom line every week and obviously a million pounds coming in*

makes his bottom line look an awful lot better and if he's off my back that gives me more freedom to do cleverer things with doctors and nurses" (Interview, IT Manager, Site B). Hence, it appeared that for some Sites (e.g. Sites B and C), the decision to become 'early adopters' was, at least to some extent, opportunistic.

Another reason given was the wish to influence the final design of the software systems by adapting system functionalities to their local needs: *"…as an early adopter you have a significant opportunity to shape the development of the product and we've been anxious to do that from a community perspective"* (Interview, IT Manager, Site H).

The importance of this factor and the opportunity to work together with clinical reference groups, other implementer sites, NHS CFH and local SHAs was highlighted by the decision of Site Q to remain one of the first to implement Lorenzo, despite that it did not receive the DIF, as it was not classified as an 'early adopter', but as a 'fast follower'.

The sites also anticipated a number of organisational benefits, including:

- Easier meeting of business objectives and governmental targets e.g. 'Clinical Five' (114)
- Efficiency gains as a result of a better process management and of elimination of maintenance costs coming from dispersed systems
- Improved sharing of information with other NHS organisations and social services
- Increased recording and availability of information at the point of care
- Improvement in data quality.

Some participants expressed a hope that the benefits of being 'early adopters' would help their Site to gain competitive advantage over other sites. Sites hoped that early participation would be seen as "*leading*" and "*forward thinking*", and hence that their status and prestige would be enhanced: *"I think we were attracted by the kudos of being the first, well OK we'll be the first. And there was something to celebrate when, well actually [name of other site] and [name of other site] are not on yet and it's just us, well there's just us, there's nobody else*" (Interview, IT Manager, Site H).

Another important factor in Sites' decision to implement the NHS CRS was their prior experiences of implementing information systems (for instance, Sites A, B and E had experienced staff). Participants believed that 'early adopters' were fundamentally different to other sites in that they had greater experience in IT implementation, were forward thinking

and innovative. They would also present themselves as having a strong vision, persistence and established working relationships with other key players (i.e. IT implementation teams, LSPs and NHS CFH). This illustrates a parallel underestimation of the complexity of implementing NHS CRS systems and an initial, perhaps naïve, confidence about their capability to implement and adopt it in an unproblematic way.

However, the decisions to become 'early adopters' were not uncontroversial or uniformly supported. For example, in Site C participants mentioned two reasons to reject early adoption: the lack of a clear business driver behind the NHS CRS and the lack of user enthusiasm. Participants from Site R, for example, argued that being an 'early adopter' was not a choice, but a decision made at SHA level: *"…our SHA chose two sites to be the first adopters of Cerner… From the Trust perspective it felt very much it was decision outside of their control"* (Interview, IT Manager, Site R). Similarly, in Site D the majority of users described the Millennium software as an imposed standard application for acute Trusts in London: *"I think you have to take the view that there was almost no choice in taking on the system, but you would try and make the system more usable with time"* (Interview, Healthcare Professional, Site D).

Furthermore it appeared that at the time of making the decision the sites were not aware how much development work they would be expected to do. Some also suggested that the decision to implement was not based on knowledge of *"what the real benefits are"* (Interview, Healthcare Professional, Site R).

Management and technical infrastructures

'Early adopter' sites set up project management teams responsible for orchestrating, supervising and managing the implementation of the NHS CRS. Teams varied substantially in terms of number, skills and expertise but in general terms they consisted of: Programme and Project Managers (e.g. for Infrastructure and Data Migration, Clinical Documentation etc), Training Leads, Business Change Leads, Configuration and Testing Leads, Data and Business Continuity Leads, Product Specialists and Clinical Leads. Implementation team members were often sub-contracted from within the Trust, NHS CFH, LSPs or from other organisations.

Implementation teams operated within broader governance structures that monitored and made decisions about implementation processes. Governance structures consisted of Programme Steering Groups, responsible for monitoring the delivery of the NHS CRS in

sites, Project Management Teams, responsible for carrying out implementation on a daily basis, and Clinical Advisory Groups, responsible for advising the Programme Board about clinical issues that surround NHS CRS adoption.

The role of SHAs, NHS CFH and LSPs in this broader structure was fundamental. Specifically, the role of the SHAs was to support sites in the management of the project by providing a link between LSPs and NHS CFH, helping to sign off key deliverables (e.g. testing and training) and providing links with other relevant stakeholders in the local health community including other 'early adopters'. The role of the NHS CFH was to manage contracts with LSPs, provide support to the implementations that took place in 'early adopter' sites and mediate between sites and other organisations (e.g. LSPs). LSPs managed implementations on a day-to-day basis by setting milestones and monitoring progress, resolving emerging issues and managing risks in collaboration with software developers.

Robust project management structures and experienced leadership were described as being key to a successful NHS CRS implementation (see the case studies of Sites D and Q). Strong leadership required personal and face-to-face contact with the users and involvement in users' work practices (see the case study of Site Q). This type of participative leadership allowed managers, as they argued, to better represent users' needs and requests in front of other parties (such as LSPs, software developers and senior implementation members) and to give users the sense of being listened to (see the case studies of Sites H and Q): *"…we do encourage them to, for it to become a two way communication, it's not just us talking at them but equally if there's anything that they don't understand because in project terms you do tend to speak in project jargon which is not all the time, you know, good with clinical staff"* (Interview, IT Manager, Site Q).

Also, leadership was important for accommodating the NHS CRS into the organisation and for bringing together its operational and its technological aspects (See the case study of Site D). It was also thought to make implementation an imperative and *"a priority project"* (Interview, Healthcare Professional, Site F) for sites. A lack of such communication was perceived as problematic (see the case study of Site B) and as a reason for failure and a top-down leadership style would often create a pressurised environment that influenced healthcare professionals' morale (see, for example, the case study of Site Q).

Apart from leadership at a top level, participants thought that middle-level managers, such as divisional managers, played an important role in fostering implementation at local level and engaging clinicians. A representative from an SHA argued that this is because middle

managers have better control over local practices: "*…middle managers which they often have more control, I suppose for want of a better word, they are able to do that more effectively for a number of reasons–they seem to work better"* (Interview, SHA).

According to the NPfIT Infrastructure Compliance Standards and Guidelines,(115) 'early adopter' sites needed to have a specific infrastructure in place before implementing. This included:

- Hardware: routers, modems and networking products, desktops, printers, scanners, handhelds, trolleys, RAM to upgrade any existing PCs, bandwidth to speed up connections, or other components
- Software system (Lorenzo, Millennium, RiO etc)
- SmartCards and SmartCard readers
- NHS Net email accounts.

Implementation strategies: approaches and methodologies

Sites followed a number of different methodologies for implementing NHS CRS software solutions, which are summarised in Table 4.6. As we show below, in many cases Trusts from the same cluster would follow the same methodology, but would name it in a different way due to the different rationales and expectations of it.

To begin with sites in the NME implemented Lorenzo gradually as it was not an existing product, but was developed whilst being implemented. Gradual implementation meant that sites would implement different functionalities of each release incrementally.

Implementation Strategies	Rationale
'Soft landing'	Identification of problems at an early stage
Small scale approach	Deal with past negative experiences from IT projects
	Preventative strategy: reduce risks & achieve results
Stepwise implementation	Interdependent functionalities
'Big-bang'	Contractual restrictions & limited autonomy
	Core aspect of their IT strategy & a means for joining-up their operations
Phased, but fast implementation	Prior preparatory work to render the organisation ready for implementation
	Geographical criteria – meeting the purposes of the London Mental Health Trusts Team

Table 4.6: NHS CRS implementation strategies

Specifically, Site B decided to go for what they called a 'soft landing' approach which introduced change gradually into selected locations. Participants agreed that this strategy allowed them to get used to the system slowly and help to identify and tackle emerging problems. This strategy was characterised by a parallel running of both paper and computer systems; for some staff though 'soft landing' did not constitute technically a "*proper go-live*".

Sites C and H went for what they called a "*small scale approach"* to implementation. Implementation team members from Site C believed that this approach was more appropriate because of the size of the project and also due to their (negative) past experiences in implementing IT systems. Participants from Site H thought that a small scale approach would reduce risks as Lorenzo was not ready for large-scale deployment (Site H). The logic that governed this implementation process was that the system would be introduced across the site gradually only after it brought about satisfactory results to its first area of implementation: *"Once we get to a known stage that's, where it's all usable and it's all reliable we can then put the whole service on..."* (Interview, IT Manager, Site H).

Site Q followed a *'stepwise'* implementation because CSC could not support two releases at any one time and due to technical dependencies (e.g. PAS functionality had to precede Care Plan functionality). They were however aware that a soft launch approach may add considerable delays to the implementation process.

Some Cerner sites implemented NHS CRS software systems on a big scale. Specifically, Site R followed a 'big-bang' approach to their implementation of Millennium. Initially, they implemented a different system provided by the same supplier (Fujitsu) but within four weeks changed to Millennium due to contractual re-arrangements. In a joint discussion with two IT Managers it was explained that the Trust did not have an implementation decision to make as *"…clearly the system was given to us, so it wasn't a question of picking and choosing and selecting the system for those benefits. There were elements of functionality that we could choose to ignore"* (Interview, IT Manager, Site R).

Sites D and E also decided to implement the NHS CRS by following a 'big-bang' approach. They rendered Millennium a core part of their IT strategy and joined-up all their operations around it. With a similar rationale, Site F went for a 'big-bang' approach aiming to eliminate their existing dispersed systems and substitute them with a single coherent system across the Site.

Site BB followed a phased, but fast (in terms of adopting upgrades of the product) implementation of RiO. The main reason for this was that the implementation team members had done a lot of preparatory work in getting the organisation ready for Millennium, but then after Fujitsu left the Programme and due to problems with the system (i.e. lack of mental health functionality), they switched to RiO. They planned then to implement fast sequential upgrades of the product. The same strategy was also followed by Site M, which as a part of other London mental health Trusts, went for a fast two-phased (initially three-phased) implementation based on geographical rather than functional criteria.

NHS CRS implementations were carried out using PRINCE 2 Methodology,(116) which involved the following stages:

1. Preparation (e.g. vision, business case, organisational readiness assessment)
2. Initiation – (training, interfaces, work process changes, PID etc.)
3. Local design – (testing configured solution and revise plan if necessary) (see 4.2.4.)
4. Preparing for go-live – (testing and finalising the solution, approval to proceed (ATP)
5. Go-live
6. Support (deployment verification period (DVP), Trust taking over)
7. Project closure (lessons learnt and review).

The preparation stage was intended to render organisations ready for the implementation. Two of the most significant stages in this process were explanation and diffusion of the vision behind the NHS CRS implementation and mapping out of existing work processes. In relation to the vision sites focused on presenting to implementers and users the need for change and the anticipated benefits from the NHS CRS. In doing so they would achieve engagement and would ensure that the system: *"…it's not seen as a system coming in for the sake of implementing a system but it's, we want to change the way we work and that's just a tool that's brought it on the back end to assist in that process"* (Interview, IT Manager, Site H).

Another important part of preparation was to map out existing business processes. The aim of this was to represent current processes and then decide on how these would be reproduced and embedded into the system (e.g. Site D) or redesigned to fit into the system (e.g. Site R, E) or a combination of both (e.g. Site F). An important aspect of this process was clinicians' involvement, since on many occasions implementation team members lacked knowledge about clinical practices. Yet, clinical input was often perceived to be lacking (see the case studies of Sites C and Q). Further, our data suggest that some sites did not map out what it is that clinicians were doing on the ground (the actual clinical practices), but

focused on what they should be doing based on protocols. In this way, they limited the potential of the system to reflect clinicians' work.

Key aspect of the initiation stage was integration of existing systems. Most sites ran a number of different computer systems across specialties and departments that had to be integrated during NHS CRS implementation. System integration aimed to achieve consistency of data across systems and required technologies, such as integration engines and other components that would link together the Spine, the NHS CRS software and sites' different systems. Integration also presupposed data cleansing, which ensured that data were up-to-date, and data migration from existing systems into NHS CRS software. Some participants however reported that despite technologies that were put in place data discrepancies between the PAS system and NHS CRS software still occurred.

The communication process between the Sites, LSPs, SHAs and NHS CFH had a significant impact on the implementation process. Sites met on a regular basis with LSPs in order to discuss previous and planned activities, assess risks and set milestones, to monitor progress and to manage issues related to software customisation (for more details about this collaboration see Section 4.4.4 Configuration versus Customisation of the NHS CRS software). Further, Trusts were responsible for developing communication strategies in order to inform future and current users of developments in relation to the NPfIT (see, for example, the case study of Site H). This intended to eliminate silo mentality and enable more joint working (see the case study of Site Q).

Training

Assistance for users of NHS CRS systems was delivered through formal training and on-hand support during the first weeks of use. Each Trust organised their own training in order to tailor it to the local systems and the needs of users. They deployed their own trainers, who themselves received training on the system from their LSP (CSC and BT). Often, the scale of training was considerable (for example, in Trust B 3,500 users were trained).

Training was primarily focused on teaching functionality of the software, and in some cases included an assessment of the staff IT skills and an introduction to basic IT-skills (e.g. in Site C). Initially, training on new NHS CRS systems tended to be generic, and sometimes on training systems that differed from the go-live system, but approaches to training evolved (e.g. in Site A). In Site M, training went beyond teaching narrowly understood IT-skills (e.g. ability to use a mouse, keyboard, word processor, email or some other software) and

included sessions on information governance, clinical governance and the Data Protection Act. Also, despite initially having fairly generic training approaches, most the sites over time, to a greater or lesser degree, attempted to relate the training to different needs of different professional groups and to focus on the use of the software within a context of their work practices. This usually was achieved by a small role-based group training sessions. For example, in Site D, following training and one week prior to go-live, more than 600 workflow familiarisation sessions for staff from different disciplines took place. These were individual face-to-face sessions conducted by champion users as well as clinical leads who had received special training and were used to the software. The aim was to familiarise the staff with the NHS CRS and its effects on their work practices.

Overall, the sites employed some or all of the following forms of training:

- Classroom-based lectures to raise awareness (although these tended to be done in individual work places)
- Workflow familiarisation or "process map" sessions for different users, including champion users and clinical leads explaining how the software systems might effect users' work practices, small group training (often in role-based groups)
- One-to-one support from clinical leads and peers
- Interactive demonstrations of the system over the intranet
- Refresher training (needed due to the delayed 'go-live' dates but also required after the implementation and the initial use)
- Performance assessments
- Paper and online materials, as well as e-learning environments.

Training was linked to evaluation and access to the system. For example, in Site M trainees undertook an exercise driven evaluation based on practical scenarios related to a patient journey. Users were only granted access to the system and issued with SmartCards upon completion of training.

Opinions regarding the experience of training varied from very negative to decisively positive. In all the sites users felt that support from trained individuals within their own team was most valuable: *"I've found that going and sitting down next to somebody and spending time and saying this is what you're doing, this is how you use it has probably been more helpful because they've been able to say oh yeah and they've done it at the time"* (Interview, Healthcare Professional, Site Q)

A common complaint was that the training was too early and the material was forgotten by the time it was needed to be put into use, which was inevitable given frequent postponing of go-live dates, which was usually beyond Trusts' control. In some instances, staff were trained and ready for imminent go-live only for the planned deployment to be put on hold (e.g. Site A). Other criticisms included concerns that training was *'"not sufficient"* and *"rushed"*. In some Trusts, users felt that the training *"was way too broad based and too generic and it missed a point"* (Interview, Healthcare Professional, Site D) and that it *"didn't focus precisely on the bits of the system that we had to use and was not about the actual workflow that we would be doing"* (Interview, Healthcare Professional, Site D). This was echoed in Site M*: "I didn't think it was useful for what we needed to know to be able to do our jobs. […] It didn't tie in our processes and it didn't tie in sort of PIs [performance indicators]"* (Interview, IT Manager, Site M). Some participants (in Sites Q and B) mentioned that they missed the opportunity to *"play around with the system"* in a safe environment, without being afraid of making mistakes on a live system.

On the other hand, in Site C, training was well-received by users on the grounds that it was focused, detailed and ongoing: *"…we were really well supported and it was training on the ground. And in fairness, I think that's probably the better part of Lorenzo experience…. It wasn't just a training session, go away and do it was real-time with real patients and that I think was really helpful"* (Interview, Healthcare Professional, Site C). Similarly, users were generally satisfied with the training in Site H. However, both Trusts embarked on small-scale implementations, and such a level of one-to-one training and support might not be sustainable in large-scale implementations.

Despite an overall positive user experience of the training in Site C, a nurse reported that the training missed an important aspect, which was users' education on EHRs. She said users lacked good understanding of what Lorenzo meant and what it could deliver, a vital part of e-literacy in the healthcare setting. A similar view was conveyed by a consultant: *"I think that they understanding of Lorenzo by us, as clinicians is not good. I think we need to understand. I think perhaps we ought to have better education about it, rather than being involved in setting it up, I think perhaps what we should have had is education about what it meant. What the outcome might be and what imprint we needed to do and how we might understand how the system actually works, that would have been useful. I also think Lorenzo needed some better understanding about the clinical processes that they are supporting with this, so I think there was a bit of a balance with that"* (Interview, Healthcare Professional, Site C).

IT teams and trainers acknowledged that it was difficult to organise training. They encountered at least some of the following problems: a difficulty with engaging professionals, especially consultants, due to their busy work schedules, different e-literacy levels, the training environment not reflecting the live system, changing go-live dates and as a result training often running months before the actual go-live date. For example, in Site B 3,500 staff were trained in 10 weeks on R1.9, but when the go-live date was postponed they all needed refresher courses. However, even without the additional problem of postponed go-live date the sheer scale of the training needs posed great challenges. Hospitals cannot be closed for staff training days and hence all frontline staff cannot attend training lessons at the same time (near the go-live date). The scale of the training and support required (particularly in a Trust-wide implementation) and the implications on resources was a source of real concern. For example, Site D deployed almost 70 floorwalkers on the wards for three to six weeks after go-live. In addition, in Site C an IT manager argued that there was limited interest coming from the Trust and the SHA in terms of how training was organised, delivered and received, stating that *"the problem I have is that training is the last thing that anyone thinks of. […]. It's always an afterthought"* (Interview, IT Manager, Site C).

Often trainers had to be flexible and adapt to the needs of busy users, providing individualised one-to-one training sessions at the individuals' place of work, as the following quotes illustrate: *"…we do have a medic who has a very busy role, hasn't had a chance to go on the training yet and so I need to look at potential different ways of engaging them in getting them trained so that they can go onto the system. And then I've got another one that it's taken them probably two months to get it but I did, I've organised so she could have individualised training, she does have disabilities so she did need additional support so what I've done again I've arranged for one to one and that happened earlier this week but it meant a trainer actually going to the service whereas most of the training has been done in our IT suites and that"* (Interview, IT Manager Site Q).

In summary, the key messages from the Trusts about the content and delivery of training were:

- Training should take place as close to the "go-live" date as possible, ideally no later than a week before (but this is rarely achievable) with refresher sessions and sessions for new people run as needed.
- It has to be delivered when and where the users need it (i.e. at the most convenient time, if necessary in small chunks and not far from their work place).

- A realistic environment that feels like “live system” and is populated with data, which can be safely manipulated, should be used. Users should be able to access the training environment to “*play with it”* after training sessions.
- A mix of different methods (e.g. classroom/group/individual training, manuals and other supporting documents and e-learning) might be offered. However, support from peers (e.g. super users) was considered as most beneficial.
- Training should be focused and specific to the user role but at the minimum it needs to include an introduction to the whole system, providing users with an understanding of the system and its implications for their (and others) work.
- It is important to cultivate good relationships between trainers and staff.
- Some participants spoke of the need for early involvement of the training team with representatives from different care settings (e.g. in business change workshops) or even for the co-production of the training with doctors and IT people working together.
- Some participants also believed that training should be provided in small groups and accompanied by standard operating procedures (SOP) before the go-live date

An important overriding message was that the training strategy needs to be as flexible as possible, i.e. opportunistic, changing with the circumstances, e.g. different for different releases and tailored to diverse users’ needs. Training is an ongoing process, and plans for training new staff (in particular rotating junior doctors) need to be in place. However, our findings suggested that no amount of formal training, however well-run, will remove the need for hands on, one-to-one and preferably peer-based support. This may also involve drawing on experienced users from more experienced Trusts, particularly during the first weeks of go-live.

Availability of resources

Sufficient resources (human and financial resources) were necessary for the timely implementation of the NHS CRS: *“If we can get enough resources we can certainly, you know, make their goals but if we don’t we never will”* (Interview, IT Manager, Site B). For Trusts that were part of the NPfIT Local Ownership Programme (NLOP) resources were estimated by the Resource Manager. Participants though felt that this estimation was not pragmatic because it drew upon the amount of resources spent on previous implementations of different software solutions.

'Early adopter' sites received financial incentives in order to implement the NHS CRS. These resources were spent on training, equipment and manpower (e.g. sub-contractors to help with project management). Participants were concerned that the Programme had limited budget to cover all their expenses adequately and that certain components they would like to implement in the future wouldn't be possible to be implemented: *"… they'll say well we've run out of money we can't, you know, can't keep, the project can't keep the contractors any longer so we'll just wrap it all up and we'll never achieve what I know we can achieve"* (Interview, IT Manager, Site H). Long-term implementation costs were thus planned to be covered by individual Trusts.

Apart from financial resources a substantial number of people were required to carry out the implementation process. These included trainers, business change leads and local champions. In many cases, extra manpower such as floorwalkers and product specialists were provided by LSPs and locums were employed (Sites H and D) to compensate for the time healthcare professionals devoted to learn the system. Some Trusts (e.g. Sites A and M) were concerned about the costs of bringing in external knowledge and expertise and about how to transfer and develop such capabilities internally.

Concerning human resources, one of the most fundamental problems that some 'early adopters' had, was the fact that some members of the implementation team were working on contracts. Contracts were created in order to ensure that competent and dedicated people worked on the project. Indeed, implementation team members would often bring experience from commercial organisations, some were even ex-employees of the LSPs or suppliers (Site A, C and Q), or had previously implemented the same system elsewhere (e.g., Site M), which enabled a better work relationship between the commercial organisations and Trusts (Site Q).

Some contractors tended to have a fairly narrow focus on implementing NHS CRS software into organisations, resulting in a relatively narrow perspective on the NHS CRS. They perceived it as an internal project that had to be successfully carried out rather than a national project with long-term consequences on both the Trust and the community it serves: *"I was given a project initiation document, team of resources and asked to implement…I'm a contractor …I'm brought in to do a job. My job is to put this system in for XXX. I have a focus that is Site C Centric and that's what I aim to do. Do I spend time belonging to an associated and an affiliated body that's bigger and wider? For the greater good I'd probably do. That's not my main focus"* (Interview, IT Manager, Site C). However, for others, it was precisely an appreciation of the "bigger picture" that characterised the work of contractors as they had

insights into the wider implementation landscape beyond the organisation they currently worked in.

Contracts often ended during implementation, and contractors would leave the project taking with them all the knowledge they had accumulated. Apart from loss of knowledge, the termination of contracts slowed down implementation processes and reduced implementation teams' enthusiasm and morale to continue with the implementation process: *"Well they've told him that's the end of his contract. I mean how long do you continue to support a pilot, and I don't want to carry on unless we've got somebody like [Name] that is as keen and as switched on and as knowledgeable"* (Interview, Healthcare Professional, Site H).

Also, changes in key implementation team members (Site Q) was thought to slow the speed of implementation.

Concerns related to the arrival of the NHS CRS in institutional settings

The arrival of the NHS CRS in institutional settings was influenced by a number of factors which are outlined and presented in Table 4.7 below.

Delays in organisational readiness due to intra-Trust differentiation
Parallel running of other initiatives and projects
Implementation dissociated from actual practice
Complex supply and management chain
Limited resources
Changing NHS policies

Table 4.7: Concerns related to the arrival of the NHS CRS

Delays in rendering institutions ready were related to substantial differences among departments and wards concerning their attributes, business processes, existing technical infrastructures and level of computerisation. For instance, Trusts that were mainly paper-based required a major cultural change to shift to a largely computer-based mode of working in comparison to Trusts that ran computer systems before the introduction of the NHS CRS and thus switched to it faster.

Also, the management and implementation of the NHS CRS had to be aligned with local business strategies. In Site M managers prioritised the NHS CRS initiative over others so as

to take it forward in a faster and more effective way. By contrast, Site B kept various projects running in parallel adding in this way delays in the implementation of the NHS CRS.

It has also been reported that both local and national management of NHS CRS implementation was often perceived as being dissociated from the actual deployment of the system and from the day-to-day reality of clinical practices: *"They put no thought into the nitty gritty and how clinical teams will use it and so with regard to long-term vision, I can see what they see is a lovely neat system where we are all using computers. That was a very superficial view. To run RiO properly and the success of RiO depends on the clinicians. They needed to come down a few layers and get people working with the clinicians from day one"* (Interview, Healthcare Professional, Site M).

Similarly, the programme and a senior manager of Site R argued that the LSP often set contractual milestones that were hard to be achieved within the timeline. This conditioned a pressurised environment for implementation team members and healthcare professionals to work within: *"The milestones in the plan were set as a contractual milestone so we weren't allowed to alter those. What was quite difficult was we had to work backwards from those milestones. … milestones that were set were probably going to be unachievable, but we had to work within the constraints of that contract"* (Interview, IT Manager, Site R).

Further, a complex supply and management chain that was adopted for the delivery and implementation of NHS CRS systems resulted in convoluted communications and delays (e.g. Sites B and C). Specifically, LSPs and NHS CFH, including LPfIT, were sometimes viewed as links in the communication chain that hindered responsiveness to Trusts and implementation progress: *"…it takes much longer to do anything than you think it's going to take and there's so many people involved, so many committees involved to get anything done at the supply side that it takes a long time to get things sorted and that's unfortunate"* (Interview, IT Manager, Site H). Further, participants from Site M were concerned about the contractual obligations of each party that was involved in the supply chain, mainly because core aspects of their work, such as reporting, were not supported by the functionalities embodied in RiO: *"Reporting was one of the things that were omitted. It's something that maybe [LSP] or not [LSP], LPfIT should have done"* (Interview, IT Manager, Site M).

There were also concerns about the commercial nature of LSPs, which led to a prioritisation (rationing) of the support they provided to 'early adopter' sites especially in the post go-live periods. For instance, it was reported that CSC would withdraw support for a site (independently of their stage of implementation) in order to focus on the highest political

profile or the next go-live site. Similarly, Fujitsu (when it was still the LSP in the South) would prioritise next go-live and fast implementer sites independently of the importance of the issues that other sites encountered and raised: *"Where you were in the plan determined how quickly you got out to supplier resources and that was definitely obvious. That is the downside of the National Programme, isn't it? They will always put the focus on the early sites"* (Interview, IT Manager, Site R).

It was also repeatedly highlighted that the management of the implementation processes was influenced by limited available resources. The latter created a pressurised environment for implementation teams and conditioned uncertainties concerning future implementation. As an SHA representative said: *"There is little money around and I think that people are very concerned…"* (Interview, SHA).

The management of the NHS CRS was also influenced by changing policies of the NHS. It has been reported that changes in policy bring about changes in the planning and management of implementation: *"I mean if you think about the history with the NHS starting back in 1948, it's never stopped changing, so when is it ever going to stop changing, you know, you can kind of use that as sort of like when is this ever going to end, perhaps when the NHS actually comes to an end then because until then the NHS will always change."* (Interview, IT Manager, Site Q).

Finally, some participants were concerned about the limited understanding that implementation team members (and in some instances NHS CFH staff) had about the requirements (e.g. technological infrastructure, training) of the NHS CRS initiative, particularly in rendering the organisation ready for its adoption, and the extent of organisational and cultural change they would need to go through. These reasons made some participants from Site M argue that perhaps a slower approach to NHS CRS implementation would allow them to prepare better, make better usage of available resources and attract and maintain key and supportive people. On the other hand, with a phased implementation of EHRs, users might not see some of the early benefits as systems are initially not integrated.

4.4.4 Working-out technology-led change – institutional, professional and 'everyday' narratives of change

In undertaking this study we have been concerned to explore the implementation and adoption of software systems to support the NHS CRS from a variety of perspectives – to tell various people's stories (even of things). In particular, and reflected in this section, we have

been concerned with the clinical users of these systems. What they have experienced, how they perceive the potential and the actuality of such systems, and how they can incorporate them into their work practice with advantage for them, for patient care and for the healthcare organisation.

The limits of 'Implementation' as discrete change

Change implies a shift from one situation to another. It assumes that comparisons between 'past and present', 'before and after' or 'here and there' are possible and indeed desirable so that change becomes manifested. A focus on change however, cannot reveal the actual process of change (the internal and ongoing 'how') or the complex drivers of changing or not changing (the 'why').(90) Furthermore, change is seldom a rapid or direct movement from 'the old' to 'the new', rather the new is born within the old and co-exists with it, and the old and the older still remain present (albeit often in different forms) within the most new.(54;117) Change, seen from this perspective, is then a process surrounded by continuities and discontinuities of ways of acting and thinking.

For the above reasons we argue and show below that implementation of the NHS CRS is a process that was made to work through the mediation of a number of people and technologies.(44) This process was conditioned not solely on predefined visions and strategies but primarily on relationships, processes and practices as they emerged on the surface. It also conditioned a number of intended and unintended consequences that were likely to give rise to new clinical practices and procedures or to reproduce or modify the existing ones. We have adopted a process-based approach to study the implementation of the NHS CRS that focused on exploring and interpreting this process of change rather than evaluating it as either 'successful' or 'failed'. On the basis of the above and in line with our sociotechnical ontology we make the following three assumptions concerning NHS CRS implementation.(50)

Firstly, people and technology are co-constitutive because actions and their effects cannot exist without the involvement of both people and technologies.(54;117;118) Secondly, the introduction of a technology in a healthcare setting requires considerable 'configuration', 'translation' and 'appropriation' before being embedded into healthcare settings.(33;39;45) As we show, NHS CRS software systems had to be adapted in order to meet the needs of the hospitals within which it was introduced (configuration) and had to be constantly interpreted and modified (translation) in order to become meaningful to the users (appropriation). By focusing on these aspects we also captured the use, non-use and 'mis-

use' of the NHS CRS not as positive and negative effects of its implementation but rather as some of its necessary conditions.(119)

Thirdly, the NHS CRS products were neither totally malleable nor fixed but were being used in ways that reconciled the assumptions embedded in them with the clinical practices and pathways that prevailed in healthcare settings.(109;120) In this way, the NHS CRS implementation is conceptualised as a process that cuts across boundaries (institutional, professional etc) in order to be made to work.

Implementation versus adoption

NHS CRS software systems (or their customisations) were built and implemented while in use, i.e. while the system was being 'adopted'. Especially for Lorenzo, intended to be built while in use, this nature of a 'continuous implementation' process was (and at the time of writing will be), "*like painting the Forth Road Bridge*" (Interview, IT Manager, Site B). Furthermore, deployment did not necessarily result in use of the software systems, making the technical, 'official', go-live date, "*as most of the [IT] world would recognise it*", different from the 'real' go-live stage in practice: *"… the hard landing for us was, I mean the soft landing was the technical go-live, the hard landing is a go-live as most of the world will recognize it in that people were using the system"* (Interview, IT Manager, Site B).

In the NHS CRS, and especially in the case of Lorenzo, the distinction between implementation and adoption is blurred; rather the software systems were being put into use, used and adapted and back to being 'implemented'. A cyclical, process of growth, that in order to 'progress', also displayed signs of 'regression', as a Lorenzo Implementation Team member explained: *"Every time you get a new build you sometimes get some regression, you sometimes get, things break you know, they broke photo upload at one point. Little things like that or things don't, they change things and assume it'll be alright and it isn't alright so…"* (Interview, IT Manager, Site H).

However, this cyclical process of building and using - implementation and adoption- clashed with the rigidity of a structured approach with a focus on documentation: *"Everything has to be specified, everything has to be written down, when it comes back it has to be multiply tested, it has to be fitted into a framework, it has to be assessed against every other national service, I'm surprised they get anything to be honest."* (Interview, Developer)

This structured approach, summed to a multiplicity of layers and stakeholders ('implementers', from NHS Trusts, LSPs, NHS CFH, etc.) between users' feedback and

'programmers', resulted in a very slow process of software systems' improvement (and users feeling not being listened to). When components of the software systems were built/developed in a cyclical mode with a relatively fast turnaround (e.g. Site H), adoption seemed more successful. Nonetheless, there was potentially a tension between users feeling disengaged from a readymade product such as Millennium and users being motivated and able to give their time to participating in system development and build, as in Lorenzo.

Each system (or build) *implementation*, *release* or *roll-out*, was then part of a lengthy and laborious processes of adoption. Direct and indirect users of the NHS CRS, initially at times sceptically hosting this new intruder in their daily life,(121) came eventually to appreciate and/or refuse it. These processes of adoption at times had unexpected endings. For instance, in Site H, healthcare professionals initially only used Lorenzo because it was mandated, but they made it work for them, only to face losing the system for another one to be introduced in its place. This was a collective achievement, with the support of a dedicated IT manager,(122) for the role of 'special people' in systems implementations). Finally their efforts were placed into not "*let [their Lorenzo] die*", a definite measure of 'success' for this implementation: *"So what we're doing at the moment is just trying not to let it die, […], we're trying to show that it still works, […], I'm trying to talk to commissioners to try and try and get them onboard […] They're looking at two systems, they're looking at [xxx] and they're looking at [yyy] and somebody much higher than me will make a decision"* (Interview, Healthcare Professional, Site H).

In other contexts, the attempted adoption was less successful, with abrupt cut-off points (Site R), or a feared slow 'death', a "*death by a thousand cuts*" as intended users slowly stop using the system: *"…the individual, each person working on the project across every Trust, across every sector, you know, if morale is low, if there's a perception that it's going to get canned in six months anyway so why bother, you know, it's death by a thousand cuts…"* (Interview, IT Manager, Site B).

The following sections will provide further insight into these processes of adoption and change.

Configuration vs. customisation of the NHS CRS software systems

Unless an EHR system is developed locally in the healthcare setting where it is supposed to be used ('home-grown' system),(23) 'off-the shelf' systems require some degree of

configuration or customisation. For the purposes of this report we define configuration as being the process of fine-tuning and customisation as being the process of redesigning software (code and subsequent upgrades) in order to meet local needs. Table 4.8 illustrates these two approaches along with the processes that participant sites followed and their results. Processes of configuration and customisation indicate that technology is a physical entity embodied with particular characteristics and built on certain assumptions that require negotiations before being used.(123) Data from our research indicate that different NHS CRS software systems were modified in secondary healthcare settings in different ways. Specifically, Lorenzo 'early adopter' sites would customise the software, as it did not exist as a final product, whereas Millennium and RiO sites would configure it within the limits of their contract.

Lorenzo had to be substantially developed and redesigned by 'early adopter' sites in order to meet their needs and clinical processes. 'Early adopter' sites would get new builds of the system on a regular basis and test them in the testing environment before they went live to the live environment. During this process they collected any issues that emerged either from the testing or from the actual use of each build. These issues were then prioritised and kept by each 'early adopter' site in a log and were collectively managed by 'early adopter' sites, NHS CFH, CSC and SHA through what they called the Issue Management Process (IMP). These issues would be reported to CSC, which would then report them to iSOFT in order to be fixed. The process however was not as smooth as presented here.

Often sites would get upgrades that were close to but not exactly what they requested or upgrades that looked like 'nothing they had specified' or new releases that fixed issues but undid past changes, allowing in that way reoccurrence of the same issues (what they called regression) or rise of other issues. Also, they would often get builds with delay, for instance in Site H implementation team members had to wait for over a year for an issue to get resolved, leaving limited time for testing or upgrades. It has also been reported that changes were often delivered in very small chunks, which meant that users felt they were left with a 'half-finished solution'. Most importantly, many times issues were not approved as such by CSC and NHS CFH on the grounds that the software met the specification and worked as designed.

To enable the IMP some project team members of the Lorenzo Early Adopter Programme (LEAP) travelled to Chennai and worked together with the developers in order to fix some bugs of the system whereas iSOFT and the LSP set up regular web-conference meetings with 'early adopter' sites during which the software was demoed from Chennai and sites

were able to comment and provide feedback before any change was made to the code. NHS CFH and the SHA also appointed “form builders” located in the UK in order to speedup customisation.

In Site R configuration of Millennium was managed in a similar way. The problems they encountered during the testing of Millennium were discussed internally and then prioritised before being reported by the Trust to the LSP (Fujitsu) in order to be fixed. Participants though reported that the version of the system they were implementing (version zero) was *“…relatively inflexible…”,* that they *“…had to push hard for every single change in the system…”* and that *“finding solutions seemed to be long winded and difficult”* (Interview, Healthcare Professional, Site R). Further, the site would on some occasions disagree with the LSP about the importance of some of the issues that were raised which meant that some of the issues would either be resolved with delay or not resolved at all.

Indeed, many issues that were raised remained unresolved on the grounds that either the software met the requirements, and thus worked as was requested, or a requested change was not a part of the contract, and thus could not be made. Further, the site was given a limited timeframe to implement with potential financial penalties for failing to meet these deadlines, adding further problems to configuration. An SHA representative further argued that one of the obstacles in this configuration was that the site did not sufficiently understand the scale of changes (in clinical work and process) they would have to make. Some of these problems were addressed albeit at later stages of implementation when people from Cerner worked directly with implementer sites from the Southern cluster.

Configuration/Customisation	Process	Result
Customisation	Redesigning the software to match clinical processes (NME sites)	Still under development Partial success
Configuration	Fine-tuning constrained by contractual limitations, strict deadlines and financial penalties (Site R, BB).	Stopped implementation went back to their old system (Site R). Chose another system that supports mental health functionality (Site BB)
	Fine-tuning of the product and the code (Sites D, E & M)	Minimal changes in the product to meet needs. Fast deployment.
	'Anglicisation': reengineering of clinical process in parallel with software adaptation (Site F)	Preparation for go-live in May 2011

Table 4.8: Configuration versus customisation of NHS CRS systems

In contrast to this, Sites D and E implemented the so-called New Delivery Model of Millennium which allowed implementation team members to configure the product to their needs. The site configured *"probably less than 2% of the system"* (Interview, IT Manager, Site D). The product was changed at two levels: change in the code which would occur every two years and configuration of the product which was delivered in a more timely way. The site configured the product by working closely together with BT and Cerner on site. Co-location was perceived as an important factor for accomplishing joined-up configuration, avoiding bottlenecks in the supply chain and dealing with failures directly. This process also gave the site a sense of control over configuration although the LSP would still play an active role by mediating between the site and Cerner.

Similarly, Site M configured RiO in order to meet the needs of clinicians. Specifically, participants argued that the functionalities embedded in RiO did not support reporting on performance and thus brought in people to help develop this functionality.

Site F in the Southern cluster configured Millennium with the University Pittsburgh Medical Centre (UPMC) with a view to 'anglicising' the software (originally a US system) so that it represented their clinical pathways and reflected their lines of accountability and hierarchy. Anglicisation, as participants explained, meant comparing what the system offered with the

Trust's clinical processes and making necessary changes and innovations. The purpose of the Trust was neither to redesign the software nor to adapt existing practices to fit into it but rather to critically look into clinical processes and improve them by using the available tools. This required extensive collaboration between clinical groups and the IT implementation team as well as between the Trust, Cerner and UPMC.

Implementation team members from Site BB that initially implemented Millennium abandoned their attempt after a few years due to the substantial amount of time they spent on configuring the software to match mental health settings and processes. Major factor for this was that mental health functionalities, although incorporated in Millennium, were not purchased in the contract. Participants raised a number of concerns during configuration and customisation, which are summarised and presented in Table 4.9.

Concerns surrounding customization and configuration processes	
Concerns	Implications
Standardisation vs. Localisation	Normative concerns: • dissociation from central purpose • branching of the code
	Concerns related to: • differentiations between Trusts • differentiations between clinical work • common needs for similar information • differentiation as manifestation of professionalism
Lack of Knowledge about: the product the English NHS clinical work	Systems not reflecting work practices and business processes of NHS organisations; conditioning critical safety issues and demanding substantial changes in clinical work practices
Complex supply chain	Mediation required significant translation of the messages being exchanged between organisations
Involvement of commercial organisations (LSPs)	Prioritisation of product delivery and its outcomes over quality of product and processes of configuration/customisation

Table 4.9: Concerns surrounding customisation and configuration processes and their Implications

Firstly, some participants raised normative concerns in terms of whether the software should be customised and configured (or not). Their argument was that the conventional purpose behind the NHS CRS is to have a national contract and similarly a nationally shared solution. Thus, the more localised the software becomes the more distant it gets from its centrally defined purposes: *"If you keep giving people the ability to localise things you kind of drive away from a centralised understanding…"* (Interview, Healthcare Professional, Site C). Also, localisation assumes deep changes in the code of the product, what a participant from Site H described as 'branching of the code', that makes it rigid for national use.

Also, there was a dispute among participants concerning the extent to which clinical processes can be standardised or not. Some people argued that hospitals work in different ways, have cultural differences (e.g. Teaching Trusts, Foundation Trusts etc) and often different care processes for the same healthcare problem: "…*it's all different everywhere you go, they do things differently and they all think their way is the best*…" (Interview, Healthcare Professional, Site H). For instance, mental health professionals have a very different way of recording data, most of the times by dictating, their data is in the form of a narrative, and they tend to work across a number of settings both within and outside Trusts (such as patients' home). Further, differences in the amount of financial and human resources that sites have at their disposal, variations in the types of contact clinicians have with patients and variation in health population conditions differ in the ways in which Trusts work. Because of these differences technology needs to be flexible and customisable in order to meet everyone's needs.(110)

Others, however, supported the view that healthcare professionals need the same type of information (such as patient demographics, diagnosis, treatment, GP details and clinical letters) to carry out their clinical processes and that '90% of the processes can be standardised across Trusts', implying that a common product would be an effective solution for all current 'early adopter' and future sites. Indeed, RiO was implemented in 8 out of 10 mental health Trusts in the London cluster bringing a number of benefits to the Trusts such as sharing experiences and learning as well as economies of scale. This, as participants from Site M reported, was despite the fear of loss of autonomy when it came to important decisions about configuration and deployment of RiO.

An SHA representative also said that often healthcare professionals emphasise their differentiation because of their professional power: *"…to a large extent, medics kind of doctors have control to a large extent over what goes on in the Trust and they are very powerful and they like to do it their way…. They easily circumvent the situation and they are*

able to do that, because they just say, you can't question my professional judgment" (Interview, SHA).

Many people also advocated that the NHS CRS would need a similar base-code that is nationally shared but configurable to local needs.

Secondly, an obstacle to configuration was the limited knowledge that 'early adopter' sites had about the software. Lorenzo was since the point of its adoption, under continuous development. CSC was not in a position to provide full demonstration of Lorenzo and consequently, implementation team members did not seem to know what it is exactly they are implementing: *"I haven't even seen R2, I haven't even had a chance to play with R2 so I don't even know what it does I just know what I'm told it does. Every time I ask to be able to get my hands on it and play with it and just see how it all works there's always reasons why that can't be done…"* (Interview, IT Manager, Site H). Similarly, sites in the southern cluster (Sites R and BB) had either limited or no understanding about what the product was or how it would function in their Trust. Some implementation team members thought that this was deliberately done because the more the sites are aware of the software the more likely it becomes that they would request for changes to be made to the software

Thirdly, software companies and service providers had limited knowledge about the clinical practices and processes NHS CRS systems were supposed to support.(39) Software developers and providers were not knowledgeable about how the English NHS works and about its distinctive nature from both other industries (such as commercial organisations) and other national health systems (such as the American health system). As two managers from a Southern site said*: "I think there were problems in terms of their view of how the system worked which was based on their knowledge of the American NHS or the American healthcare processes"* (Interview, IT Manager, Site R). These differences had to do with *"…how they would call certain things, some issues had to do with semantics, some issues had to do with who does what, the flexibility that goes with each system, some things had to do with the different pathways"* (Interview, Healthcare Professional, Site F). As a result, the system reflected developers' perceptions of clinical processes, often as being linear and homogeneous, but not the actual complexities that surround clinical practices:(109) *"…what was delivered was a clumsy system that seems to have been designed for one clinician who has clinics booked up in advance that uniquely come in and everybody who comes shows up or maybe they don't show up. There is nothing more complicated than that"* (Interview, Healthcare Professional, Site M).

The mismatch between perceptions of and actual clinical practices would often lead to builds that raised clinical safety issues or demanded substantial changes in clinical work practices. For example, managers from the Southern cluster explained that they had to educate their users to the new language embodied in the system, such as Emergency Department (ED) rather than Accident and Emergency (A&E) and the different clinical pathways. For this reason, clinicians and members of the implementation team had to interpret the initial design before translating it in a way that reflected clinical practice.

A fourth concern was the lack of direct communication and contractual relation between implementer Trusts and software companies. This mediated, by LSPs, communication made it difficult to exchange messages that are interpreted in the same way by all the involved parties. As an SHA representative argued: *"We were hearing things from the NHS … third hand as it went from Cerner to Fujitsu to us. A lot of times when things weren't quite right and when things were not explained to us correctly, and, not through any malice at all, but just because they didn't understand it either and it wasn't explained"* (Interview, SHA). This complex supply chain has been characterised by participants as a *"cumbersome process…a chain of command"* (Interview, Healthcare Professional, Site C) and a *"Chinese whisper situation"* (Interview, IT Manager, Site C). Also, the lack of a direct contractual relation meant that they had *"to fight for every single change"* (Interview, Healthcare Professional, Site C) and *"had to keep pushing for them"* (Interview, IT Manager, Site Q). An illustrating example is when participants from Site H threatened to pull out of the process.

Finally, participants raised concerns about the consequences that the involvement of commercial organisations brought about to the quality of the software and thus to the level of its customisation and/or configuration. Specifically, they argued that contracts were focused on the delivery of the product rather than on its quality, process of delivery and consequences of its implementation: *"I think it's always very difficult when you involve a commercial company with a public service, because a commercial company will always be driven by profit and the money that they are making. Maybe as things get critical the quality of what's delivered becomes a secondary issue."* (Interview, Healthcare Professional, Site C). Implementers of the Southern cluster also argued that the contract incorporated an 'unachievable plan' and constrained the configurability of the software adding problems not only to implementer Trusts but also to the LSP*: "…the contract was set out for the South, it constrained not just us but probably the supplier as well in terms of us putting workable solutions in locally"* (Interview, IT Manager, Site R).

Work processes, changes in work practices

The NHS CRS as a technology-led change programme was intended to change work practices towards making patient care safer, standardised, more effective and efficient.(15;124;125) This section focuses on the changing of work and work processes for clinicians, clerks and other front-line staff. Though the unfolding of the Programme also led to changing practices for other staff members, such as for instance, the NHS Trusts' managers, and local IT helpdesks (for instance: the existing IT support services within Trust B had to be restructured, covering for a national service desk too removed from the local needs; Site M took the opportunity to develop a help desk software to improve their services).

As each implementation was different – different organisations, of different sizes, with different geographical distributions, different legacy software systems and IT infrastructures, skill mix, work processes, histories, visions for change and NHS CRS technology deployed – findings vary across sites. Some recurrent themes emerged from the case studies. They are presented under the two headings of changes to 'clinical and administrative work processes for patient care' and 'local management processes' for clinicians' role as local managers or service leads. A summary of the themes is presented in Table 4.10.

Type of work	**Aspects of changing practices**	**Issues and characteristics of aspects of change**
Clinical and administrative work processes for patient care	A variety of 'users' and reasons to use the systems	Use of the NHS CRS as 'part of the job'
		Time constraints and wasting resources
		Team-working
		Direct use/data entry versus use of the data for secondary purposes
	Processes of adaptation, compensating, workarounds	Time for change
		Software systems usability problems, technical issues and disruptions
		Adapting the software or adapting to the software
		Workarounds for work coordination, waiting for full roll-out
		Workarounds to 'trick the system' and 'get the job done'
	Changes to sequencing in recording clinical notes	The myth of the paperless practice?
		Concurrent note-taking when with the patient

		Retrospective data entry, after patient care
	Redistribution of work and time for patient care	The myth of 'speeding things up'?
		Redistribution of data entry workload
	The affordances of 'being digital'	Information access and retrieval processes
		Legibility of written information
		Saving time
		Real-time data
		Critical mass
	Flexibility and mobility of work	Hardware and Infrastructures
		Remote work
		Wireless work
	Quality of work life	Frustrations
		Satisfactions
Local management processes (clinicians as managers)	Managing with real-time data	Direct use of reporting systems
		Data warehouses and time-lags
		Time for managing
	Making work visible	Accountability and Trust
		Professionals' profile and costing
		Changing relationships and team-working

Table 4.10: Changes to work processes and work practices

Clinical and administrative work processes for patient care

A variety of 'users' and reasons to use the systems

Across all implementations, the main clinical users of NHS CRS software systems were administrative staff (e.g. ward clerks), junior doctors, nurses, matrons and allied healthcare professionals (AHP – e.g. podiatrists, mental health therapists, psychologists). NHS staff tended to accept the use of the NHS CRS software system as 'part of the job' as they were asked to do so by their Managers: *"…to me it's just something that I've been asked to do, so I do it"* (Interview, Healthcare Professional, Site H).

Senior doctors – consultants – more rarely engaged with the system on a daily basis. For instance, in Site M, a consultant psychiatrist explained the junior doctor would type the information on RiO: *"I have a team. I probably use [RiO] less than 10% of the time, because if I'm seeing patients in a ward setting, it would be my junior doctor that's inputting the information…"* (Interview, Healthcare Professional, Site M)

In Site BB, consultants were mandated to enter progress notes in RiO, but they then returned to their previous practice of dictating notes for their secretaries to type: *"…as a Trust, we mandated the fact that [consultants] have to put their progress notes in to avoid any delay, because of best practice. We did that with all of them, but we actually went back and checked, […] the majority of those consultants in Phase 1 we're doing it. Now we are onto Phase 6 and we are hearing through the grapevine and suddenly they are dictating those and the admin are now entering the progress notes on their behalf, as a separate to the dictation of letters which may take, you know, three to four weeks to come through"* (Interview, Healthcare Professional, Site BB).

Pre-existing work practices allowed junior clinical staff to perform tasks on behalf of consultants (team-working). But NHS CRS software systems and access-control technology at times mandated data entry to senior clinicians, and this was seen as conflicting with the required flexibility of team-working: *"The thing with ICD* [International Classification of Diseases] *in coding is, it has to be a consultant that puts it in [RiO] and can't even be a junior doctor, so that's just slightly irritating to me"* (Interview, Healthcare Professional, Site M).

Some consultants objected to use of the system and argued for their junior doctors or admin staff to use it. For instance in Site Q, psychiatrists argued for, and obtained, administrative support for typing notes, as this would impinge on their clinical time and would be a *"waste of resources"*. However, NHS CRS systems were also implemented with the support of senior consultants (e.g. in Sites C and E NHS CRS systems were implemented because of a consultant motivation).

Consultants and service leads showed a greater interest and use of reporting functionalities and data available through the software systems, to inform and manage the services they lead (more on this in the following pages).

Processes of adaptation, compensating, workarounds

In some cases users were asked to use a system that was perceived as not ready, and/or required duplication of work on parallel systems, was cumbersome, had slow response time, was time-consuming, at times stressful and frustrating. Getting the NHS CRS system to work initially required so much attention that they felt they were "*spending more time with this system than we were actually with the patient*" (Interview, Healthcare Professional, Site H).

In sites where the NHS CRS system replaced an existing PAS, problems with data migration resulted in over- or under-booked clinics, information missing in the system etc., with major disruptions in the running of services and *"fundamental effects on coordinated activity (as it informs both patients and clinicians where they need to be at any point in time)"* (Researcher Field Notes, Site B).

Yet, despite a feeling that the NHS CRS was making their traditional job more cumbersome, NHS staff generally kept using it as they felt they had to (and they still are at the time of writing). In some cases, interface design and system functionalities were viewed as having considerably improved in the two years since Lorenzo was first introduced "*the difference was much more noticeable …the number of clicks and the speed as well…"* (Interview, Healthcare Professional, Site H). In some cases there was a perceived lack of improvement. In other cases with time, users got better at using the system they were given. The software systems were made to work through a process of adoption and adaptation: if the technology could not (or would not) be changed to fit the existing work process (and if the new work process as intended could not be made to work), the work process needed to be adapted to accommodate the idiosyncrasies of the technology. Getting to know the limits of the technology, clinicians learned to prepare and compensate (for instance for the slowness of the system, logging in well before the arrival of the patient in the clinic (Site H)). Workarounds abounded.(126) For instance, keeping the paper record as the shared, official, patient record and printing off from the NHS CRS system the information recorded in it. In the words of an IT manager, printing the record is the 'biggest workaround': *"… you see so one of the workarounds would be the print. I mean that's the biggest workaround isn't it at the moment that they're printing off and putting it in the case notes […], but it's temporary until they've rolled out the rest of the functionality within it, isn't it?"* (Interview, IT Manager, Site Q)

The most common 'workaround' involved the use of paper (printouts, post-it notes, diaries, etc) as a reminder of activities or for coordination of work. Some workarounds, such as printing the record, related to the more general workflow, and were due, for instance, to the need to share the record with users currently not on the system (other healthcare professionals in Site H) or with other paper records (e.g. other radiology requests from wards not using Lorenzo, in Sites B and C); others were 'creatively' devised to overcome usability issues with the technology, such as taking screenshots of the just-typed notes when the system *"froze"*, and printing it to add it to the paper file, to avoid having to re-do time-consuming work. The need to *"trick the system""* in order to overcome constraints and *"get the job done"* (e.g. mandated fields/screens unfit to a specific clinical activity (Site Q), or

absence of the right clinical code in a drop-down menu (Site H)) resulted in issues further down the line, for instance, impacting on data quality or management's ability to monitor activity levels (see also data quality section).

Changes to sequencing in recording clinical notes

The major change in work practice that was expected of the NHS CRS was concurrent entry of clinical information on the system at the time the activity takes place (e.g. when consulting with a patient). For instance in Site D, management intention was for "*staff to update the record in real-time, so that CRS became accepted as a normal part of their work*" (Interview, IT Manager, Site D). Most EHR implementations are based on this implicit assumption, that EPR would enable a paperless practice, though more than once this assumption has proved to be false. In the case of the NHS CRS, for the majority of Trusts clinicians did not enter data in the system while they were with the patients (either at bedside, during ward rounds, or during outpatient clinics). The example of mental health patients presenting in A&E was particularly telling: *"I think there is a big issue for junior doctors out of hours and the nightshift in A&E because what the psychiatric assessments are quite lengthy and there is quite a lot of notes that go with it. What they usually do while they are in with the patient is, they make the notes as they go along and they are the record. They've raised concerns that they will be in with the patient and they are then going to have to come and type those notes up. They are not going to be able to do it while they are with the patient, because of issues like risk. These are patients that are really quite disturbed. You can't kind of be faffing around getting them by computers. So it's going to increase the time spent and you are then delayed seeing the next patient, that's going to impact on the breaches of A&E which is I think the big anxiety"* (Interview, Healthcare Professional, Site M).

At times the context of use clashed with using NHS CRS software for concurrent note-taking. For example, during a new patient assessment with an elderly patient who had hearing problems, the patient could not hear the clinician sitting away at the desktop computer (Site H); using a laptop when assessing a patient's wound could be similarly challenging and a clinician suggested that working in a team could offer a solution: *"Yeah, you know, stuff that I get over my lap with a patient you wouldn't want anywhere near a computer, you know, particularly in the high risk clinics, you know, there's a lot of mess and different things you're doing. I think it works better as well in the high risk clinics when there's two of us working together because if I've got a wound and I'm getting all messy because I'm dealing with a wound then, you know, I measure it and I can't go suddenly to the computer to put in a measurement, you've got your gloves and you're covered in everything, you can't do that…"* (Interview, Healthcare Professional, Site H).

Concurrent notes, if any, were still taken on paper and sometimes written up from memory hours after the care activity had taken place. But the need and requirement to record data in the NHS CRS software system led to a change to sequencing in recording clinical notes. Data entry into Lorenzo was most usually done retrospectively, sometimes days after the clinical encounter, raising safety as well as efficiency concerns[3]. In using Millennium, clinicians in Trust D decided to limit their use of the software system to requests and reporting, but to keep annotating clinical notes and diagnosis on paper for the same safety and efficiency reasons: *"…Of course people don't have the time to do that, because you might have to see seven patients on a ward and you can't be whisking between a patient and a computer all the time, because you'd have to do it in between each patient. If you start doing it at the end of the round people would start forgetting and then you might put the wrong information into the wrong set of notes. Then you are going to have increasing errors, which if they are clinical can have significant consequences"* (Interview, Healthcare Professional, Site D).

Redistribution of data entry work and time for patient care

Although some Trusts (e.g. Trust D) had to increase the number of their administrative staff, at least temporarily, to make the NHS CRS software work, computerisation also generally led to a redistribution of work, with clinicians doing more of the data entry that would otherwise be done by 'typists' or 'data entry' clerks. The NHS CRS software systems were originally intended to reduce clinicians' administrative workload and in some cases (Lorenzo, but also a non-NHS CRS system such as the Electronic Discharge Summary in Trust P were presented to the clinicians as ways to 'speed things up'. However, it is well known that data entry at the computer often takes longer than on paper, so for instance in Trust H, outpatient clinics were given 5-10 more minutes to have time to access and complete the electronic patient record (Lorenzo). But no similar provisions were made across all settings, for instance in Trust D: *"All our doctors and nurses are having to work harder now, because we are having to see the same number of patients with less time, because you are spending more time on a computer now and we have got no more doctor or nursing resources to do that"* (Interview, Healthcare Professional, Site D).

Having information already typed in the system by the clinician at the point of care (versus having to wait for a typist to complete it) and the real-time electronic transmission of

[3] Implementation teams were looking into hardware as a potential solution (laptops, voice recognition software and digital pens). But it may not be just a matter of hardware?

messages (such as Requests and Reporting, Referrals, Discharge Summaries) can make the activity in its entirety collectively faster, though part of the work has been redistributed at the point of data entry. A participant, from Trust D, explained this shift, with a comparison between paper and digital requests for tests and investigations: *"I use [Millennium] only to request lab tests and X-rays - I have no choice in that - but when I work at peripheral sites, I save a lot of time as I can there use 'old fashioned' paper request forms which are very much quicker to complete albeit that the process is then presumably slower for someone in the labs or imaging department."* (Interview, Healthcare Professional, Site D)

The affordances of being digital, and changes in information access and retrieval

Computerisation of previously paper-based practices brought benefits associated with the positive affordances[4] of 'being digital' (see (127) for a comparison of positive and negative affordances of paper and computerised written information). For instance computerisation made written information legible. As a nurse pointed out, the problem with illegible handwriting was 'across the board': *"The main thing really is that we can read people's writing. That was a big thing before that you couldn't actually read what people were writing in the NHS across the board. Now we can read everybody's writing. That is a major thing. And people I think forget that over time. You quickly forget the bad old days of not being able to read what somebody has written or reading traditionally, they say doctor's entries, but it was everybody"* (Interview, Healthcare Professional, Site M).

It also made more (if not all) clinical and activity information available digitally (anytime, anywhere, given access with the right SmartCard). The more successful NHS CRS systems implementations saw the benefits of having all information at hand, by saving time and effort by not having to have to "*route through drawers for notes and constantly try and find patients notes and queries and stuff*" (Interview, Healthcare Professional, Site H). Similarly, for finding information within the record, RiO facilitated information retrieval by searching and filtering: *"... If you are going, wanting to find something, you will be able to find it much more easily. If you think I want to find the entry that I know the psychologist made, rather than hump through, you can just filter by psychology and you are going to be able to find things much more easily"* (Interview, Healthcare Professional, Site M).

[4] The term 'affordance' was coined by James Gibson (1977) to refer to "what [the environment] offers the animal, what it provides or furnishes, either for good or ill". The term is often used in relation to computerised systems to refer to what people can use the systems for (positive affordances), or the systems constraints (negative affordances), the quality of the systems, its benefits or disbenefits

Clinical information in RiO was seen as 'live', 'secure' and 'accessible from clinicians' desk', and the benefit of having real-time access to the notes was felt across the board: *"I think the uniform response by the benefits of RiO and using RiO at the moment is everybody saying the same. It's the kind of speed and ease of access to client notes there and then, the data is live. It's secure and we can access it from our desk. From the ward and anywhere in the Trust that if we need that information. That is quite uniform in the Trust"* (Interview, Healthcare Professional, Site M).

However, this benefit of computerisation only really materialised after the software system use reached a 'critical mass' of users and data. One site reported that the use of the software system, both for managers and clinicians on the ground, became really meaningful only with use. Initially one had to 'feed the beast' (Site H), getting very little, if anything, in return.

Increasing flexibility and mobility of work

In the changing process, there are continuities and discontinuities of practice (see also for instance, the case of Trust C). Thanks to the infrastructure put in place for NHS CRS, users were now computerised and connected and this enabled more flexible and mobile work. For instance, mental health clinicians in Trust BB, "*if they are at home and they finished in A&E they don't come back to finish writing up their notes and do it at home*" (Interview, Healthcare Professional, Site BB). Clinicians then were able to work remotely, exchanged information across settings (see section on working across boundaries) and more flexibly and efficiently attended to patient care. For instance: *"…a patient from this particular clinic needed to be seen as an emergency the week before, we couldn't fit them in till this Tuesday so I arranged for them to go to another clinic and I was able to access their records on Tuesday so I could actually see what had happened to them on the Friday.* ***Now that wouldn't normally happen****, I would know they'd gone to another clinic but I wouldn't know any more than that probably so that was good and I like to be able to do that just to click on that patient, see that they have gone to another clinic, what had happened and I'd got that information in front of me. So I like the fact that I can access the information"* (Interview, Healthcare Professional, Site H).

Changing quality of working life

Despite the fact that Lorenzo is *one* system, its design and functionalities are different in the different settings and possibly with a different combination of hardware and network infrastructures. While the healthcare professionals in Trust H made it work for them, changing their work practices for the better, and even eventually transformed their practice into an (almost) paperless practice, for other Lorenzo users, the system seemed to have made their work practices 'worse' (see case study of Trust B) and, at the time of writing, were still experiencing the frustrations usually only encountered at the initial stages, when learning and getting used to a new system. Coping with NHS CRS implementations over a long period of time (e.g. 12-18 months), had (and at the time of writing are still having) an effect on the quality of people's workdays, for better or worse. In Trusts B and Q, because of the additional workload linked with the use of the technology, and no extra support, one of the medical secretaries had to go *"off with stress"*, staff were found *"in tears"*, people started *"looking for other jobs"*. The stress was particularly apparent amongst administrative staff, seeing work piling up and the system (or its configuration, or combination of hardware and network) "*taking 2 or 3 times as long*" (Interview, Administrative Staff, Site B). Clinicians are also *"driven mad"* but they did have the option of not using the system: *"I fill about 5% of Lorenzo in and the other 95% just doesn't get done because I just emotionally can't bear to try to do it cause after 15 minutes I just want to throw the computer out the window, it drives me mad so I just don't do it"* (Interview, Healthcare Professional, Site Q).

Similar frustrations were experiences with Millennium implementations. For instance in Trust D, clinicians and admin staff experienced frustrations and a sense of embarrassment for the created inefficiencies: *"There have been inexcusable problems with booking patients initial and follow-up appointments. …. Appointments are often sent out to close to the day of the appt, so pts don't get them. They are therefore discharged and have to go back to the GP to start the whole process over again. …. The system seems to be geared primarily to collecting payments and not providing a patient friendly service. The level of service we are able to provide is embarrassingly poorer than pre CRS - this is very demoralising. Having worked in private practice, there is no way you would send a patient back to their GP to trigger the next step in the pathway should they have discharged SOS"* (Interview, Healthcare Professional, Site D).

Clinicians as managers and changing local management processes

Managing with real-time data

One of the *"business change elements"* of NHS CRS implementations was connected to being able to manage teams and services on the basis of real-time activity data, captured during clinical work processes. The reporting functionality of Lorenzo was highly valued amongst managers. Though not all CRS software systems gave direct access to clinicians or service leads to real-time data, as 'reporting functionalities' were not included in their initial releases. For instance, in RiO: *"Reporting was one of the things that were omitted [from the contracts]"* (Interview, IT Manager, Site M). However, while reporting problems experienced post-deployment could reflect NHS CRS functionality, they could also reflect problematic underlying organisational processes that became exposed when the new system came into use or overly optimistic expectations of the system, or a combination of these.

In cases without reporting functionality, clinicians interested in extracting activity and/or clinical data relied on the Trust central data warehouse and information analysts' intermediation, with an inevitable time-lag: *"We are struggling now a little bit as to how we can monitor that. Because we can't get a live report from our reporting warehouse. If the data is on a Monday, it's three days out of date. It's already too late. There is no point"* (Interview, IT Manager, Site M).

With funds from DH and assistance from Cerner and BT, Trust D embarked on an ambitious project to build its own data warehouse extracting data from the Millennium software and various other systems including a financial system. The vision was "t*hat data warehouse will be a Foundation for all other Trusts, because we are developing the data warehouse for the NHS in London, really*" (Interview, IT Manager, Site D). However, at the time, users criticised its limited reporting functionality: *"I think one of the biggest things I find frustrating is the report element. It seems to be in a warehouse, somewhere. It's like very little I can see access to be able to go into the system and pull off something you need"* (Interview, Healthcare Professional, Site D).

More information, more time needed for managing

If entering data on the system requires more time for clinicians (than annotating on paper), also making use of this data requires more time on the part of managers: *"I have better access to the quality of care. There is nowhere to hide with RiO. If you didn't put something down, it's going to be missing and you can see straightaway. When you do an assessment*

it's logged. I go well, why didn't you do the risk assessment? It's much easier to manage, you would think. It takes more time to manage" (Interview, IT Manager, Site M).

Making work visible

Digital activity-data made people's work visible, and this enabled service managers to bring service adjustments and monitor performance of individual members of staff. For instance, in Trust C, a consultant of the Radiology department argued that Lorenzo brought about visibility to their work by allowing them to know who is responsible for each of the electronic requests they receive. In Trust H, being able to see each others' caseload and 'risk level', motivated AHP to improve their practices and ensure they would record activity on the system so that it would show up in the reports: *"It's good for performance management as well, so you can go back to clinicians and go OK never mind how many patients you saw this is your risk level of your case load, this is the risk level of somebody else's caseload, look at the difference? Why do you think that might be and you can also look at numbers, you know, this is the number of letters that you've sent to GPs how come so and so sends this many letters and you only do this many letters, you know, because you've got absolutely everything there."* (Interview, IT Manager, Site H)

The process led to changes in team-working, for instance, towards a fairer distribution of work among the team members. A Lead Nurse in Site M suggested that this transparency is changing relationships: *"I think it would change our relationship. I think it's more transparent. I have more Trust in them [my staff] because I can see everything there are doing"* (Interview, Healthcare Professional, Site M).

Making work visible was one the reasons for supporting the NHS CRS among a variety of stakeholders, for instance 'to raise the profile' of their profession, and justify the cost of services. For instance, in Site H, the Service Lead felt that being able to access this information would raise the profile of their service and that it would facilitate getting access to financial resources: *"And that was another opportunity with Lorenzo to raise the profile of [the service] to show everybody that this is what we do, we don't do that, that and that but we […] you know, we do extend people's lives and quality of life and this was a way of actually proving it. Because one of these days the commissioners are going to turn round to me and say why should I pay you £600,000 a year […], so I was looking for some activity information that was a bit more detailed, a bit more quality information"* (Interview, Healthcare Professional, Site H).

4.4.5 Data quality

This section discusses the respondents' perceptions of data quality and potential implications of work processes and changing work practices on data quality. Data quality was identified as one of the potential benefits of the NHS CRS in the national policy and in the Trusts' documents; hence it is discussed separately here.

Data quality is described as *"the state of completeness, validity, consistency, timeliness and accuracy that makes data appropriate for the purpose intended"*.(14) Other commonly used categories of desirable attributes (or dimensions) of data include accuracy, correctness, currency, completeness and relevance.(128;129)

The NHS CRS was seen as a way to achieving legible, accurate, comprehensive records (e.g. through using structured forms with mandatory fields). This was linked to other perceived benefits, such as improved accessibility, storage and searchability of data.

The mix of different computerised and paper systems used in the Trusts with its complex infrastructure of multiple suppliers, interfaces and several copies of the same data, was deemed as exacerbating data quality problems (for example in Sites D and E).

However, our research has revealed a far more complex picture in terms of the effects of using the NHS CRS on data quality. Many interviewees believed that data quality would be improved in the future; however their opinions on its quality at present (at the time of interviews) were mixed.

Electronic forms, although often cumbersome to complete, were generally thought of as more legible and comprehensive than the paper forms. In Sites B, H and Q implementation team members tended to feel that data quality was improved by the system, particularly due to mandatory fields in the electronic forms. Some participants also felt that the ability to trace who entered data or authorised the treatment was a benefit.

However, the following problems with data quality were identified by some of our interviewees:

- Incomplete data
    - Incomplete and free-text rather than coded data for clinical use
    - Insufficient data for mandatory reporting and legal requirements
- Unreliable (not accurate or consistent) data

- Data not useful for practice (not relevant or timely)
- Ambiguity and the temporal nature of data.

Incomplete data

Incomplete and free-text rather than coded data for clinical purposes

A respondent for the CLICS survey (Site D) complained that *"there is so little information on the computerised system, for individual patients that the paper notes have to be referred to for relevant information, before treatment can continue"*. (CLICS survey, anonymous respondent, Site D).

Users were not always using the system as intended e.g. they were not finalising forms (Site H). Assigning codes was at times difficult because appropriate terms could not be found or it was too early to provide diagnosis. In such cases healthcare professionals would leave fields blank or enter data in free text section*: "So if you try and put in another term it comes up nothing found and you can spend like 10 minutes trying to just find this term […]. I just type in when they were diagnosed with it underneath it so people know. […] So you actually don't have a diagnosis you just leave it empty or you just put it under free text*" (Interview, Healthcare Professional, Site H).

Some users also felt that they might be providing less detailed notes that they have done so in a paper record. This was seen by some as a potentially negative development, while others suggested that a more concise style of writing would encourage others to read the notes. Generally, our observations revealed that many healthcare professionals found it difficult to enter data while seeing patients. Also, it seems that in Site H the electronic forms structured to some extent conversations with patients (and hence information obtained and data recorded).

Insufficient data for mandatory reporting and legal requirements

In Site D, the version of the NHS CRS software (Millennium) in use at the time of interviews did not allow for recording sufficient data needed for monetary and legal reports, as well as for monitoring and performance purposes. The Trust retained their paper system because *"Cerner doesn't keep enough data for you not to keep a Medical Record Department"* (Interview, IT Manager, Site D). In addition, some users including nurses needed to use a parallel system, so-called CCMDA (Critical Care Minimum Dataset) with Millennium, *"because CRS does not facilitate us for a lot of the data we are mandatory required to collect from an IT point of view"* (Interview, Healthcare Professional, Site D).

Unreliable (inaccurate) data

The CLICS survey[5] distributed in Site D included the following statement respondents were asked to agree or disagree with: "The information recorded in the clinical computer systems is usually complete and accurate". About half of the respondents disagreed or strongly disagreed that information was usually complete and accurate. The results are presented in Table 4.11 below:

	Answer	Doctor	Nurse	Midwife	Pharmacist	Other	Unknown	**%**
Strongly Agree	1	0	0	0	0	1	0	0.8%
Agree	34	12	6	0	0	16	0	26.2%
Undecided	25	2	6	0	0	17	0	19.2%
Disagree	47	9	8	0	3	20	7	36.2%
Strongly Disagree	17	6	1	0	0	7	3	13.1%
[Not answered]	6	0	2	0	0	3	1	4.6%
TOTAL	130						130	

Table 4.11: CLICS survey in Site D

Some negative opinions on data reliability were also voiced:

"I can't rely on any of the figures [from RiO] that are returned to me at the end of every month by the information team, because I know they are completely false. I know that they have been for the last six months. I know that they will be for another three or four months. The business manager also can't rely on those figures. That's a disaster. You can't say that's a success. It mightn't be a failure, but it's completely disastrous, you know" (Interview, IT Manager, Site M).

"The information recorded is often inaccurate because the option you need is not given and there is no facility to record information that you or others might need in the future. You cannot move forward until you give the system the information it is asking for in the format it requires which can lead to frustration and the temptation to just choose any option given in order to move on. This is why I do not think the info recorded is accurate - it is definitely not

[5] These views might not be representative as the survey return rate was poor (130 from about 4000)

complete as it will not allow complete information to be entered." (CLICS Survey, anonymous respondent, Site D)

The view that *"the quality and the quantity is very variable between practitioners"* (Interview, IT Manager, Site BB) was shared by many interviewees. Nevertheless, the expectation was there that the quality of data would improve with time. Furthermore, despite some problems, the ability to access patient data and find out 'who is doing what' was cited by a number of interviewees in different sites as a benefit.

Data not useful for practice (as these were neither meaningful nor timely)

A number of users complained about the inability to extract useful information from the system. This was due to the way the data was reported (e.g. in big, incomprehensible tables, providing less sophisticated statistical analysis) and accessed (no real-time access to reporting facilities).

For example, in Site H users anticipated early access to detailed reports on activity. However, at Time 1 of the study this has not been achieved: *"After a year I have nothing but that I think is down to the fact that the way the information comes out, there's daily downloads of massive spreadsheets. They talk about three tables but actually it's tables you could wallpaper a room with and our business information unit hasn't got the man power or the expertise to actually decipher that data into something that is meaningful reports for me, and I only want simple stuff."* (Interview, IT Manager, Site H)

While in Site D the interviewees noted:

"We had customised the system over a significant period of time to make it usable and also to generate accurate statistics. When we took on Cerner's maternity module it was in no way as refined as we had had before. It didn't give us the data that we needed. It was a much more basic system" (Interview, IT Manager, Site D).

"It was a new system that all the staff had to learn and it didn't generate the information and today it still had the information that we need. So it was a retrograde step" (Interview, IT Manager, Site D).

"I think one of the biggest things I find frustrating is the report element. It seems to be in a warehouse, somewhere. It's like very little I can see access to be able to go into the system and pull off something you need" (Interview, Healthcare Professional, Site D).

Ambiguity and temporal nature of data

Users were aware that the data on the system might be used by others at different points in time. This made them somewhat anxious about what data they were entering, knowing that it might be used out of context. Some also noted that data had to be correct the first time as the patient might not be around to answer questions at the time when data is being used. However, certain conditions are ambiguous, and an understanding of 'correctness' varies depending on a person's perspective.

Furthermore, data is temporal and its validity changes over time. For example, in Site C, although patients' referral forms for radiology included questions about pregnancy these had to be repeated at the time of the appointment. There has to be a place to record such new data. More importantly, we would add, such 'redundant procedures', double checking and not over-relying on data are to be encouraged.

Confidentiality and Role-Based Access Control (RBAC)

Access to the NHS CRS software systems was subject to the use of NHS SmartCards enabled with specific Role-Based Access (RBAC) profiles – a series of attributes associated with different healthcare roles resulting in different levels of access to the patient record. RBAC arrangements were based on the Care Record Guarantee (see Appendix 14), founded on the Data Protection Act, and NHS Code of Confidentiality.(130-132) NHS SmartCards were not specific to the NHS CRS initiative but – at the time of the evaluation – they came to constitute a new standard across primary and secondary care. Although nationally led, individual organisations were responsible for setting up Registration Authorities to oversee local confidentiality and access arrangements. These local authorities also oversaw the issuing of SmartCards to individual users.

RBAC principles meant that users could only see those parts of the record relevant to their responsibilities and/or have limited access to certain functionalities. For example, administrative staff, in principle, would not be able to see clinical details of a patient. RBAC enabled organisations to identify and track who has accessed records and when. The underlying aim of RBAC arrangements was to protect confidentiality and prohibit illegitimate access to records by those who do not have a "legitimate relationship" with the patient.

Legitimate relationships were based on the principles of workgroups: all staff belonging to the same workgroup (based on profession and resulting level of access) should have the same level of access to the record. Again, these structures had to be set up by local authorities, which at the time of the evaluation had begun in some 'early adopter' sites.

NHS staff only received their SmartCard and passwords to access the NHS CRS systems on successful completion of training: *"Everybody had to do two days and then do the test in the end and get 85% now that you have to get correct answers in the final exam to be able to get your SmartCard. Yes, there is an exam at the end of the two days. If you don't get the percentage you don't get your SmartCard. You have to get I think it's 85%. It's quite high of the answers correct. If you don't get that, you have to do a refresher training on the things that you fail in the test, which is identified then by the trainers and they can focus on the things"* (Interview, Healthcare Professional, Site M).

There were, however, a range of difficulties arising from a strict allocation of roles and workgroups determining access to the record. For instance, receptionists needed to be given the same access to all records as doctors in some occasions:

"I think when initially it came in and people saying, there will be role-based access and so if you are just a receptionist, telephonist booking appointments, you won't see any of the clinical records. It transpires that's not true, because they need to be able to do one particular thing, which on RiO means they need to be able to get into a particular screen and in order to get into that screen they actually need to be able to go through the clinical record and so, therefore, they have access to everything" (Interview, Healthcare Professional, Site M).

"I think it's not so much the code, it's the way we work. I don't know what it is admin are needing to do, but the only way you can do it is through going through a clinical record. Therefore, you have to have access to the clinical record and if you have access to the clinical record, even a small part of it, you have access to all of it" (Interview, Healthcare Professional, Site M).

Individuals also often moved from one workgroup to another and a range of teams worked together to provide care for one patient, in multilayer and complex team arrangements that did not necessarily match the initial profile model. More flexibility was required, together with individually defined access profiles:

"I think it should be individually, because our admin worker here, an admin worker is just a title and RiO reads that as somebody who just needs access to the progress note and uploading documents. Our admin worker needs access to diaries and clinical case notes. She has to put in notes and everything. I had to write and say, no, it's different and it needs to be much more full" (Interview, Healthcare Professional, Site M).

"I think it has to be quite flexible. I think because across different organisations and different roles do different things. Even within our organisation, just because you are a nurse in one team, […] you may have a different role from a nurse in another team and it means your access might need to be slightly different. I think it's right that it's flexible in that respect. But then you just need to be very careful that people understand their responsibilities about having access to it" (Interview, IT Manager, Site M).

The RBAC system was based on the assumption that the person recorded as accessing the record actually did, or that she has acted on the record on her own. However, this was not always the case in hospital settings. First of all, NHS staff may have accessed the record/entered data on behalf of someone else in their team. Typical was the case of junior doctors acting on behalf of consultants during ward rounds. But also in outpatient clinics staff may have worked in pairs, with one person entering the data on behalf of the other:

"Some of the high risk clinics we've managed to get a little bit faster but then you've got two people working together so one can drive the machine and one can treat the patient, […], but then you've got the issue of whose card is in the machine and who's treating the patient and that's, you know, I'm sure Caldecott would have something to say about that" (Interview, Healthcare Professional, Site H).

"Yeah, well sometimes you see in clinic because of lack of space this morning we had one laptop between the two of us so it's got my card in so even if she treats it's still on my card on there which I don't know how we get on with that, like legalities. Although we've both been there and we've sort of been sharing that patient anyway because we're definitely talking over, we're following the patient between us but it's not always the person who's treating who is actually inputting the notes, again because of time restraints in the clinic" (Interview, Healthcare Professional, Site M).

Secondly, in ward settings NHS staff used shared computers and they would leave their SmartCards in the SmartCard reader while their work was in progress, when they needed to move away from the computer or they were interrupted. In the meantime, their SmartCards

would be used by someone else on the ward. This practice was especially found in emergency settings, when leaving the computer logged-on would save time: *"you won't remember to take your SmartCard out and log out. You go and look and there will be a SmartCard in every terminal in this department right now. If there is a SmartCard in a terminal already of course you are going to use it, aren't you"* (Interview, Healthcare Professional, Site D).

Using SmartCards had effects on the ease of accessing the record. These included users not being able to log into the NHS CRS system, either because they had the wrong access rights, or because the system would not recognise the card (Lorenzo in Site Q), or, as in the following example, because the user locked himself out: *"One [AHP] also mentioned that he was not able to use his SmartCard for a week as he had 'locked himself out of the system' by putting in the wrong password three times as he did not realize that the cap lock was on. In this case he had to revert to using paper notes, which he felt was worrying for the future when the primary record would be held on Lorenzo as there would be no back up system"* (Researcher Field Notes, Site H).

Mostly, users had to wait for authentication before they were able to access the record. Initially, this took between 30-40 seconds in some Trusts, but was then reduced to around five seconds. This was particularly disruptive for individuals who moved around and had to log-on to different machines. Furthermore in some Trusts there was no session persistence in relation to NHS SmartCard log-in. Both authentication time and session persistence were not contractually defined. This meant that once the users had logged on for the first time, when they subsequently logged on they would not automatically be taken back to where they were, but they had to start the application from scratch.

Controlling access, maintaining security and confidentiality through RBAC had to be balanced and made more flexible than initially intended, in the trade-off with efficiency and the reality of patient care.

RBAC, SmartCards and single-sign-on were not part of the NHS CRS, though they were part of the infrastructure that would enable a smooth and (relatively) controlled access to the NHS CRS. Investments in this infrastructure were needed for a 'successful' implementation of the NHS CRS.

Integrated clinical pathways and automated workflows

One of the reasons for choosing to design and implement a new system (Lorenzo) was that the NHS CRS was to bring an IT architecture that would enable 'business process re-engineering' in the NHS: *"…a single architected application that doesn't differentiate between clinical and administrative processes, what it looks at is the patient journey and sees what other clinical and administrative events that need to be supported"* (Interview, Developer).

Work processes would be *"re-engineered"* along *"multi-disciplinary and multi-organisational"* clinical pathways, also in order to improve *"health policy development"* (Confidential NME document from 2004). Advanced releases of NHS CRS software systems were planned to provide clinical pathways' functionalities (see Lorenzo Release 4 and RiO Release 2). The NHS CRS was to drastically change the concept of EHRs, from applications supporting work in specific settings (e.g. systems for specific wards or clinics), to applications capable of supporting workflows across intra-organisational boundaries (e.g. hospital ward to hospital ward) and between organisations (e.g. secondary and primary care, or health and social care). If the expression 'integrated clinical pathway' (ICP) is used in different contexts with different meanings,(133) from a technical perspective, in the context of the NHS CRS, it was used to refer to automated workflows along a patient's journey of care, that integrate clinical and administrative work: *"There are functions in here, lets say I'm a nurse manager, I want to see my list of my patients, I want to manage my wards but I also want to see what drugs they're on, I have to go back and forth between two applications [PAS and a clinical system] so there's some disconnect, we can smooth it out with single sign on and things like that, there's a bit of a disconnect. There are processes, Integrated Clinical Pathways, ICPs, they require a combination of specific clinical things which are called from within an administrative framework of scheduled events…"* (Interview, Developer).

Thus NHS CRS software systems were intended to go beyond the traditional electronic patient record as a database, to a dynamic combination of data, decision-support, communication, planning and scheduling tools (Site P). The scheduling, order entry, and requesting, would be automated as a result of events or interventions. ICP would constitute a really innovative 'killer application': *"…an active tool to assist in the delivery of care incorporating clinical decision support to identify actions, reminders and guidance at the point of care, across the continuum of care"* (NME confidential document).

At the time of writing, these intended advanced functionalities (both for Lorenzo and RiO) have not been fully implemented.

"One of the things we did look at […] was the thing called, Map of Medicine, which has quite a lot of the mental health pathways as well. We were hoping at some point to join that up with records so that we could have […] if you make a diagnosis or something like that and you can go into get the process of the steps that are needed in terms of managing and diagnosing those sort of things. They haven't done that and I don't know if it's going to happen at some point" (Interview, Healthcare Professional, Site BB).

From both a technical and clinical perspective, ICPs require to be specifically designed for each diagnosis. An NHS CFH Lorenzo team of clinical background was dedicated to the design of desired paths and clinical forms for each condition, starting from a relatively simpler, elective one such as hip replacement (Site C), to eventually more complex pathways (e.g. stroke). Building the Clinical Data Capture (CDC) forms (in Lorenzo) was only the first step (a 'building block') of a long complex process and clinicians using some of these forms have not yet seen the working of entire automated pathways supporting their work.

Nevertheless, some changing in integrated working across settings in the NHS has been taking place. This will be discussed in the next section.

Intra-organisational dimensions and crossing boundaries

Because the patient journey crosses boundaries of care, clinical and administrative work also needs to cross inter- and intra-organisational boundaries across both health and social care services (Table 4.12). The crossing of boundaries was visible, first, in the form of team-working, with multidisciplinary teams sharing a patient's care on site or across sites, and second, in the form of transfers of care, especially with referrals/discharges or requests for investigations/reports. This section discusses the crossing of boundaries, with a brief reference to its technical dimension, and a focus on expectations and work practices and the changing that was enabled (or hindered) by information 'being digital'.

Dimensions	Issues and solutions
Technical dimension of interoperability	NHS CRS national architecture
	Record identifiers
Expectations and visions of shared records	
Digitally crossing boundaries	Care across settings and disciplines
	Affordances of 'being digital'
	Team-working and information sharing
	Communication systems and real-time transmission
	Awareness and control for coordination of work
Information governance	Confidentiality

Table 4.12: Crossing inter- and intra- organisational boundaries

Technical dimension

From a technical perspective, NHS CRS architecture was meant to remove the interoperability barriers in order to enable sharing of data across boundaries and across software systems (facilitated by the connection to the Spine and the applications of standards such as NHS numbers). Also, servers were centrally hosted and the inter-communication across NHS Trusts servers within a same software system (e.g. all Trusts on RiO servers) was expected to be possible. Still some technical issues existed that hindered complete use of systems across boundaries. For instance, Site BB – a mental health Trust – intended to share RiO with social services but encountered infrastructure problems: *"Something on the social services infrastructure, we can't currently run RiO across one of their technical environments and it just doesn't work and at the moment we haven't managed or they haven't managed to find a solution. We are still working on that."* (Interview, Healthcare Professional, Site BB).

Expectations for, and visions of, shared records across boundaries

The limited scope of the implementation, in the case of Lorenzo, hindered information sharing across services, but the implementation was progressing with this vision in mind. For instance, as an IT manager explained, some healthcare professionals' patients can often also be seen in diabetic clinics, and these could benefit from accessing existing records in Lorenzo: *"But if you could roll this out for example to diabetes we know roughly a third of the patients that the [group of healthcare professionals] see are diabetics…So if we can have for example a one in three hit of the patients that are on the system, you know, so when they're*

running a community diabetes service that they begin to, you know, look up the system and find that their patient record is already on there..." (Interview, IT Manager, Site H).

In line with an NHS CRS vision of making patient information available across settings, some clinicians expected to be able to access records held by other Trusts, especially if these Trusts were using the same software system. In the case of RiO, the account from the interviewee below also suggests that the clinician expected record identifiers to be consistent and usable across settings[6]: *"The worrying thing, we discovered the other day, a patient came from *Trust B+, which has RiO. They gave us the RiO number and everything else. What we recognised was that their RiO number was for a completely different person on our system. So it's not nationwide. They gave us the number of their person, I said, brilliant you've got RiO. Typed in the number and I said, this is a woman. The RiO number is different in every Trust. Was that supposed to happen, I don't know. When I typed in that man's name, I had to say to them, that's actually a completely different woman in our Trust, so could you give me his date of birth and so I typed in his date of birth and he was there but with a different RiO number. This is crazy"* (Interview, Healthcare Professional, Site M).

Alternatively, NHS staff lamented that NHS CRS implementation disrupted the previously possible sharing of information when Trusts that were previously using the same software applications were now on different systems. For instance in the case of Site D: *"…we are sitting here and [hospital x] are up the road and they don't want to go with, they didn't want to go with Cerner and yet we do clinics at [hospital x] and we do clinics here and so we no longer have that connectivity that we had previously and that's just a hospital which was within spitting distance of us"* (Interview, IT Manager, Site D).

In Site M, as a workaround to lack of interoperability, a computer with RiO was installed in a hospital A&E to enable mental health liaison clinicians to access patient information recorded in other settings.

*"Our A&E Liaison Department will be on shift with the Crisis Team member, because it's not a Mental Health building, it's a *Hospital W+ building, general hospital building. We don't have network access within that building for our members of staff to be able to access the RiO information to see if that patient is presented previously within mental health. There is a*

[6] It is unclear how and why this mix of identifiers occurred; there is a clear potential safety concern in the use of the same range of record numbers for different settings all using the same systems, if this is occurring.

risk there […] and all Trusts are identifying that risk and placing machines co-working with general hospitals to make sure that we have accessibility to the RiO system there…" (Interview, IT Manager, Site M).

Clinicians in community and acute settings expressed the wish that the NHS CRS would enable them to access information from GPs (e.g. in Sites B, C and BB), for instance accessing GP medication records for accurate medicine reconciliation.

"There is a lot of benefit of patients' records being electronic because that means that the GPs can access it and they can put their information on and we can have that information when we access the notes here. But again, it falls down to sufficient terminals for people to put that information on." (Interview, Healthcare Professional, Site C).

A possible solution for information sharing with GPs was seen in the NHS CRS software integrating with the Summary Care Record (SCR). Although interfacing was to some extent possible, full integration was not possible at the time of writing:

"…what we'd really, really like to see is summary care record. If the summary care record was in there we actually wouldn't even need the GP referral because you could ask the patient what's the matter with [them] and everything else would be on there, and there's a little bit of arguing and stalling going on about that at the moment. But if you had summary care record it would really give Lorenzo some value" (Interview, Healthcare Professional, Site H).

Digitally crossing boundaries

Thanks to the positive affordances of 'being digital', having information available in NHS CRS software systems supported and facilitated: sharing information within teams (e.g. doctors with nurses); distributing information across teams (e.g. community and acute); facilitating access to real-time data (synchronously or asynchronously). In the case of RiO, through the connection to the electronic record, team membership was made more evident: *"The one thing that I've really noticed is team-work now. A lot of the teams you would go to […] quite often a consultant sits elsewhere from the team. You talk to a consultant and if they say are you in this team and you say, no, no, I'm not in that team, I work with my secretary over here and it was very much like that. They didn't even themselves understand they were actually part of that team. Because of the structure of RiO now […] people are actually coming to training and helping each other, which I think is vital, actually. It's just nice*

to see […]. How long have social services been integrated, you wouldn't know they were integrated. RiO has actually brought them together. I know they feel now the full relation with their infrastructure" (Interview, Healthcare Professional, Site BB).

Also workflow components of the NHS CRS software systems made information transfer potentially immediate, by enabling real-time transfers of referrals, discharges, requests for, and reports of, investigations. Information transfer was also expected to be more effective because information was legible and potentially more complete. Box 4.3 provides some examples of these practices, continuities and changes. The change was especially appreciated in mental health community care, as a clinician explained: *"I would think that actually your computerised system is even more important for mental health service than acute hospital, because of the very nature of how we work. If you are in an acute hospital your wards are there and your staff is all there and you have a set of notes that you can take out. The sense is that we are scattered about and we are based in one place and we see our patients in another place and we see patients at home and patients in A&E department somewhere. One patient can be accessing five or six different sites in the course of a couple of weeks. The one thing is you go in and look at it and you know somebody tells you somebody has been in A&E and you don't have to ring the A&E and you don't have to ask the doctor and you can look at it immediately and see what's happened. I think that's the big advantage."* (Interview, Healthcare Professional, Site BB).

However these positive affordances were often counterbalanced by user interface and interaction issues, and related data quality problems. For instance, in Site D, Millennium functionality for requesting tests did not provide a comprehensive list of available tests:

"Some pathology tests aren't listed on CRS as well as some radiology test" (Interview, Healthcare Professional, Site D).

Furthermore, information available on computers also suffered from being only visible if and when the computer was accessed. Rarely, it alerted of its presence. Furthermore, electronic messages often lacked feedback mechanisms, leaving users unaware whether the message had been received. Thus traditional communication systems were still relied on.

"Q: if someone has been in A&E and you do know about it.
Participant 1: Not always, no.

Participant 2: They would often let us know and they certainly would know. They don't have a system [in RiO] where they are automatically alerted." (Interview, Healthcare Professionals, Site BB)

The absence of systems for alerts and/or feedback mechanisms raised issues for coordination of workflow and patients' flows. This was the case, for instance, in Trust B, where clerks lost control of the ward, where patients were, which ones had been discharged, which patients were booked for a scan:

"…they still haven't resolved the operational thing for the wards knowing what's going on so if somebody needs a scan and maybe that's discussed outside of the ward round and then they send the request down on the system the nurse coordinating the care still doesn't know that that's been done unless you go in… that's the biggest issue for me … oh it's huge. If you're coordinating a ward, and it has resulted in us not preparing patients for that scan …" (Interview, Healthcare Professional, Site B).

"…I think that's a kind of real requirement [for Lorenzo] ... Because what we do is we give views against patients, so they've got to go into a patient, come out and go into the next one come out to find out what's going on..." (Interview, IT Manager, Site B).

Similarly in Site H, administrative staff had not been alerted by Lorenzo if referral letters had been issued by GPs, so they had to keep checking the system to see if the letter had come through. In Trust C, a workaround with paper was devised as a 'flag' to alert the ward that patients had gone to and returned from X-Ray: *"…our X-Ray is out of the department. And so we needed still to give the patient's paper in order for them to know when they arrived in X-Ray that the people in X-Ray knew and for us to know when they come back from X-Ray…. We need a better system flagging when patients have been and come back from X-Ray ...When they come back we need something in clinic to say that they've returned so that we can bring them back into clinic, so [paper] is a flag for the professionals as well"* (Interview, Healthcare Professional, Site C).

Users of Millennium encountered similar issues. For instance, in Site D a user commented: *"…the lists should be easier to see what each patient is having done rather than having to click on each patient which is lengthy and time wasting"* (Interview, Healthcare Professional, Site D).

Millennium has a system of pushing reports into clinicians' inboxes, thereby alerting them of their availability. However, in Site D (and also Site R) this functionality could not be relied on: *"Results are variably sent to clinicians (i.e. I can't rely on all results coming to my inbox) and it is not unusual for senior clinicians to receive results on children that they have had no involvement with which is of concern"* (Interview, Healthcare Professional, Site D).

"Not all XR /MRI reports come back to the person requesting them, especially where the initial referral was to another person in the team. This means there is a constant worry than something might be missed or get lost. It is impossible to keep double checking everything you do …" (Interview, Healthcare Professional, Site D). In Sites D and E, work is going on to create "favourites" boxes for clinicians to help address such problems.

Information governance

Clinicians working in mental health in Site M valued the ability to access patient information across settings, though others were concerned about the confidentiality of their mental health patients data (for instance, for patients in a forensic mental health setting, Box 4.3) (Site G).

Referrals	*"[RiO] sometimes makes things for our patients easier in terms of waiting. … if I want to refer for example to a day centre, I would write a referral form and then send in CPA and then send in risk assessment and then wait for them to kind of meet them up. Actually, they can now go and I can say, here is the referral form and they can go on RiO and have a look at the CPA…"* (Interview, Healthcare Professional, Site M).
Discharges	*"… we used to do that on our wards on a piece of paper called a discharge summary … sending that electronic discharge form electronically to primary care that's a massive step forward for the NHS because it's now almost immediate, it's legible, it's complete, there's all sorts of information you can put it in there .... But in effect what we're doing is we've electronised the piece of paper and sent that electronic paper to primary care"* (Interview, IT Manager Site B).
	"[…] we currently produce something called a flimsy document which is carbonized, three sheets of paper, it's recognized as being not fit for purpose, clinically unsafe, can't communicate it and all this sort of stuff, so it should be an easy win. But because it's taking us 20 minutes to produce an electronic version of it and it takes 5 minutes to produce something that doesn't work we're being measured against the 5 minutes, so straight away it's seen as a disbenefit because people don't recognize, they don't want to recognize that fact that the source document is not fit for purpose" (Interview, IT Manager, Site B).
	"When we go-live with the new discharge summaries …what that will enable us to do is

	make sure the doctors record diagnosis procedures and investigations on Cerner, … and then the discharge summary will pull those fields to create the discharge summary automatically. Also that will, hopefully, we will link it to our [xxx] site so the local GPs can pick it up, so there's lots of things but we've been working on this a year to get a new discharge summary" (Interview, IT Manager, Site E).
Requests	*"…a doctor fills in a request card and depending on the scenario, …[it] gets delivered into our department .... That request card is then entered onto our system. From then onwards, it's kind of processed through the system. Whereas an electronic request is actually somebody in Lorenzo fills in a request that drops automatically into our system. Somebody looks for that electronic request and then processes it through. … The process is the same, in a sense, it's just that one is a paper source and one is an electronic source"* (Interview, Healthcare Professional, Site C).
Information sharing	*"For example, CPAs, we don't have to kind of duplicate a lot of things. … say, risk assessments and risk incidents…. Information that we were kind of having to email to the ward or kind of distribute within the Trust, we can now say, it's all on RiO and just have a look"* (Interview, Healthcare Professional, Site M).
	"When doctors do ward rounds, what we used to have is that if somebody from our team couldn't attend […] somebody else would go. They might have written a note in the patient paper file saying, attend the ward round and see this person and just do a couple of lines of you know for follow up on her return and I want to know what's been discussed and then I would have to chase the doctor up or chase the ward up. The ward might have not put in the community slant of things on their ward notes. And then information would have gone amiss or they would have been delayed. Now I can just log in and have a look at the patient notes and I can see what the ward has entered" (Interview, Healthcare Professional, Site M).
	"…is the pathway of the joint replacement patients … a lot of the pre assessment clinic information obviously comes with the patient to the ward. But, unfortunately, the wards went live [with Lorenzo] before the pre assessment did. In fact, the pre assessment are still not live with Lorenzo. That means that information from pre assessment still came in paper form, so the ward staff then had to upload a lot of that information electronically, whereas, if that part of the pathway had of been live first that information would have already been on. …" (Interview, Healthcare Professional, Site C).
	"Yeah it is because now we know that definitely everybody has access so things like, so last week we had a really urgent […] surgery on the Wednesday and I could actually book her in to have it on the Thursday knowing safely that her assessment was all there and I didn't have to rush off a set of notes and everything else it was all done. And that's only minor benefits for us but everyday where we use it more and more now we're paper free we just think of more things" (Interview, Healthcare Professional, Site H).

Team-working	*"One of the nurses in our Memory Service called me in the week and I said, oh, this is what we need to do in relation to the medication. I was thinking it would be great when I'm on RiO, because what I'll do is, I'll just quickly type that in you know, at the time, rather than sort of thinking, well, she's got the notes so hopefully she'll make the entry confirming what I've said. I'm relying on her to do that, whereas I'll be able to kind of check much more"* (Interview, Healthcare Professional, Site M).
	"… we actually had still running 19 Legacy systems. So not only did we have very little information that we actually could share within the same teams, we couldn't share anything across teams. And certainly, we had this horrible mix of teams treating individuals and they didn't even know that each other were seeing the same person . We had a desperate need for something let's just say something like RiO as in a single electronic record, which the practising clinicians and the support staff could use as one" (Interview, Healthcare Professional, Site BB).
	"But certainly on a positive side it's all the kind of stuff that is the inter agency stuff you will be making affairs from other teams or you are receiving affairs from other teams (Inaudible 00.21.45) it makes life so much easier" (Interview, Healthcare Professional, Site BB).

Box 4.3: Information sharing and information transfer across settings

The experience of change

Experience of change is a fundamentally complex concept in that it is constituted by temporal, relational, cognitive, technical and natural aspects of change. In many cases narrating experiences simultaneously involves evaluation of these experiences i.e. positive versus negative experience or bad versus good experience. Findings suggest that participants (i.e. implementation team members, healthcare professionals, and administrative staff) had mixed and varied experiences of the implementation and adoption of the NHS CRS software that cannot be outlined in their totality in a single section. For this reason, this section outlines the main factors and conditions that shaped individuals' experiences, also summarised in Table 4.13, and, in doing so, describes some of the most representative experiences. It is important to note that patients' experiences are not outlined in this section because out of the 33 interviews that we conducted only two patients were aware of the NHS CRS and even those did not know how to differentiate it from other computerisation initiatives in the NHS. Patients did however express their experiences of NHS computerisation, expectations of the NHS CRS and projections in the future.

Sources of experience	Aspects of experience		
Time	Projection	Remembrance	Present dis(benefits)
Self and Others	Identity	Peers	Engagement
Knowledge	IT use	IT literacy	Learning
Technology	Maturity	Implementation strategy	Monitoring
Change	Nature	Resistance	Working-out change

Table 4.13: Sources (and their aspects) that shaped participants' experiences of the implementation and adoption of the NHS CRS

Time: projected benefits and implementations, past experiences of IT & NHS initiatives and present (dis)benefits

Participants' experiences of the processes of change that the NHS CRS initiated were influenced by the way in which they projected its benefits in the future. Some participants for instance foresaw the future link between the NHS CRS and the SCR and anticipated great benefits from accessing more comprehensive, and especially clinical, GP data.

Respondents' experiences were also shaped by the way in which they projected NHS CRS implementation in the future, which they considered as being larger in scope, i.e. Trust wide and inclusive of more functionalities: *"I think there's nine phases, we're in the first one, people probably think oh my goodness I can't hack another eight of them, it's going to be too hard…So if you think, like if you say to staff that you've only got one little bit of it and they're battling with that one little bit and they've got eight more phases and it's going to go on for the next, I don't know four or five years (laughs), oh it will never be done by 2012, then that's demotivating people, you just think ohh."* (Interview, Healthcare Professional, Site Q).

Not only individuals' projections for the future but also their memories of the past shaped their experiences of the NHS CRS implementation and adoption.

Specifically, respondents' experiences were shaped by the use of computer systems in the past. In Site H for instance users' attitudes towards Lorenzo were influenced by their negative experiences of the use of iPM, also developed by iSOFT: *"…if I'm really brutally honest, you know, if you talk about CSC or iPM to a user I'm not sure they'll talk in a very positive manner about them. It's a fact, I'm afraid…"* (Interview, IT Manager, Site H).

Lack of such past negative experiences with a supplier had a beneficial effect on shaping positive attitudes towards Lorenzo implementation in Site Q: *"I think one of the good points is that they, unlike perhaps other Trusts they didn't actually have a clinical system before hand so therefore, you know, they're not sort of comparing it to a clinical system that they had before, so I think they like the look and the feel of it"* (Interview, IT Manager, Site H).

In addition, past experiences of users' involvement in NHS initiatives shaped their attitudes towards the NHS CRS: *"And that really, and I've worked in the health service 29 years and I've seen a lot of things like that happen particularly in the last, …we're probably talking the last 10 years or so, so many initiatives, as I say nothing to do with computers, so many different initiatives that come in and they get us all involved and, you know, we all spend loads of time on training and having these things implemented and then a year later they shelve it all. And as I say this is just, to me this is just another one of those so when I hear the negatives that it's not going to carry on, it just really annoys me…"* (Interview, Healthcare Professional, Site H).

Participants' experiences were also framed by current benefits and disbenefits of NHS CRS systems delivered. Healthcare professionals from Site H saw clear benefits from the system, such as completeness and availability of information, to such an extent that they 'hate to use paper now' and would not like to go back to using paper notes: "*From when we first started to now there's massive differences and I can't imagine as [Name1 0.48] was saying going back to paper notes.*"' (Interview, Healthcare Professional, Site H).

In contrast to this, respondents from Site H would rather argue that the system far from being beneficial provides "just more work": *"…if I said what's the benefits of using Lorenzo at this present time I would probably say none, there's no benefit to me at all. It takes longer to do than paper notes, you can't see the last treatment that you wanted to, you still can't co-ordinate your care between departments because we're not at that stage, so at the moment no there's no benefits"* (Interview, Healthcare Professional, Site H).

Professional identity, peer relations and engagement with the NHS CRS

Participants' experiences were also influenced by social relationships. Specifically, our findings suggest that experiences were shaped by the way in which the NHS CRS aligned with participants' sense of their professional identity, by their peers and by the level of their engagement in the NHS CRS implementation.

Many times participants' experience of the NHS CRS was dependent upon the way in which the system complied with their sense of professional identity. For instance, some participants from Site B reported that constant use of computers was 'not really what they signed up for' and interviewees from Site H argued that Lorenzo would attribute to their profession technically and take away clinical responsibilities: *"…especially when it started for the first few months it was very much, we felt like IT people, we felt admin people instead of actual clinicians because we were spending more time with this system than we were actually with the patient"* (Interview, Healthcare Professional, Site H). Other participants from Site H saw the use of the system as being a part of their job and thus were happy to continue using it despite its limitations: *"To be honest I don't have any bad or good feelings about it to me it's just something that I've been asked to do so I do it"* (Interview, Healthcare Professional, Site H).

Participants' experiences were also influenced by the feedback they would receive from colleagues. For instance, the second wave of healthcare professionals that used Lorenzo had negative views about it because they heard from their colleagues that it was initially very difficult to use*: "Well I'd seen it in use but to be honest I kept a distance from it because I thought I wasn't going to be involved at any time and I had quite a negative opinion of it so I just thought I'm not going to get involved in it, its caused all these problems"* (Interview, Healthcare Professional, Site H).

Also, experiences were shaped through knowledge sharing with other implementer sites. Participants from Site D reported that site visits made them more conscious about the difficulties of the implementation process and more optimistic seeing that the product can be made to work. Specifically, as a consultant said, site visits *"changed a lot of opinion here, a lot of the consultants who were a little bit negative suddenly realised, right, this does work. We can use it"* (Interview, Healthcare Professional, Site D). Also, a representative of an SHA from the Southern cluster argued that the experiences of one Trust were *"…obviously influenced and I suppose it's kind of confirmed what people felt"* (Interview, SHA). The impact of this sharing was so powerful and effective that some interviewees from Site R reported that they were not allowed to share their experiences with others in order to minimize their influence on future implementer sites: *"Once we had gone live with us then I thought, it's part of my job now as a part of the NHS community to make sure other hospitals don't suffer. I wasn't allowed to tell other hospitals how bad it was"* (Interview, Healthcare Professional, Site R).

Users' experiences were also shaped by the level of their inclusion and involvement in the implementation of NHS CRS systems. As a manager in Site C said *"… you can explain to them all the benefits, look, these are the reasons we're doing it and they're good reasons. The people here can see that and they're good people, they all want patient care to be better and they all want things to be good"* (Interview, IT Manager, Site C). Indeed, deep involvement made some healthcare professionals from Site H describe the system as their *"baby"*.

By contrast, when users thought that the NHS CRS was being implemented in a top-down, and thus exclusionary way, then it conditioned low morale and negative feelings: *"I think people have used it because they've had to and it's been, you know, it's directive from the Trust, and it's quite clear that that's what we have to do … But certainly at the time of it coming it really hit team morale, it really, people really struggled with it"* (Interview, Healthcare Professional, Site Q).

IT use, literacy and learning

Positive and negative experiences of the NHS CRS could be influenced by the users' familiarity with IT use and literacy and ability to learn new skills. Participants who described themselves as *"techies"* were sometimes, but not always, more positive towards the NHS CRS in comparison to those who were *"not computer minded"* at all. A role was played by the participant's age. A researcher noted down in her field notes that: *"Both users and implementation team members felt that users from the older generation often struggled more than others with learning how to use Lorenzo and computers in general. Problems mentioned in this context included issues with typing and issues in motivation to use computers as it was difficult to learn for some"* (Researcher Field Notes, Site Q).

Also the need to update and expand IT skills, as technology was becoming a part of their everyday job, shaped healthcare professionals' experiences of the NHS CRS: *"I think a lot of them don't feel confident and they are frightened. It's fear. It were never part — it would have never been part of their role, ever…they fear the fact that it's IT and they don't want to cross over into that boundary. It's a bit fearful for them'"* (Interview, IT Manager, Site C). Although evident across all software systems, this was particularly true for many users of the NME cluster who had to constantly re-learn new releases of Lorenzo that became sequentially available.

Technology: Maturity, implementation and monitoring

Interviewees' experiences of the implementation of the NHS CRS were influenced by the maturity of the product. Depending on their perceptions about the product users had different experiences to report. For instance, one healthcare professional from Site H said about Lorenzo: *"I don't do computers at all but I find it really simple, easy to use and I love it, no problems at all….. I find that all the information is all to hand which is, I find that makes my life easier"* (Interview, Healthcare Professional, Site H) whereas another healthcare professional said for the same product: *"…I've been involved with it for over three years now. I'm hugely disappointed, because it's not delivered… It makes everything much much slower. And they hate it. Nurses hate it"* (Interview, Healthcare Professional, Site C). Also, a participant from Site R commented on Millennium they implemented: *"IT is terrible…It has cost us millions of pounds. It's brought out hospital nearly to its knees. It's destroyed staff morale"* (Interview, Healthcare Professional, Site R). There was also a general concern about data safety which made many participants mistrust NHS CRS systems: *"…it's not safe, because it's a computer system. A lot of people think that computers are not 100% safe and don't trust them… The minute you take familiarity away that they start, it's not going to work"* (Interview, IT Manager, Site C).

Apart from the product it was the site's present and future implementation strategy that influenced interviewees' experience. For Lorenzo users the gradual implementation process created insecurity due to the fact that they were preparing a lot for a product that did not arrive in the way in which it was originally planned: *"…the difficulty has been managing expectations. I think the end users feel they have been lulled into a false sense of security so when we get this system, it was going to be doing all this and that we were going to get it soon, the implication was that it would be fairly easy to implement and it hasn't been"* (Interview, IT Manager, Site C).

Also, participants from Site R reported that their, largely negative, experiences of the implementation of Millennium were shaped by their limited choice over the product and the implementation process. As a consultant argued people's morale and confidence were affected by the fact that the system was perceived as being *"…imposed rather than we had willingly signed up to this"* (Interview, Healthcare Professional, Site R).

Also uncertainty about the future strategic direction of Trust, of the whole Programme and of future resources and support – especially as concerned with key members of implementation team who worked on contracts – were important aspects that influenced interviewees' overall experience of the NHS CRS to the point where they started questioning

the value of continuing working on the project: *"I think people get a bit, is it worth it? Is it worth me continuing? Should I put the effort in? I don't know where I'm going to be this time"* (Interview, IT Manager, Site C).

Interviewees' experiences were not only shaped by the implementation of the NHS CRS but also by its consequences. Specifically, interviewees were concerned about the monitoring aspects of NHS CRS systems, which conditioned a pressurised environment to work within and loss of confidence in the technology: *"I think what it is I don't think, I don't think people have confidence in what they're doing so they're worried. Anything you put on Lorenzo stays on Lorenzo whether you strike it out it stays on, so if you make a mistake it's going to be there and it's going to be recognised as you so I think there is a lot of pressure on people…"* (Interview, Administrative staff, Site Q).

Change: nature and resistance

Interviewees' experiences were also shaped by their perceptions about the nature of change. Thus, they would often legitimise negative experiences by linking them to a necessarily painful process that precedes change: *"…but it's a journey to getting to that endpoint and I don't think you can get there without some pain and without learning some lessons…"* (Interview, IT Manager, Site Q).

Further, one of the most common justifications for participants' negative experiences was the perception that clinicians resist change. This was almost presented as a taken for granted part of clinicians' nature: *"The users don't like change, they never do. …They don't like the struggle with change"* (Interview, IT Manager, Site C).

Rather than accepting clinicians' natural proclivity to resistance our findings suggest that resistance came from participants' anxieties about working-out change, perceived shortcomings of software functionalities and dealing with its implications.

Some respondents thought that change would take a lot of their time, energy and intellectual capacity, rendering the change that the NHS CRS initiates threatening: *"I think it's the application of a computer system is threatening. It's a change and it take if you like intellectual capital, it takes time and it takes energy and you might see your contribution to it is actually giving, but not getting anything back"* (Interview, Healthcare Professional, Site C).

Others were afraid that they wouldn't be able to learn new skills and thus make proper use of the system. This made *"people …frightened they may lose their job"* (Interview, IT Manager,

Site C). Some others were afraid of failing to meet expectations and to deal with a possible failure: *"…there's an awful lot of people who are just worried about having their name attached to it if it does fail and I think that's causing some of the problems around getting people to sign up…"* (Interview, IT Manager, Site H).

Also, participants were often concerned about the way in which the NHS CRS influenced or would influence the way in which they worked, their productivity and their routines: *"It was quite a shock to not being able to do the things that they are used to doing on Word, for example, very easily to do CPS or risk assessments"* (Interview, Healthcare Professional, Site M).

4.4.6 Organisational learning

This section describes the processes put in place by the Trusts to support learning and learning that had taken place related to: (1) managing and implementing large-scale IT-led organisational change projects; and (2) utilising IT to support organisational and healthcare goals (e.g. how to realise benefits envisaged from the NHS CRS). These two areas require learning of different skills and acquiring different capabilities, e.g. from an ability to use the software to perform simple tasks to developing IT-supported practices that help to achieve organisational goals.

The assumptions here are: first that organisational learning takes place at different levels (individual, group and organisation) and involves feedback between those.(134) Thus, this section discusses learning by and between individuals, groups and the Trusts. Secondly, organisational learning consists of different social and psychological processes, including sensemaking, sharing ideas and developing common meanings and institutionalising (i.e. embedding into organisation or routinising).(135;136) Learning can be supported by formal processes, e.g. training, or be an outcome of doing things (learning-by-doing). Indeed, learning need not be conscious or intentional.

Processes in place to support learning

Processes put in place to support learning within individual Trusts and between Trusts included ongoing support and training on the NHS CRS software systems and related work processes (described in section 4.4.5), local interim evaluations, lessons learned documents on the implementation process, as well as forums and meetings organised by the SHAs and

NHS CFH. Informal ways of learning mainly included on-hand support from group members belonging to the same Trust and cultivating relationships with members of other Trusts.

Evaluations

Local interim evaluations were in some cases conducted as a part of the deployment verification process and benefits realisation assessment. Also, our team members provided informal, formative feedback to each site on their staff's attitudes, lessons from the implementation process and the systems' implications for the way healthcare is delivered and the implementation is managed in their Site. However, gaining understanding of the implications of the NHS CRS software systems was constrained by a number of factors, including early stages of the implementation and adoption, changing software, lack of agreement on baseline measures, assessment measures and targets, as well as complex environment characterised by many other change initiatives taking place simultaneously[7].

Lessons learned documents

Generally, lessons learned documents from other Trusts were seen as not very useful. Some felt that due to the fast moving nature of product development, these documents might be out of date relatively quickly and not be relevant for a wider implementation. Others considered the documents as too long and overcomplicated.

"Much of what you would read in these lessons learned would either be so complicated that you couldn't really learn from it. If they told you the route that they've gone from London to Brighton via Edinburgh, you would get bored. Whereas really all the information that you needed was, it's impossible to go from London to Brighton for what you needed to know. It wasn't sort of condensed in that way" (Interview, IT Manager, Site R).

More significantly, perhaps, knowledge cannot be simply imparted (in a package of lessons learned documents), but needs to be internalised and ideally gained through experience. Interviewees felt that certain lessons had to be learned by doing and as this was the first ever national implementation of the software it was difficult to plan for everything in advance, particularly that each Trust was different.

"I think some basic principles are absolutely transferable. But they do come down to details that are not transferable, because they are very specific to an individual organisation. […]

[7] Difficulties with evaluating outcomes of information systems implementations intertwined with complex organisational change processes are well documented in the academic literature.

each Trust has to have its own systems and its own difficulty with simple things like the ratio of secretaries to staff, the presence of ward clerks, you have them 24 hours a day on a ward or only 9-5. It's a question of which staff are going to be using the system and how" (Interview, Healthcare Professional, Site R).

Staff feeling submersed in the "here and now" could make it difficult to take someone else's lessons on board.

"We had all of the lessons learned documents from all of the previous go-live sites, apart from [place] and [place], but all of the other ones didn't help us at all…. It's a difficult thing to understand why it didn't. I think we were so submerged in, have we got that sorted out? […] We shouldn't have the problem that they are having should we, because we've got a workaround. You ended up actually with the same problem, but you just had a very convoluted workaround that took huge amounts of resources to make it happen" (Interview, Healthcare Professional, Site R).

"*The fact that we had carefully documented all of the lessons that we'd learned and there is a huge document out there somewhere saying all of that. A subsequent go-live site in London learned absolutely zero"* (Interview, IT Manager, Site R).

This interviewee even suggested that *"there is a cliff just there and people have to walk to the edge"* (Interview, IT Manager, Site R).

Forums and meetings

Various forums and groups for representatives from Trusts, LSPs and NHS CFH to meet were set up. They were mostly seen as valuable but not always as responding to the needs of people 'on the ground'. For example, In NME, 'early adopters', NHS CFH and the LSP (CSC) met at an Early Adopter Forum monthly to facilitate learning across sites, e.g. to discuss issues 'early adopters' encountered such as configuration, training and requirement analysis. The meetings were organised at a project management level with limited participation of the people who were hands-on the actual roll-out and use of the software (LR1). As a result, they tended to focus on the management rather than the implementation of Lorenzo.

The Southern cluster care plan group, which included clinicians, met monthly to discuss issues related to RiO. These were seen as useful. However, according to an interviewee, information was not shared between clusters and more could have been learned from the

Trusts in London which implemented RiO earlier. Nevertheless, s/he later stated that *"we are starting to work together and we'll start to share experiences […] but at the moment it's only just starting to happen"* (Interview, IT Manager, Site BB).

The role of NHS CFH in facilitating contact was perceived as ambiguous. Some appreciated its coordinating efforts, whilst others saw it as constraining direct communication between 'early adopters'. Some felt that sharing experiences was not encouraged and that this might almost be done intentionally in order to prevent individual Trusts "*ganging up*" and *"pulling in the same direction"*.

However, other interviewees described the NPfIT and its associates as effective in their exercise of the implementation of the NHS CRS, because a platform was created to "*learn from the places that got it wrong and the places that got it right and to sort of use that as a vehicle for securing trouble free deployment through the rest of the Programme"* (Interview, IT Manager, Site D). They thought there was enough learning now to be able to roll-out the NHS CRS, so "*to step back from it now I think would be wrong*" (Interview, IT Manager, Site D).

Informal ways of learning

Our research indicates that the Trusts perceived informal ways of learning as more beneficial. Members of different Trusts developed relationships with each other in order to *"share experiences"*, ask specific questions regarding the implementation or management of the system, and invite members of other Trusts who experienced the implementation to visit or work alongside them. The discussion between the Trusts was not limited to project management issues but also included learning about different work practices, e.g. through informal comparisons of procedures or forms used.

"Possibly one of the most valuable things that one could do for a site that was going live is to take somebody like me and then plonk them in [another future Millennium site] wherever it is and say: You can't do it that way. You do it this way" (Interview, IT Manager, Site R).

However, for those on the ground, contact with other Trusts was viewed as difficult (acknowledging time and geographical distance constraints). Furthermore, sharing lessons with others was also seen as potentially distracting from the main task of implementing a system as this was often time-consuming with different stakeholders from different organisations often asking the same questions. Also, some interviewees suggested that not everyone wanted to *"tell the truth"*.

In summary, our research suggests that sharing of lessons learned and communicating between 'early adopters' was viewed as very important but somewhat difficult to achieve and also as – perhaps as is inevitably true – something that could have been done better.

Learning that had taken place

Learning about managing and implementing large-scale IT-led organisational change projects

The staff developed knowledge of managing implementations of IT systems (e.g. in terms of allocation of resources, organising training, cultivating relationships and involvement) as well as gaining more technical skills (e.g. about systems integration).

It also appears that the Trusts and perhaps the NHS more generally, had accumulated some knowledge about IT-led programmes of change, and understandings (but not necessarily shared understanding) of what such change means to the NHS and how IT might be utilised to facilitate changing. One of the Trust managers suggested that as a result of many years' attempts *"there are a lot now of experienced people that understand what this type of change means to the NHS and how to help them to make that happen that I think you wouldn't want to lose that"* (Interview, IT Manager, Site D). However, as people leave this knowledge might leave with them.

Our research also suggests that NPfIT had 'pushed IT to the fore' and that the Trusts are more aware of the potential of IT to meet evolving national as well as local NHS needs. This, in somewhat extreme terms, was expressed by one of the interviewees:

"RiO pushes IT to the front of that and just as important as clinical practices. And so, therefore, the Trust needs to have an ongoing budget to be able to maintain their IT equipment and also look at advanced technologies, i.e. handwriting recognition that can go directly into RiO" (Interview, IT Manager, Site M).

"So the Trust needs to be aware … that no longer is IT the naughty little boy that sits in the corner. It is now in the centre of the room and has to be addressed and has to be listened to, because if IT department says, this cannot be done then, the Trust has to realise that it has a direct impact on their clinical care, etc," (Interview, IT Manager, Site M).

Lessons learned about how to manage such future initiatives included the importance of sharing information between Trusts, considering benefits to the Trust before committing to

implement, analysing and perhaps standardising workflows and work practices before computerising them, and allocating adequate resources. Although it was acknowledged that sharing data across professional teams and organisations required some level of standardisation there was no shared understanding on how standardisation should be achieved.

"I've definitely come to the conclusion that ['brutal standardisation'] is just wrong. Localisation is very important to individual hospitals. The trick I think in an IT system is to make the underlying structure equivalent so that you can then compare like with like with different hospitals and you can produce regional and national data with ease. To make the bit at the front end look different" (Interview, IT Manager, Site R).

Learning to utilise IT to support organisational and healthcare goals

At the time of the research it was too early for the new practices to be fully institutionalised and new innovative ways of working, taking full advantage of functionalities offered by the NHS CRS systems to emerge. New working practices arise not only through planned actions (e.g. an introduction of a computerised referral system) but also through day-to-day use of the system, and people finding out how the system works and how it can be made to work for them.(87) Our research indicates that the healthcare professionals learned new IT skills, become more familiar with computers in general and specifically with the NHS CRS software, and developed their understanding of what such system might mean for their work at present and in the future.

One interviewee expressed a concern that the need to make savings in the new economic situation would mean that the support required in terms of training and access to experts would not be provided and as a result *"the huge change that you were asking about in terms of working practices will not happen. People will do what they've always done"* (Interview, IT Manager, Site BB).

In summary, our research indicates that the Trusts developed knowledge relevant to managing other large-scale IT-led implementations and change programs. The staff's e-literacy, including an understanding how IT might effect their work practices and healthcare in general increased. However, it is only through using the systems that opportunities for learning new things and new (and hopefully better) ways of doing things with IT will arise.

4.5 Conclusions

The major insight that any interested observer should draw from the experience of the NPfIT, and in particular the progress with deploying software systems to support the NHS CRS in secondary care setting reported in this chapter, is that implementing clinical operational systems of any richness is not a straightforward activity.

It is hard, takes time, and needs to be approached carefully and as more than a one-way implementation effort led by (or delegated to) technical experts and project managers, particularly if they are removed from the context of system use.

Rather, we must understand that among important requirements for the deployment of such systems, such as the need for strong commitment from the organisation's leaders, perhaps the most important principle is:

> It is the clinical and administrative staff who have to work day-by-day to make such systems work. Their commitment to do this work needs to endure for as long as a system is in use.

The reader may find this a rather trivial and obvious assertion. We would argue in reply that much of the evidence collected in WPs 1, 2 and 3 suggest that this significant principle has at the very least been often lost sight of. More importantly, by firmly restating it and following the implications, we can develop new and stronger ways of thinking about how the potential of information technology and information systems can be realised in healthcare.

In this conclusion section we briefly follow through some of the implications that derive from our research findings and this guiding principle.

4.5.1 Vision and purpose

Our research shows that the NHS CRS embedded various visions that are expressed in different accounts of its intended purpose. We identify three broad and distinct components of this vision, balanced in different ways among our various respondents. These we have labelled as data-centric, business-centric and policy-centric views (Table 4.3).

It is quite legitimate and indeed necessary that different people, and people in different roles, should hold different views about the NHS CRS or any EHR project. But a consequence that follows is that the overall deployment approach needs to give space for each perspective to

be accommodated and developed over time. In particular a simple data-centric view that over-emphasises data and information at the expense of workflow, clinical innovation, business change, management and policy ambitions, will be unable in the longer-term to engage the system's users. Embodying these various perspectives and allowing them to be reflected within an existing healthcare organisation as it introduces new systems makes certain demands, not least on the technology itself.

First and foremost the technology has to be 'fit for purpose', passing a basic test of utility and reliability. Our respondents often reported a deep sense of the immaturity of the software solutions on offer. Beyond this basic test, not always passed, we have seen the enduring debate over the constraints and governance structures that support software configuration and the negotiation of the limits of customisation of chosen software systems to meet Trust's expressed needs. We have found that administrative, technical and clinical users at the Trust level are often quite aware of the main themes in the complex debate as to the mix of standardisation and localisation that is appropriate, and report negatively on the lack of attention to supporting positive change in local work practices. Often, it seems, they would like to be able to take a stronger role in working out the inevitable compromises. But the complex supply chains and convoluted communication processes between Trusts, LSPs, software developers and NHS CFH, together with the commercial nature of LSPs' and software developers' relations, often led to a perceived premature establishment of fixed outcomes (*what* is to be achieved) and a lack of attention to productive processes (*how* different positive things could be achieved). Thus participants raised normative concerns as to whether NHS CRS software should be customised, reflecting on the risk of it becoming dissociated from its understood central purpose or of having its code fragmented such that ongoing support and upgrades would become very hard to undertake. Others insisted on the common information needs of clinicians but also on their tendency to protect their professionalism by encouraging unnecessary or dysfunctional differentiation.

Just as we should draw lessons from the way in which technology has been drawn into NHS CRS implementations so too we should consider the role of healthcare organisations. Our studies have shown a variety of approaches that were taken to preparing for implementation and a number of factors that seemed to have shaped them (both enabling and impeding them). For example, some departments or areas may be more computerised than others, multiple projects and initiatives often ran in parallel with the NHS CRS and could have rendered its implementation of secondary importance. Over the time span of this study, changing NHS policies added further uncertainties and further delays to the process – for example working to achieve Foundation Trust status, and then the new powers it offered.

More concerning, the fundamental disjunction between a Trust as the 'client' or problem owner, and their lack of budgetary control or direct communication with the service supplier (e.g. software company) could lead to a sense of detachment or inevitability.

4.5.2 Implementation vs. adoption

This chapter started with a model that differentiated implementation from adoption. In the studies reported here we see this distinction between implementation and adoption was blurred, with often limited or partial account taken of the latter. Especially in the case of Lorenzo, built while in use, the fundamental implication of the approach taken – that users should feel able to contribute and be major actors in shaping the systems – was not always achieved. Rather, the cycle between user and developer was too often extended and fragmented and the ongoing process at times clashed with the structured approach embedded in software contracts and processes of requirement specification.

More generally, and taking the perspective of adoption, we see that the introduction of NHS CRS software influenced changes in the work practices of a variety of stakeholders in clinical and non-clinical roles. As systems were implemented people within the Trusts studied reported varied experiences and emotions, often reflecting temporal perspectives such as the way in which they projected the NHS CRS into the future and its anticipated benefits, their past experiences of the implementation of computer systems, and the immediate benefits and disbenefits they saw during implementation for themselves or for the patients they directly worked with.

A sense of achievement (or not) was also often reflected in the way in which individual respondents and their peers identified themselves as clinical professionals and the degree to which this was reflected in the system they came to use. Consistent with the overall sociotechnical model introduced at the start of this chapter, we find that this link to a professional identity, be it as a nurse, doctor, ward clerk or healthcare assistant, is probably more important and significant than levels of IT literacy *per se* or willingness to expand IT skills.

We deliberately include in the list of 'professionals' ward clerks and healthcare assistants. The NHS CRS is often portrayed as a set of clinical systems with primarily clinical users, but the users of the software studied here were often AHP and administrative staff. Yet their interests seemed to have been too often ignored in the wider plans and their concerns not captured as implementations went forward. In a number of cases NHS CRS software

systems offered functionality for these types of user that were either ‘not ready’, required duplication of work in parallel systems, revealed data migration problems or slow responding infrastructure. Usability problems were often encountered. These problems could become critical, not least in reducing commitment or enthusiasm of the systems users, and directly reflect the consequence of a narrow understanding of the clinical role of these systems. The result was, inevitably, locally developed workarounds, especially to overcome constraints in coordination of work or when the systems did not fit the needs found in the context of use. At times such workarounds lead on to data quality issues.

We also see that using the NHS CRS in day-to-day tasks tended to be perceived as requiring more time than previously and as a consequence the NHS CRS was seen by some as reducing the time for direct patient care. We have also seen clinicians required to enter data in NHS CRS systems, a redistribution of data entry work often up the hierarchy – e.g. from admin staff to clinicians, from nurses to doctors, from junior doctors to consultants, etc. If data entry in NHS CRS systems is envisaged as happening ‘at the point of care’, this should not be surprising, indeed it might be welcomed. However, concurrent data entry while with the patient was most often done on paper, the data entry referred to was done retrospectively, raising in turns concerns for efficiency and safety.

Nevertheless and despite such concerns, enhanced management of data and its availability was usually perceived as a benefit as when information was legible, available in ‘real-time’, more easily searchable and retrievable, accessible ‘any time’ and ‘anywhere’, by multiple concurrent users. Electronic transmission of messages (referrals, requests, reports, etc) were reported as making some workflows faster in their totality, though more or less time-consuming in some stages, and for some of the staff involved. To make the most of these data sharing and transactional benefits, a critical mass of users and data needed to be achieved, and this required time and a continuation of faith in the system while volumes built up, data quality issues were addressed and new practices were established and absorbed into the work team.

4.5.3 Crossing boundaries

The ambitions of the NHS CRS from the outset included the ability to move clinical data between healthcare settings. At the Trust level this suggests the digitalisation of integrated multi-disciplinary clinical pathways, seen by some as a means to ‘business process re-engineer’ the NHS. However, no NHS CRS software implementations studied here included such functionalities and most sites studied were some way from considering such issues in earnest or at a Trust level. Indeed, we saw that the process of designing digital support for

integrated multi-disciplinary clinical pathways, or even establishing the tools needed to do this, revealed the deep ambiguity of the term pathway and the complex organisational and medical ecology that they exist within. Our finding, consistent with the principle established at the start of this section, is that such computerisation of clinical pathways is a complex process that requires intense engagement among multiple stakeholders, and is not principally achieved by means of some specific functionality designed into software systems. On the broader theme, our research has, however, shown that digitalisation can facilitate sharing information across teams or services within a Trust, by making information available concurrently and in real-time.

The next step, crossing organisational boundaries, is needed for 'joined-up' patient-centred care. One of the NHS CRS systems implemented (RiO) was more successful than others in this regard and revealed how computerisation can support team working across geographical and institutional boundaries.

4.5.4 What has been learned: What might we do next?

The guiding principle established in the introduction to this section has one final important implication. As healthcare organisations engage with the NHS CRS or other EHR or eHealth technologies, and as they work-to-make-it-work, they can and should learn. Our data suggest that, in all the sites we have studied, significant organisational learning has indeed taken place – even in those with the worst experiences. People, through their experiences good and bad, are able to reflect and adapt their understanding and to achieve a quite subtle understanding of the complexities of making these systems deliver to their potential, and few report a diminished commitment to the idea, even if they have firm opinions on what they would like to do differently if given a chance. But often the response to us as researchers when we invited such a conversation was of relief and gratitude that at last somebody was asking them. At the individual level, as well as within professional groupings and even among Trusts, the potential to respect, enhance and support such learning is clear. By taking such a route the real long-term benefit of the NHS CRS in the past decade may indeed be found, emerging from the foundations laid by the NPfIT.

The following section summarises lessons learned from the research described in this chapter.

4.5.5 Key lessons for implementing EHRs and other similar health information systems

The lessons presented in this section are based on findings from our qualitative research into the NHS CRS. However, they are relevant not only to the NHS CRS but also to other similar systems. They are divided into lessons for policy; for design of such systems and for their implementation locally and presented in Boxes 4.4, 4.5 and 4.6 below.

Complex systems such as EHRs will always need (at least some) configuration at the level of Trust / settings and it is unrealistic to expect otherwise. Hence, we suggest that:

- Contracts with software suppliers should be open to an incremental and iterative definition of requirements.
- NHS Trusts implementation strategies should cater for an iterative and incremental roll-out of functionalities, and an IT system 'growing' in time.
- Adequate resources need to be allocated for those processes.
- Configuration requires direct channels of communication between the implementer hospitals and software suppliers. Intermediaries cause bottlenecks in the communication and slow down collaboration.
- Configuration requires a clear and transparent contractual relation between the involved parties. The contract needs to identify the sites as the clients of EHR systems, to outline clear specifications provided primarily by the implementer sites, to specify what parts of the software are amenable to change and to set feasible timelines that appreciate the complexity and difficulties associated with implementation and configuration processes.
- There has to be national agreement over the degree of software configuration and standardisation permitted. Presupposition for this is that decision makers are aware of the design of the solutions that are to be implemented and of the clinical and business processes these solutions will support. This would hopefully lead to software that meets both national and local purposes.

Expectations regarding the outcomes should not be set at unrealistic levels.

- Our research indicates that paperless work practices are difficult to achieve: e.g. they require complete computerisation of all processes for all stakeholders, availability of time and resources for concurrent data entry, intuitive and fast software interfaces available on a variety of hardware, including easy to handle mobile devices. These may be necessary, but not sufficient conditions for aspects of care to become paperless.

- Procurement decisions should not be based primarily on unrealistic assumptions of achieving cost-savings or even returns on investment, but rather on introducing clinical as well as administrative functionality early so that these systems are used.

National EHR implementations start off with a core vision, which through time gets interpreted, translated and modified to a number of visions in line with implementers' understandings, healthcare organisations' needs and local strategies and evolving political and economic context. Different visions should be accommodated and supported in as long as they are aligned with national and local strategies.

Information systems take time to embed in organisations. Their utilisation and different implications (e.g. for practice, efficiency, user satisfaction and health outcomes) vary with time. Hence, evaluations should be done at different points in time, not only immediately after the implementation. Longitudinal evaluation is most desired if we are looking to understand processes of change.

Box 4.4: Key lessons for policy

There is a need for a shared understanding among all stakeholders of the purpose and content of the system to be designed.

Successful design of future technologies relies on understanding of the context of use. For example, we found that community settings tend to lend themselves better to a model of shared care (or at least shared information) underlying the vision of shared EHRs.

The physical environment (e.g. space) and the nature and time of the clinical encounter (e.g. pre-booked versus ad hoc) will affect to what extent a computer system is used, and in particular if data can be entered at the time of a clinical encounter. This has to be reflected in the design and implementation of such software and in the preparation of the environment in which it will be used.

Providing relevant functionalities is a necessary (but not sufficient) condition for the successful adoption.

- The systems need to be 'fit for purpose'. Configuration can only be successful in as long as the product provides functionality that is useful for the implementer healthcare organisations.
- The systems should satisfy both the needs related to the care of a specific patient and the needs of users managing patients' flows and groups of patients (e.g. wards). Changes in

patient status (e.g. admitted/discharged, or test requested/completed) should be highly visible at both levels.
- Reporting functionalities are key features of electronic patient records that enable evidence based management of NHS services at local level. Such systems should be built on indexes, databases and interfaces that enable clinicians to have direct access to their data in real time. Centralised data-warehouses are not equivalent alternatives to reporting functionalities directly accessible by clinicians.

EHR systems and their use need to comply with the ways in which users identify themselves as professionals.

Delivering visible benefits is very important.
- The systems should deliver noticeable benefits to the immediate users not just to the NHS as a whole, i.e. to the health and allied health professionals, managers and administration staff and ultimately patients.
- The systems should be focused on helping the NHS organisations to deliver performance standards (e.g. referral within X amount of time).

An appropriate design process is needed.
- The principles of User Centred Design (UCD) should inspire the design process.[8]
- The adoption of agile methods for software development might make it easier to locally configure the systems and to do so within realistic timescales.

Box 4.5: Key lessons for design

The implications of new systems (such as EHRs) will vary from site to site, as any new system needs to co-exist with and affect established work practices, norms, power and control mechanisms amongst other things.

Decision to implement EHRs or any such system should be a conscientious choice of each site.

[8] UCD is an engineering model that seeks to understand the users of a technology, their needs and context of use, to inform the design of a new technology. It does so by engaging with users throughout the design/implementation process, and by iteratively evaluating prototypes or interface designs before final implementation, within a cycle of requirements elicitation-design-evaluation-revision of requirements.

Sites need to be given the freedom to set up their implementation strategies depending on their previous experiences of IT implementation and use, local priorities, legacy systems etc.

Apart from being (financially) incentivised healthcare organisations need to become ready to accommodate the new systems and their prospective changes.

There is a need for a long-term strategy and for a continuous support from the top management and (influential) clinicians throughout often long process of implementation/ configuration and post-implementation.

Managers need to shape and maintain users' expectations of EHRs pre-during and post implementation. They need to provide a clear reason and a long-term strategy that will maintain users' enthusiasm and engagement.

Organisational learning within and between the NHS organisations needs to be given high priority and full hearted support. Informal channels and relationships appear to be more effective for learning than formal channels such as 'lessons learned documents' which, even if shared, are seldom read and even less likely to be reflected in practice.

Allocating adequate resources (e.g. for support activities, extra clinical staff to cover for time lost for training and learning the system while in use, etc) is essential. Extra resources will be needed for some time after the system implementation, (although the first few weeks might be the most resource intensive) and some will be required indefinitely (e.g. for IT support). It is easy to underestimate the effort and resources required.

Before the system is designed or implemented an overview of current work practices and work flows should be done to consider how they can be improved, e.g. standardised and normalised, and potential problems that might be brought about by computerisation need to be identified.

Hands on, one-to-one and preferably peer-based support in the first weeks of and after the implementation is very important (even more than formal training).

Training strategy needs to be as flexible as possible, i.e. opportunistic, changing with the circumstance and tailored to diverse users' needs and their roles. Training is an on-going

process, and plans for training new staff (in particular rotating junior doctors) need to be in place.

Ideally training should be delivered no earlier than a week before the system's go-live date but as it is not realistic with a large number of users, special attention needs to be paid to providing ongoing support and 'learn and play' realistic environment where users can use the system without changing live data.

Box 4.6: Key lessons for local implementation and adoption strategies

Chapter 5: Assessing and understanding the costs of implementing and adopting the National Health Service Care Records Service

5.1 Introduction

Electronic health record (EHR) systems hold the promise of improved safety, higher quality, and greater efficiency of healthcare.(137) Despite this promise, few hospitals have as yet implemented and adopted such systems due in part to their inhibitory cost and the uncertainty that surrounds their return on investment. As the core component of England's National Programme for IT (NPfIT), EHR systems were procured centrally rather than locally at an estimated cost of £12.7 billion.(10) The complexity of the implementation of this facet of the National Programme posed an immense evaluative challenge. This was because there was only very limited previous research specifically concerned with the evaluation of implementations of the National Health Service Care Records Service (NHS CRS),(138) and comparative quantitative studies evaluating different forms of EHR are virtually unknown.(19) A systematic review of the literature found that studies' description of the implementation process and EHR systems was limited, thus making it very difficult to ascertain whether some capabilities were absent or simply not reported.(19) In addition, empirically measured cost data were found to be limited and inconclusive.

Previous US and UK evaluations of Picture Archiving and Communications Systems (PACS) and EHR systems have used some form of 'before and after' comparison of costs.(139-141) Other studies have used a modified Delphi technique to obtain an expert group consensus on estimated costs, which were unavailable from the published literature or from primary data.(142) This consensus-based work has however not captured all relevant cost categories – for example, unforeseen costs associated with productivity loss (during unscheduled system or network outages) had not been adequately considered. Walker et al. have suggested that a phased approach to EHR implementation may reduce costs, but this assessment was based on only limited evidence.(143) In addition, the size and complexity of the organisation may mean greater implementation costs associated with system integration.

Methods of cost-effectiveness analysis exist for technologies prior to investment or implementation, such as the so-called "headroom method", an approach to establishing an upper bound to implementation costs that can preserve cost-effectiveness.(144) These methods can be employed to some extent in investigating new technology implementations

in the face of front-loaded uncertainty. However, this approach cannot easily be used for multiple-production technologies in an environment such as a hospital Trust.(145-147)

Hospitals are characterised as *multi-output* producers: they use all inputs more or less simultaneously to produce all outputs, and the process is seldom tractable. That is to say, a given input cannot be tracked through a production process to a given output. This is required across inputs and outputs in the producer – in the case the hospital Trust – in order to quantify: (i) benefits; (ii) induced/opportunity costs; and (iii) process changes due to the new technology, which are necessary to quantify the impact on the costs of other factors, such as hospital Trust characteristics. Therefore, production and costs are not homothetic (or related) with respect to something as far-reaching as a new, comprehensive IT system.

This has been found elsewhere; Himmelstein et al. for example, analysed linked data from 4,000 hospitals in the US, but found no savings overall in administrative costs.(148) However, this is too narrow an area in which to define relevant benefits, including cost-savings, a point reinforced by Arlotto and Oakes' criticism of focussing on return on investment analyses on operational and tactical benefits, as relevant costs (whether called disbenefits, induced costs or opportunity costs) will be missed.(149) Studies focussing upon setting (e.g. a physician practice outpatient setting) were similarly restricted in their findings.(150)

A recent systematic review found limited literature on commercial, multifunctional health information technology (IT) systems.(151) Moreover, they stated that little information existed on contextual factors and process changes associated with large-scale implementation of health IT systems. This is not surprising given the immense difficulties in isolating tractable, quantifiable changes or even grouped inputs, process or outputs of production with regards to technology and technology changes mentioned above.

This is an important consideration for our evaluation, given that we sought to categorise implementation costs, because these have direct implications for costs associated with workflow and process – specifically productivity losses, or so-called induced costs.(142) Training costs that involve staff back-fill, for example, are very difficult to track without an auditing tool in place. Similarly, productivity losses due to process cannot be tracked through the process change itself. For example, a paper order form was routinely held to be faster to more complete than the NHS CRS equivalent; however comparative completion times will vary by: individual; NHS CRS software system; clinical functionality involved; level of training; and by level of staff performing the task. A simple before-and-after survey of task-

completion time is possible, but only with specific measurement and auditing tools available prior to implementation. None of the Trusts studied had chosen to monitor the task-completion time and no *post hoc* evaluation can capture such data, for the reasons discussed.

This work-package (WP) examined the cost of implementing the NHR CRS in hospital Trusts. There is no standard evaluative framework in place to assess the costs of EHR implementation and adoption, and implementation of an EHR on this scale is unprecedented.(152) Moreover, it was difficult to extrapolate findings from existing studies to different health systems such as the NHS: we therefore needed to obtain the necessary hospital Trust costs and construct the cost framework *de novo* using appropriate techniques.

5.2 Aims and objectives

5.2.1 Original aim and objectives

The original aim of this WP was to assess the costs of NHS CRS implementation from the perspective of the NHS Trust-level.

We sought to:

- Assess exceptional introduction per-provider costs
- Assess annual (recurring) per-provider costs
- Develop evaluation frameworks to assess the impact of the NHS CRS on costs
- Validate cost categories with local providers and with NHS Connecting for Health (NHS CFH)
- Make recommendations about a core dataset for NHS CRS evaluation post-implementation.

However, the national implementation and roll-out of the NHS CRS underwent substantial contemporaneous change during our study (as discussed in Chapter 1). Most importantly for this WP, the difficulties in finding areas of enquiry that could be replicated across the different systems (or different functionalities in different releases of the same system), along with a reluctance to provide documents containing cost information at a Trust level, meant that a revision of both the aim and objectives of this WP was necessary.

5.2.2 Revised aim and objectives

The revised aims of this WP were slightly expanded i.e. to assess and understand the costs of NHS CRS implementation at Trust-level. However, our objectives to satisfy this aim changed.

We sought to:

- Identify the exceptional (start-up) and annual (recurring) per-provider costs;
- Explore the perspectives of NHS CRS implementation staff, including clinicians' views, on the different start-up and recurring costs, and on the factors which impact on the amount of resource spent by hospital Trusts;
- Categorise and describe implementation costs (the cost framework), validate the cost categories contained within it with local providers and with NHS CFH;
- Develop a Minimum Data Set (MDS) to evaluate NHS CRS implementation costs.

5.3 Methods

5.3.1 Sampling and recruitment

Recruitment and selection of hospital Trusts

We collected economic data from Trusts that were part of our 12 case studies. These included hospital Trusts across London; the North, Midlands and East (NME); and Southern England implementing centrally procured NHS CRS systems. Purposive sampling was guided by the research aims of this WP to include hospital Trusts implementing different types of NHS CRS system (i.e. Lorenzo, Millennium and RiO).

Recruitment and selection of participants at hospital level

Details of relevant hospital staff (e.g. Director of IT, Finance Director) were obtained from site leads and approached directly by the researchers to arrange a suitable time and place for interview. All participants within the hospital Trusts were selected if they met the sample inclusion criteria stated above. In the later stages of interviewing, this was also influenced by the attainment of thematic saturation. The researchers judged that thematic saturation had occurred when the themes suggested by interviewees began to repeat themselves and subsequent participants' interviews yielded no new themes.

Recruitment and selection of participants at Strategic Health Authority (SHA) and NHS CFH level

At NHS CFH level, individuals were approached opportunistically at national conferences and meetings. Contacts within NHS CFH provided details of staff that were involved in the implementation of the NHS CRS at SHA level. At Trust, SHA and NHS CRS levels, participants were asked if they could also provide the details of any other individuals within their organisations who may be able to provide relevant cost information.

5.3.2 Data sources

Interview data was obtained from a total of 36 different participants. Some participants were interviewed more than once, as indicated below; other interviews were conducted in pairs, as requested by the participants.

Implementation team members included mixture of change managers, project managers, programme managers, and benefit leads. Users interviewed consisted of a mixture of ward managers, consultants, and nurses. Field notes were also collected.

A summary of participant details, including participant code, is given in Table 5.1.

Participant Code	Times interviewed
Site B.ITman.CQ.20.04.09.NOTT01F Site B.ITman.SC.CQ.25.06.09.NOTT18F	2
Site B.ITteam.CQ.20.04.09.NOTT02F	1
Site B.Fin.Dir.CQ.20.04.09.NOTT03F	1
Site B.ITteam.CQ.21.04.09.NOTT04F	1
Site B.ITteam.CQ.21.04.09.NOTT05F	1
Site B.HCP.CQ.21.04.09.NOTT06F	1
Site B.HCP.SC.15.05.09.NOTT10T	1
Site B.ITteam.SC.22.05.09.NOTT12T	1
Site B.ITteam.SC.29.05.09.NOTT13T	1
Site B.ITTeam.SC.24.06.09.NOTT16T	1
Site B.HCP.SC.CQ.24.06.09.NOTT17F	1
Site B.ITteam.SC.CQ.25.06.09.NOTT19F	1
Site C.ITteam.SC.CQ.26.06.09.NOTT20F	1
Site P.ITteam.SC.CQ.23.07.09.NOTT21T	1
Site H.NLOP.SC.CQ.19.08.09.NOTT22F	1

Site H.NLOP.SC.08.10.09.NOTT26F	1
Site H.HCP.SC.08.10.09.NOTT27F	1
Site H.ITteam.SC.08.10.09.NOTT28F	1
Site H.FinDir.SC.CQ.16.10.09.NOTT29F	1
Site H.FinDir.SC.CQ.16.10.09.NOTT30F	1
Site H.ITteam.SC.CQ.16.10.09.NOTT31F	1
Site E.ITman.SC.CQ.26.10.09.NOTT32F	1
Site H.ITman.SC.18.12.09.NOTT34F	1
Site D.FinDir.AT.CQ.16.03.10.NOTT36F	1
Site Q.ITman.SC.19.03.10.NOTT37F	1
Site Q.ITteam.SC.19.08.10.NOTT42F	1
Site J.FinDir.SC.AT.04.10.10.NOTT43F	1
Site H.ITman.SC.01.11.10.NOTT44F	1
Round 2: To verify the cost categories contained within the MDS with Trust participants	
CfH.SC.CQ.14.01.10.NOTT35T	1
Site B.ITman.SC.26.11.10.NOTT45F Site B.ITman.SC.12.01.11.NOTT52F	2
Site B.FinDir.SC.26.11.10.NOTT46F Site B.FinDir.SC.12.01.11.NOTT53F	2
Site E.ITman.SC.CQ.16.12.10.NOTT47F	2
Site E.ITteam.SC.CQ.16.12.10.NOTT48F	1
Site C.ITman.SC.21.12.10.NOTT49F	2
Site C.FinDir.SC.21.12.10.NOTT50F	1
CfH.SC.10.01.11.NOTT51F	1

Table 5.1: Summary of participants' details including participant code and organisation

We also obtained the following range of local cost documents from Trusts:

- Business cases, which contained projected costs
- Project Initiation Documents (PIDs), which also contained projected costs
- Actual expenditure data, which varied in time period collected, e.g. one year post ‘go-live’.

Filename	Site	Software	Description
NHS CRS Expenditure Report (2007)	Site E	Millennium	NHS CRS financial report
Appendix _NHS CRS Financial Report	Site E	Millennium	NHS CRS financial report
Appendix _Training Plan	Site E	Millennium	NHS CRS training
NHS CRS High Risks & Issues	Site E	Millennium	NHS CRS risk assessment
RiO Full Business Case	Site M	RiO	NHS CRS Business Case
PID	Site M	RiO	NHS CRS PID
NLOP Resourcing	Site H	Lorenzo	NHS CRS financial report
PID	Site C	Lorenzo	NHS CRS PID
Local cost reporting tool	Site C	Lorenzo	NHS CRS Expenditure
NHS CFH NHS IM&T Investment Survey 2008.pdf	NHS CFH		NHS CRS financial report
Copy of Local NHS CRS business case VFM tool.xls	NHS CFH		NHS CRS business case
Resource Budget	Site B	Lorenzo	NHS CRS financial report
EPR Next Stage Business Case Board	Site B	Lorenzo	NHS CRS Business Case
Product Initiation Document	Site B	Lorenzo	NHS CRS PID
WES.doc	Computer Sciences Corporation (CSC)	Lorenzo	Technical Specification
NAO_2008.pdf[2]	National		

	Audit Office		
Reporting Update	Site D	Millennium	NHS CRS financial report
NHS Cerner Implementation	Site D	Millennium	NHS CRS financial report
IT Director's Report	Site D	Millennium	NHS CRS technical report
CRS Finances	Site D	Millennium	NHS CRS financial report
Planning Overview	Site D	Millennium	NHS CRS planning

Table 5.2: Detailed documents assessed

5.3.3 Data generation and handling

We undertook a mixed-methods approach to establishing the cost framework. This involved first using microeconomic production models to identify domains of inputs that could be affected by a broad-reaching technological change within a hospital setting (e.g. EHR). Qualitative research methods (semi-structured interviews, documents and field-notes) were then employed to identify the costs involved in implementation and explore the factors which impact on the amount of resource spent at trust level. Financial, planning and other resource-use documents obtained from hospital Trusts were also assessed in order to specify inputs within these domains and estimate their values. Finally, a second round of purposive interviews was conducted to formally verify our cost framework and MDS with Directors of IT, Finance Directors, and NHS CFH staff.

Semi-structured interviews

Interviews took place between February 2009 and January 2011, and lasted from 20 minutes to two-and-a-quarter hours. Prior to the interview, each participant was informed of its purpose and reassured that all information supplied would be treated in the strictest confidence. Any personal details and information, which could lead to a participant being identified, were removed at the data transcription stage and a code applied. The interview schedule (see Appendix 15) consisted of open-ended questions on topics underpinning the WP's aims and objectives. Every attempt was made to improve the clarity of questions for participants over the course of the interviewing period, with some being reformulated as understandings emerged. All participants were asked towards the end of the interview if

there was anything else they would like to add to increase understanding of the issues discussed, and also whether they were willing or able to provide any documents relating to implementation costs or activity.

Documentary evidence

Documents containing cost information (e.g. business cases, PIDs, financial reports, current and previous expenditure files) were requested from each Trust as mentioned above, and relevant data (e.g. cost categories and figures) were extracted from them. Available data and evidence generated by other WPs was also assessed, so as to ensure that all costs were included appropriately. All documents reviewed and assessed are listed in Table 5.2 above. Through this process a framework was developed, which characterised likely, representative implementation costs.

Validating the cost framework

The process of validation involved presenting the developing cost framework to Directors of IT and Finance Directors at hospital Trusts implementing different NHS CRS systems, and to members of the Project Advisory Board, Independent Project Steering Committee, NHS CFH Benefits Realisation Team and other key NHS CFH members of staff. Each of the cost categories were discussed in turn and any suggested changes they would make to the overall layout, cost categories and sub-categories sought. This process enabled us to reflect on whether such a framework contained all the necessary cost categories for Trusts deploying different systems, different sets of functionality, and commencing from different starting-points (thus aiding generalisability). This also ensured that the cost framework could function as a MDS (see Appendix 16) to be used by other Trusts implementing NHS CRS and to guide future evaluations.

Sensitivities of getting the information

We faced a number of challenges collecting cost data from hospital Trusts. First, hospital staff appeared to be reluctant to be interviewed when approached. There may have been many reasons for this, including the substantial costs associated with implementing an EHR system and the highly publicised losses reported by some Trusts.(153) Second, for those who agreed to be interviewed, issues were raised surrounding ‘the identification of the interviewee’ or ‘Trust’, and ‘the comparing of one Trust to another’. This problem may have been exaggerated by the apparent lack of communication between Trusts. Third, documents containing actual expenditure data of the hospital Trust were rarely provided. These

documents were viewed by hospital staff as confidential in nature and containing sensitive information, which was unpublished and not available to the public.

Validity, reliability and generalisability

A number of strategies have been incorporated into WP4's methodology to help strengthen validity and reliability. These include data triangulation and peer de-briefing. The triangulation of data sources was a guiding principle of this WP's design. To ensure the credibility and trustworthiness of study findings, different sources of data both from within and between hospitals, SHA and NHS CFH were obtained. This process not only provided considerable insight into the various costs associated with NHS CRS implementation, but it also added `weight' to findings by revealing similar factors that impacted on costs. Supplementary data, in the form of detailed field notes and documentary evidence (e.g. business cases, project initiation documentation and interim financial reporting), also offered the ability to triangulate methodologically.

During the various stages of data collection and analysis, the researchers took every opportunity to discuss their interpretations and findings with colleagues to increase the Trustworthiness of the study. As suggested by Russell and Kelly,(154) this "team based" approach allows multiple, diverse perspectives to be considered at each stage in the research. Although it is encouraged that this process of "peer de-briefing" should engage colleagues outside the research study,(155) experts on our Project Advisory Board were consulted in an attempt to reduce the possibility of researcher bias and encourage reflexivity.(156)

5.3.4 Data analysis

Phase 1: Qualitative data analysis

Data analysis aimed to identify major cost categories associated with the implementation of an EHR system and the factors that impact on the amount of resource spent by hospital Trusts. This systematic and rigorous process was initiated with data collection. Throughout the interviewing process the researchers thought about the data being gathered, refined questions, pursued ideas and investigated further cost categories in greater depth. A thematic framework was developed by identifying the recurring themes and concepts. A workable list of main- and sub-themes was applied systematically to the whole dataset with the aid of the computerised qualitative data analysis software QSR N-Vivo version 8.(157) These data were then sorted and synthesised by grouping data with similar content. This

reduction, ordering and collation enabled the researcher to concentrate on each specific theme in turn, looking across different hospitals and understanding the range of views and experiences shared by interviewees. The researcher moved backwards and forwards between the data, using the "constant comparison" technique,(158) and evolving explanations, until a fit was clearly made. Participants' own explanations for particular phenomena were investigated and the diversity of their accounts explored. This process involved interrogating the dataset as a whole to identify linkages between sets of phenomena and exploring why such linkages occurred. In the quotes presented below, words in square brackets [ ] and ellipses (...) were added; the former to clarify meaning, the latter to indicate the removal of unrelated text.

Documents were also analysed to obtain a contextual understanding of the costs relevant to particular Trusts. Using our cost framework, developed from the initial round of interviews, our documentary analysis determined whether we had included all relevant cost categories appropriate to NHS CRS implementation. By conducting this analysis across a number of Trusts, a more complete understanding of all relevant costs emerged which, in turn, increased the generalisability of the data set.

Phase 2: Quantitative data analysis

Financial and other resource-use data sourced from documents could not be analysed using a standard meta-analytical approach (e.g. relying upon transitivity and points in common).(159) This was due primarily to the incompleteness in data provided at the Trust-level (e.g. some provided capital but not personnel costs), and the substantial heterogeneity between Trusts (e.g. at different stages with different functionalities).

Reported amounts of resource use were analysed, giving due regard to costs that were considered 'more certain' and those that were 'less certain': the latter were costs that varied too greatly between Trusts (because they were too dependent upon choices made at the Trust level during implementation), or because they were opportunity costs that were not easily captured by accounting procedures (such as the utilisation of existing space, reliance upon staff goodwill to commit their time, etc.). In terms of economic analysis these are two different categories of uncertainty; this is addressed later on. The framework used to initiate this approach was based upon a standard production function, where the domains of the impact of NHS CRS implementation can be identified: in terms of the levels and productivity of personnel, capital expenditure and IT/technology (i.e. other IT/informatics systems).(160) Assuming a hospital Trust attempts to minimise costs, whilst maintaining treatment and

overall quality, one can expect that a change in IT technology – NHS CRS implementation – can feasibly affect each of these. At the same time, the impact of the implementation can be dependent upon the existing levels of personnel, capital and IT; their existing efficiency; and the scale of the hospital Trust overall. This allowed us to categorise the domains of impact, with our purposive interviews identifying other site-specific costs as the framework was developed.

5.4 Results

5.4.1 Phase 1: Qualitative results

The cost framework

A cost framework was developed to identify, categorise and describe the range of exceptional (introduction) and annual (recurring) per provider costs associated with implementing an EHR system. The main cost categories in this framework include:

- Infrastructure (refers to key IT architecture required to implement EHR e.g. hardware and software)
- Personnel (all staff costs related to EHR and implementation of EHR, including training)
- Estates (costs incurred while installing an appropriate environment for EHR)
- Other materials and costs.

The key costs associated with each element were also considered, and presented in the framework.

This framework was developed from interviews and documentation, but also designed according to conventional production models under technological change:(146;160) factors that affect levels of capital and labour employed during production (hardware and personnel in particular); factors that affect the efficiency or productivity of both existing and acquired capital and labour (either level or type: including different types or utilisation of computers, the integration of specialised management in the process, for example); and factors that affect the level and productivity of technology itself (such as server and data backup costs, ongoing oversight of data integrity). The framework also matches those found in other industries.(161)

Importantly, our cost function includes technology costs themselves, in the form of superseded hardware and software, as well as interim hardware and software required. This is important because we cannot make assumptions about either economies of scale (the degree to which increasing IT expenditure is beneficial, depending upon the size of the Trust) in Trusts, or returns to scale of the new technology that the NHS CRS represents (the degree to which improved IT can increase efficiency, via the NHS CRS). This, in turn, makes it much more difficult to estimate the effects of the technological change.(162) Importantly, this also captures the potential for the NHS CRS to deliver early disbenefits before longer-term benefits.(149)

There are a number of major factors that impact the cost of EHR implementations, including size and complexity of the project. Different hospital Trusts may choose to implement the same software e.g. Lorenzo or Millennium using different approaches, and some may also choose to integrate different software applications (already in existence) with these systems by following the same procedures. However, all these factors can impact on the cost of NHS CRS system implementation. We highlight the costs involved and also discuss the factors that were found to affect the amount of resource spent in each of these categories.

Finally, there are also important distinctions to be made between the costs of implementing NHS CRS in individual Trusts, in those who have chosen to be 'early adopters', and in those who have also agreed to be 'early adopters' and beta-testers of the product. In the current environment, and in our data, 'early adopters' of Lorenzo were partners in development in ways that 'early adopters' of Millennium were not. The costs incurred were not tractable in this regard, although the extraordinary development costs tended to consist of increased expenditure on hardware rather than issues relating to personnel or business processes.

Infrastructure

We define "hardware" as the physical units that make up the computer, such as the system unit, keyboard and monitor. We found that Trusts purchased and deployed a range of different types of hardware to support EHR implementation, including: standard PCs, computers on wheels, wall-mounted computers, keyboards, tablet PCs and printers (mobile and heavy duty). SmartCards were supplied to the Trusts studied free of charge by NHS CFH. There was also a maintenance cost associated with resolving any hardware problems. Hospital Trusts varied considerably in the type and quantity of hardware purchased.

We define "software" as the detailed instructions used to direct the operation of a computer

to perform a particular task. iSOFT's Lorenzo, Cerner's Millennium and CSE's RiO software applications were provided to Trusts free of charge as part of NPfIT. One Trust chose to develop their own additional software at an extra cost. The amount of resource associated with implementing the national applications depended on a number of factors, including:

- The stage of hardware maturity within the Trust
- The products currently available on the market
- The hardware budget
- The requirements of the application
- The physical requirements of the ward/room.

The stage of hardware maturity within the Trust

Prior to commencing the implementation of EHR systems, some Trusts reported having hardware of *'good spec'*. These Trusts appeared to be more advanced in terms of hardware, replacing all keyboards to make them SmartCard compliant when implementing previous computer systems. One Trust already had a number of computers on wheels on each ward and reported using them a lot with their current prescribing system. The Director of IT at another Trust felt the EHR system could be implemented in outpatients with little cost, recounting how the infrastructure was already in place with a PC in every outpatient clinic.

"…we've had to replace the keyboards as per the SmartCard access but we did that when we did iPM [iSOFT Patient Manager] a couple of years ago, so I don't think there are any other significant infrastructure costs" (Interview, IT Manager).

"…virtually every outpatient clinic now has got a PC, all the reception areas are covered with PC equipment so there'll be very little cost to actually start to actually roll this thing out into those sorts of areas'" (Interview, IT Manager).

As part of an ongoing programme *'to refresh the kit'*, hospital Trusts either directly purchased the hardware from or had a leasing agreement with a technology provider. Synonymous with their three or four year 'refreshment' cycle, the hardware in these different Trusts was of varying stages of maturity as the finance manager of one NHS Local Ownership Programme (NLOP) (see Chapter 1) explains:

"Trusts are in different stages of hardware maturity, some have invested, some haven't (…) I mean hardware we don't think is a lot, (Hospital name) and (Hospital name) are largely modernised (…) they've got mobile devices, laptops, tablets. (…) (Hospital name) is

probably the one that hasn't got so much investment. But generally all of them have an ongoing programme of, you know, desktop printer type replacement'" (Interview, IT Manager).

With this ongoing programme, the Director for IT at one Trust admitted that it was *"difficult to be precise"* about what was specifically a cost of a Lorenzo implementation and what was *"just business as usual"* (Interview, IT Manager). The project manager at this site outlined how the purchasing decisions, around the number of computers per ward, came down to the individual choice of each Trust. In his view, providing each person with a PC on each ward was not practical. The Director of IT at the same Trust highlighted that 'space' was an issue. Despite having a generous amount of technology already in place on the wards, he accepted that the current level of technology would not satisfy the demands of ward staff at peak times. Consequently, he had tried to create more space on the ward in order to provide staff with more equipment. The Director of IT at a different Trust felt that this rise in demand was down to the fact that clinicians rarely (if ever) used the previous Patient Administration System (PAS) system. She felt this rise was to be expected, as they now had to place orders and check results on the newly implemented Millennium system.

"*…some people might decide that 1* [PC] *between 10 is fine, some people might decide that if you don't have a PC to yourself then you're wasting your time. So it's not something you can give a catch-all answer to I'm afraid. If it was down to me it would be great if everyone had their own PC but on the wards and stuff like that, that's not possible'"* (Interview, IT Manager).

"What we do know is the clinicians never used it, they never used PAS so we had 320 users of PAS on a daily basis at lunch time which is the prime time because you can see them using it, as soon as we went to Cerner it was 700 and the difference there is the clinicians, so they're on it, getting results, placing orders and everything else" '(Interview, IT Manager).

The hardware products currently available

Another factor influencing Trusts' decision-making process regarding the type and quantity of hardware purchased was products currently available on the market. In an attempt to address the rising demand mentioned above, one Trust chose to increase the number of desktop PCs by 1 or 2 per ward at a cost of around £2-3,000 in total per ward, and to trial mobile tablet PC devices sponsored by NHS CFH. The Finance Director of the Trust was keen to point out that they had "*saturate(d) the wards with the tablets"* as they *"didn't want it*

to fail because of lack of available resource" (Interview, Finance Director). An IT Manager at the same Trust illustrated how these devices enabled clinicians to view clinical information whilst on the move. He later acknowledged, however, that they were very poor for entering information on and that the Trust had already trialled two different sorts of tablet PCs that, in his view, were not 'fit-for-purpose'. The Finance Director also echoed this, stating that they were too heavy and the batteries got too hot. The third PC tablet trialled was lighter, faster and allowed clinicians to more easily log in when in close proximity to the tablet PC.

"*So the third one looks quite (…) promising because it's lighter, it's faster and it also supports the proximity card instead of the old chip and pin, instead of the things we all use now. So that means the clinician can in effect walk up to something and log in by virtue of being a few centimetres away from it and stay logged in by virtue of being close to it'"* (Interview, IT Manager).

The Director of IT of another Trust expressed how the tablet PCs were *"no good"*. At a cost of £1,500 each, she outlined how the device contained a SmartCard slot that did not pass the infection control standards for her hospital. This was in contrast to the third tablet PC device mentioned above, which allowed clinicians to log on by virtue of their proximity. She also explained that the Millennium system has a very busy screen and viewing the information on the tablet was *"nay on impossible".* The length of battery life was also raised as an issue, and presented in her account as the reason why "*you'll be paying for a new one in less than, you know, two years"* (Interview, IT Manager) if the battery was not allowed to go flat on a regular basis. She also raised a health and safety issue, explaining that the tablet PCs got very hot at the back (when in use) and staff could easily get burnt if they did not hold the device correctly. She felt the devices needed to be further developed.

"…the other thing is it gets very, very hot behind and the concept of those tablets is you put your wrist behind and there's a piece of elastic at the back of it and we thought you'd walk around with it, well if you had your wrist on the back of that you'd burn yourself. (…) Well it's just so hot you just couldn't do it. Now if you hold it around the plastic it's OK but they're not there yet'" (Interview, IT Manager).

As part of the process of implementing Millennium, this Trust had also purchased two mobile label printers per ward. These devices were just about to be 'pulled back' as they were, in her view, *"no good".* She explained how their batteries gradually deteriorated as staff kept putting them back on charge, a problem similar to the tablet PCs mentioned above. However, by contrast, she later went on to say that *"nobody ever charges them"* and the

label roll needed to be replaced very often.

The hardware budget

The decisions made by Trusts on which type and quantity of hardware to purchase was also found to be dependent on whether a predetermined budget had been set. One Trust set a budget of £500,000 to spend on hardware. The Director of IT explained how they could easily have spent this 'one-off' amount *"twice over"* as the label printers *"cost a fortune"* (Interview, IT Manager). One hundred and fifty standard PCs, 100 wall-mounted PCs (described as standard PCs in metal boxes which were screwed onto the walls), 50 computers on wheels (COWs), and around 300 infection-controlled keyboards at £110 each were purchased with this budget. The Trust decided to allow each of their 47 wards the option of choosing between five and eight different devices from the selection of hardware on offer. The IT manager explained how their team had *"tried to be fair"* by allowing each ward an allowance, and insisted that one COW was 'equivalent' in worth to three PCs. They was keen to point out that the infection-controlled keyboards were *"a total waste of time"* (Interview, IT Manager) as nobody ever cleaned them within their own Trust.

"We had half a million and then we decided what kit we liked IT wise and we had a COW, a wall mounted or a normal PC and we said OK come to the shop and that's what they could choose and they all chose their own. (…) I think we bought 50 (COWs) and that's for 47 wards, so some wards haven't got any and some wards have got three, it's just what they wanted.(…) we said you can have between five and eight devices per ward. If you have more COWs, they are the value of three PCs, so it's like we sort of allowed them an allowance and then that's it" (Interview, IT Manager).

The requirements of the application

In order to run the Lorenzo, Millennium, and RiO applications, local hospital Trusts needed to ensure that their hardware satisfied certain requirements. These requirements were set down by the software provider and know as the *Warranted Environment Specifications (WES)*. For example, tablet PCs were required to have between 512 MB – 1GB of RAM (Random Access Memory) in order to run the Lorenzo application. The finance Director of one Trust explained how the memory of 450 machines needed to be upgraded and another 450 replaced in order to satisfy the requirements of the new Lorenzo application compared to the interim solution (iPM).

"*We put in 450 new PCs or replacements if you like and we upgraded the memory of another 450, and if we'd been using iPM or a thin client system we wouldn't have had to have done any of that that was purely driven by the new requirements of the application"* (Interview, Finance Director).

The cost involved in meeting these requirements appeared to be absorbed, in part at least, by the Trust incorporating them into their 'refreshment' cycle (as referred to in the previous section). By adopting the WES as their standard, this Trust felt that they could guarantee that the specifications would be rolled out across the whole hospital Trust in four years.

"*We upgrade our standard build and any PC, that (…) because of its age or because of a problem, is replaced by a PC of that spec. So we're constantly refreshing our estate anyway and every four years the whole lot gets rolled over and every four years we guarantee that the WES is met across the whole of the Trust'"* (Interview, IT Manager).

However, the Head of IT at another Trust believed that the WES was set too low. She explained that in order to run the new EHR system alongside other packages (normally running at the same time e.g. anti-virus), machines would just *"grind to a halt"* (Interview, IT Manager). Her Trust ended up spending more on equipment than they had originally anticipated, replacing all PCs in outpatients after go-live. The Head of IT in a second Trust also shared this view stating that the WES was potentially 'flawed' and the problems with performance were fixed by his Trust spending more on equipment.

"…they just didn't spec it out right. What they didn't think about was the anti virus, the anti virus sucks power like nobody's business, all the memory and CPU [Central Processing Unit] and everything and they didn't really think of that. So what they said was "you only need this to run Cerner" which was absolutely true, what they didn't think about was all the other factors. (…) So we said one gigabyte has got to the standard for every future Trust going forward, so we did invest again about three months, four months after go-live we replaced every PC in outpatients to a faster model'" (Interview, IT Manager).

The physical requirements of the ward/room

Another factor influencing the amount of resource spent on hardware depended on the physical requirements of the ward or consulting room. With space limited in some wards and consulting rooms, a wall-mounted computer may be the most suitable choice. However, the finance director of one Trust admitted that it would be very expensive to put a wall-mounted

computer in each of the small consulting rooms, and therefore a computer on wheels which could be shared between different areas might be a less expensive choice.

"…the physical aspect of where you want to put the kit. So some wards, there might be a desk on a ward that needed a PC so it was really easy, another ward might be really tight for space so you've got to put a wall mounted unit up which is more expensive. (...) If you've got five small consulting rooms and literally a bed and a curtain across the side at the sink to put a PC on the wall of every room would be very, very expensive so the COW, you'd fit your clinics out in the morning to suit'" (Interview, Finance Director).

Personnel

Staff were required to carry out a number of concurrent procedures involved in the process of EHR implementation. These included the accurate transfer of data from the old system to the new Lorenzo (or interim iPM system), Millennium and RiO software applications (data migration); the identification and 'cleaning up' of any anomalies in the legacy data prior to migration (data cleansing); the testing of the NHS CRS system post data migration (testing); the optional procurement and instalment of a wireless network and/or configuration of Virtual Private Network (VPN) connectivity (networking); the building and testing of interfaces to integrate software systems (integrating); and training and supporting end users (training and support). The costs associated with *data migration, testing, networking,* and *training and support* were found to be dependent on a number of factors, as discussed below. We also touch briefly on the cost associated with a loss of staff productivity *(Productivity loss).*

Data migration

The costs associated with the process of 'creating' data extracts, 'cleansing' them, 'mapping' them on to the required Local Service Provider (LSP) format, and 'migrating' the data over on to the new CRS system were found to be dependent on a number of factors including:

- The NHS CFH – LSPs agreements
- The hospital Trust - LSP agreements
- The number of systems directly replaced by the new EHR system.

<u>The NHS CFH – LSP agreements</u>

According to the national Approval to Proceed documents, data migration was a cost attributable to the local hospital Trust. The IT programme delivery manager at one Trust explained how it was their responsibility to develop the interfaces necessary to migrate the data to the LSP's interim system. He described how difficult it was to satisfy the LSP's

specific data requirements and populate the tables requested with data extracted from their old PAS. However, he appeared to take some consolation in the fact that, once the data had been transferred, it was the responsibility of the LSP to migrate it (from the interim iPM solution based in their LSP's data centre) to their Lorenzo system. The hospital Trusts in this study developed their own interfaces on site, with others reportedly paying an external company to do all their data migration for them. Checks were also conducted by the Trusts to make sure that the data were inputted and propagated correctly on output. Despite recognising the amount of work this involved, the Director of IT at another Trust felt that moving to the LSP's interim solution *"just makes things easier",* as it required them to think about their data cleansing earlier in the implementation process.

"*In terms of data migration (…), that's their [LSP's] responsibility (…) because the [interim system] sits in the [LSP] data centre and (…) they essentially then do the data migration from [interim system] to [nationally procured system]. Obviously we have to do the sanity checks and has it gone in right and is it the right format, etc, and does it come out correctly as well which is important, but obviously that's kind of their responsibility whereas before we had to do all of that. They gave us a lot of tables and we had to populate all those tables from extracting it from our old PAS and, you know, that was bloody hard work but we don't have to do that going forward'"* (Interview, IT Manager).

"…even if you go into iPM for six months to kind of skim off it and go into the next one it just makes things easier because it allows you to bring forward your data cleansing, your Spine connectivity, you satisfy the requirements around data migration. But the big thing is you've got it in a CSC data centre, boxed up (…) And it then becomes CSC's responsibility not mine to migrate it from there into Lorenzo, it's CSC's responsibility to deliver all the interfaces that I had to deliver when we went into iPM'" (Interview, IT Manager).

<u>The hospital Trust – LSP agreements</u>

The costs associated with data migration also related to the specific agreements reached between the local hospital Trusts and the LSPs. For example, if an agreement was reached where the data could be migrated in a similar format (the same fields) to that extracted from the previous PAS system then the costs were likely to be less. However, if there was a need to obtain additional information from another source then the cost was expected to be higher.

"…some of the costs would depend, I mean, if it was just the same, exactly the same records, same fields, you know, but if they wanted some additional information for example

that we had to pull in from somewhere else that's where it (the cost) starts to get (high)" (Interview, Finance Director).

The number of systems replaced

The costs associated with data migration also related to the number of systems directly replaced by the implementation of the new EHR system. The more systems replaced, the more data would need to be migrated from the previous separate 'islands' or systems (like maternity, accident & emergency, theatre and laboratory systems) to the new, more integrated system.

"*…you've got your main PAS system but you've got a separate maternity system, a separate theatre system, separate lab system, separate GP systems dotted all round over the wider community. As Lorenzo grows the idea is (…) that Accident & Emergency functionality, that's part of Lorenzo, so you don't need an interface for that, so that's more integrated. Theatre system is part of it, maternity system becomes part of it (…) Lorenzo just grows and gets more and more. So you can do more within the one system so it's more integrated, more seamless, more joined up"* (Interview, IT Manager).

Testing

Data entered into different NHS CRS systems needed to be tested to ensure that every component of the system was performing as expected. For 'early adopter' Trusts, testing was viewed as an important requirement as the beta software was, by its very nature, new and unstable.

".. we were in effect Beta testing the product so this was a Beta deployment, this was the first time it had ever been seen outside of India so we had to test" (Interview, IT Manager).

The Director of IT at one Trust recalled the difficulties experienced by her team when testing their Millennium system. She recognised that it was British Telecom's (BT) responsibility to test the system prior to go-live, and sought to demonstrate that their testing had failed to meet her expectations with different test elements not working when passed to the Trust. She also emphasised the amount of time the Trust had "wasted" with this, culminating in them taking over the testing from BT after go-live.

"Well, they did the first element of testing and then they handed it over to the Trust and said "Over to you now" and then we'd do it after that but I think there is definitely a kick back (...)

in the first year or so where they'd hand over stuff that you know you could see clearly that didn't work and then we just wasted so much Trust time saying "No, that doesn't work" and then pass back (...) since go-live we've taken on the testing ourselves cause we don't Trust them" (Interview, IT Manager).

The IT and Finance Directors' accounts at another Trust also displayed a lack of Trust of their LSP's testing, explaining how their hospital Trust had got *"horribly burned"* (Interview, Finance Director) when implementing their interim iPM system because they had regretfully believed that it was *"a robust product"* (Interview, IT Manager) that had been tested thoroughly by the Computer Sciences Corporation (CSC). Based on these experiences, they recounted how they *"wouldn't let anybody test something as important to us [them] as a PAS"* in the future and so insisted on testing their own Lorenzo system themselves. This testing was carried out in parallel to the testing conducted by the Single Instance Board for Lorenzo (SIBL) Group, a group that tests Lorenzo software for NHS Trusts. The Director of IT reflected on how the establishment of such a group was likely to result in less testing costs for future Trusts.

"... for a Trust going forward testing is probably an extremely small cost because there's this SIBL group, Single Instance Board for Lorenzo and what they're tasked with is (...) performing a set of tests at each upgrade to guarantee that that upgrade is fit to deploy for the rest of the NHS, so the principle being that the rest of the NHS doesn't have to develop its own testing expertise and run it's own testing then have a bun fight at the end of testing that, you know, "we think it's good to go", "we don't think it's good to go" so that's all kind of handled through the SIBL group. (...) We're allowed to run it parallel to SIBL so we are incurring quite a significant cost in testing but Trust B next door I don't think would be allowed to do what we're doing so they would make a saving" (Interview, IT Manager).

Networking

Views varied extensively between Trusts on whether a wireless network was needed as part of the implementation of EHR systems. The Director of IT at one Trust explained how they had installed a wireless network from the third floor upwards (where all the clinical wards were located) but insisted that this was *"nothing to do with Cerner"* (Interview, IT Manager). As far as she was concerned, she thought it would be a good idea to put one in at the same time as putting in Millennium. In contrast, the Director of IT at a different Trust felt very strongly that a wireless network was necessary and that any Trust implementing the Lorenzo system would have to put one in (in order to operate the clinical record on the ward). He

reflected on how they would probably have included the cost of installing a wireless network in the original business case, if they did not have a solid, reliable wireless network already in place. This view was shared by the finance director (and project manager) at the same site, who explained how a "green field" site would have to put one in.

"I would argue strongly the opposite (Wi-Fi is needed) … It's something we would probably have put in the original business case if we didn't have it already, we'd put it in against other projects, to satisfy other objectives but we couldn't really be operating a clinical record in a ward environment without a proper, robust, secure wireless network" (Interview, IT Manager).

One possible explanation for the difference in opinion between sites may lie in the way that some interviewees perceived the scope of their new EHR system. The finance director felt it was possible to run a PAS without a wireless network in place. However, such a network was viewed as necessary to run an electronic patient record (automating both clinical and administrative processes): *"Could you run a PAS? Yes. Could you run an EPR then I'd say "no"."* (Interview, Finance Director). The finance manager of one NLOP offered another perspective, reflecting on how the age and consistency of the hospital buildings may have influenced their local decision to implement a wireless network. He suggested that it might be easier to implement a wireless network in older buildings than to hollow out a wired way, whilst also recognising how some older buildings are prone to weak spots.

"…they've got an old building they've inherited with a lot of asbestos and stuff and rather than (…) re-caving in a wired way they're looking at wireless, but with some of the older buildings you get problems with weak spots and that sort of thing. But it's discussed at a local level" (Interview, IT Manager).

Training and support

There were a number of costs associated with training clinicians and administrative staff to use the Lorenzo and Millennium systems. These included producing training documents e.g. manuals, quick reference guides, e-learning materials (Training materials), providing rooms or lecture-style theatres to teach staff (Training facilities), replacing staff members whilst they were being trained (Backfill staff), employing / hiring staff to train and support the users (Trainers, Floorwalkers) and running courses to train the trainers (Train the Trainer). In addition to the number of users at each site, the amount of resource spent by hospital Trusts on training depended on the following factors:

- The training strategy
- The decision to backfill staff
- The level of support
- Trainers' employment status.

The training strategy

Each hospital Trust developed their own training strategy, consisting of either one-to-one, classroom or 'mass' training sessions, or a combination of the above. The Director of IT at one Trust recognised how difficult it was to remove clinicians from each ward to participate in training sessions and so employed extra trainers to coach clinicians and other ward staff on the ward. One of the ward managers felt that this one-to-one approach (supported by e-learning disks) was good, explaining how "*you can't pull one of them (trained night staff) out to do even half an hour of Lorenzo training"* (Interview, IT Manager). The IT team also made a room available close to the ward so that staff could drop in for 'booked' and 'top-up' coaching sessions. The project manager regarded the establishment of the coaching room as *"one of the best things"* (Interview, IT Manager) they did as part of their training strategy. The Director of IT acknowledged how this had *"worked extremely well"* for the two wards that they had deployed Lorenzo in but admitted that it was going to be very difficult for his team *"to sustain that (same approach) across all 55 wards, 2,500 members of staff"* (Interview, IT Manager). To avoid large overheads, he felt that they would now need to take three or four wards at a time.

"*…what we've tried to do is come up with a very much blended training strategy, (...) It's very, very difficult, in fact impossible to get a classroom full of clinicians out of a ward to train them. You might get two or three but you're more likely to get one. So we staffed ourselves up to, in effect, individually coach people within the ward"* (Interview, IT Manager).

He drew a distinction between the different releases of Lorenzo, explaining that the training required for Release 2 (R2) needed to be conducted in as short a time as possible (over a 10 week period) and as intensely as possible, in order to get the 2,500 members of staff trained before "go-live". In contrast, the training associated with Release 1 (R1) could be conducted over a much longer time period and with varying intensities subject to available resource. He felt this intense approach for R2 was necessary, reflecting on his experiences and lessons learnt from implementing iPM (Lorenzo interim solution). During this implementation, he explained that staff had being trained too far in advance (about 7 or 8 months prior to go-live) with the result that they had *"forgotten everything that we'd told*

them" at go-live (Interview, IT Manager). In his opinion, this had been due to the numerous false go-live dates set and emphasised how they had no time to do top-up training towards the end. Should the Trust have decided to run top-up training courses prior to go-live, the costs associated with training would (needless to say) have increased.

"*I think the other aspect of training is R1 we can do incrementally and you can speed it up, slow it down, according to the resource you've got. R2 in a 10 week relapse time period we've got to train 2,500 members of staff (...) with iPM we got so many false horizons for our go-live we started training about seven or eight months before the actual go-live event"* (Interview, IT Manager).

A classroom style training approach was employed at a different Trust. The Director of IT recounted how they ran ten training sessions simultaneously, each session accommodating up to 10 members of staff (mainly administrative). She emphasised the enormity of the challenge in training 5,000 members of staff and the difficulties associated with pulling staff out of their respective departments for training. According to her, a deliberate attempt had been made to train clinical staff in all the basics (as well as the extras) by running 'mass sessions' everyday for three to four weeks in a lecturer theatre style. Despite offering clinicians the freedom to choose any session they would like, she reflected on their poor uptake (less than half of the clinicians attended the sessions) and how their non-attendance was, in part, because they just could not be spared.

"*I mean we had 10 training rooms running simultaneously with 10 people in each training course, that's how big it is (...) it's massive (...) Not so much clinical these are admin staff mostly. Clinical staff only did half a day each and then we did mass sessions in a sort of theatre style to show them extra bits (...) we ran them everyday, half day sessions for about three or four weeks and they (clinicians) could choose anyone. Some of them did, probably, I don't know, maybe 180, but including all the junior docs there's about 500, maybe a bit more and so like the rest of them just didn't, couldn't be spared"* (Interview, IT Manager).

However, six weeks prior to go-live the Director for IT recalled how the outpatient supervisors voiced their concerns about the training approach employed, explaining how the training environment (in which their staff were allowed to learn) was not the same as the hospital build (viewed as more complicated). In her account, she appears to validate the authenticity of their concerns and change the training strategy such that two trainers would now be based in outpatients and provide one-to-one training to frontline staff on a copy of the go-live environment.

"*So what we did we based two trainers in outpatients and brought them out of outpatients and sat with them and went through it in the cert environment which is a copy of our go-live even though we were testing it and then they went back to their desk and then we brought another two [for] (...) one hour, two hours"* (Interview, IT Manager).

The decision to back-fill staff

The decision to back-fill staff on the wards varied between Trusts. As part of the training strategy at one site, the Director for IT acknowledged that a 'once off' cost of £750,000 was spent to back-fill clinical staff. He admitted that this money had come from the Deployment Incentive Fund (DIF) (see Glossary), but there was an insistence that this was justified.

"*…the other big thing that we've done is the DIF of one million for R2, we've worked out that three quarters of a million pounds will be required to back-fill clinical staff to support that training exercise. So straight away three quarters of a million quid's gone"* (Interview, IT Manager).

The Director of IT at another Trust presented a contrasting view, explaining how no money had been spent to back-fill staff.

"*…if a Trust ever wanted to do back-fill then it would cost millions but no Trust will ever pay back-fill for that"* (Interview, IT Manager).

She reflected on these actions as legitimate, as no Trust in her opinion would ever do this as it cost too much. This is an important finding, as one might hypothesise that the reason staff 'couldn't be spared' to attend the training sessions in this Trust (mentioned above) might have been due to the lack of money spent on staff backfill.

The change management lead at a different Trust also raised important concerns over the availability of staff to replace or 'back-fill' those involved in the implementation. In his account, he drew a distinction between staff roles, highlighting how it would be easier to replace a member of the administrative staff than a member of the clinical team, due to a perceived scarcity of consultant specialists.

"*…one of the other issues that we found with this just in terms of backfill (...) if I give you an admin person so (...) I give you [Name] for a day and you give me a hundred quid that's great because I ring up Office Angels and they say "No problem. Somebody will be there first*

thing tomorrow morning" works really well. If I give you a consultant psychologist for a day and you give me a thousand pounds in return which is about the cost for a day of a consultant psychologist what do I do with the thousand pounds? I can't get a locum, they just don't exist because they're rare" (Interview, IT Manager).

The 'hidden' costs associated with 'lost' productivity was also raised in interviewees' accounts as being a significant cost and very difficult to measure. A deliberate attempt was made by one interviewee to try and include this cost in his business case. In his account, he acknowledged how difficult it was to try and calculate the amount of time a person may spend on other tasks apart from what they were employed to do. Acknowledging that these costs may be substantial, he was keen to emphasise that he did not want to be *"sort of fuelling that fire"* (Interview, IT Manager) that Lorenzo was too expensive. However the opportunity costs of lost productivity in sites with insufficient back-fill of staff in training is an important consideration. Simply refusing to back-fill may not, necessarily, be cost-saving.

"*I genuinely believe that that is the highest cost that an organisation, a Trust, will encounter yet it's something that's actually very, very difficult to write up in a business case (...) I don't have any money to put into their budget to cover it, it's something that they do often on top of their other work, if not instead of, but that's still a real person doing real work, taking real time it's not, you know, an entry in the spreadsheet, it's not a theory, it's an actual tangible thing but how do I cost that?"* (Interview, IT Manager).

<u>The level of support</u>

The level of support provided to clinical users by hospital Trusts varied extensively. One Trust chose to support their clinical user base outside normal working hours by extending their existing service desk to run from seven o'clock in the morning till 11 o'clock at night, at a cost of £250,000 per annum. The Director of IT was keen to point out that his Trust had also gone to great lengths to get this service desk accredited through NHS CFH. This meant that those users seeking help could talk directly to the LSP, thus avoiding the national service desk established (and later wound up) by NHS CFH. The finance director at the same Trust considered this advantageous for the Trust, explaining how the national service desk was *"another step between us and (LSP)"* and *"too far away from the actual operational role to work"* (Interview, Finance Director). Direct access provided them, in his view, with *"efficient first-line support"* (Interview, Finance Director). He also emphasised the distinction between a local help desk, which would typically log the call of the clinician (and call you back), and a service desk whose personnel would have the specialist skills necessary to resolve the problem usually immediately. From his perspective, other Trusts were also

struggling to provide around-the-clock IT support due to financial constraints and felt the SHA should give more attention to the sharing of services across organisations so as to get economies of scale.

"*…every informatics team I'm aware of runs a nine till five model. Two years ago we put this to the acute Trust and said what about a 24/7 service, redesign, we've got Lorenzo we run nine till five, I need a quarter of a million pounds to extend my working day to run a shift up to 11 o'clock at night. So the acute Trust went for that and (…) so they invested a quarter of a million pounds of their money into my service for me to run from seven o'clock in the morning till 11 o'clock at night"* (Interview, IT Manager).

"…It would be mad to have one acute Trust set up a seven by 24 service with this type of person at three o'clock in the morning who's skilled up to know the business processes, they understand Lorenzo and then 30 miles down the road you've got another one, another acute Trust doing exactly the same thing. And then 30 miles up the road (…) doing the same again, that's wrong (…) The service support model is frustrating for me because the revenue's not there to go right round the clock and yet I can see organisations right on our doorstep, on our boundaries, who've got the same problem and they're struggling with similar budgets and there needs to be some big thinking if you like to get economies of scale" (Interview, Finance Director).

The funds to support the extension of the service desk's opening hours in this Trust were released from no longer providing the maintenance support (now provided by the LSP) for the newly implemented LSP's interim solution. This was in contrast to the original PAS for which the maintenance support was being provided by the Trust.

"*…that actually released revenue to the Trust because the national application to the Trust cost nothing in terms of maintenance contracts. So the previous PAS maintenance contract, that revenue became available if you like. And some of that allowed me to restructure my team around this sort of service delivery focus so the seven to 11 working hours and the dedicated service delivery manager that was all funded out of that revenue stream if you like"* (Interview, Finance Director).

<u>Trainers' employment status</u>

The amount of resource spent by hospital Trusts also depended on whether the trainers where employed as permanent or agency staff. As trainers were needed for relatively short periods, the Director for IT at one Trust noted how *"it would be a nonsense for me to employ*

12 people for 10 weeks, well 12 weeks, because I've got to train them" (Interview, IT Manager). The Director of IT at another Trust admitted leaving it too late to go out and recruit trainers, and reported getting 'absolutely stung' by contractors' fees (a cost of approximately £500 a day). In her opinion, the recruitment process could take between three to four months and trainers skilled in using Millennium were in short supply. She also ended up keeping the trainers much longer (approximately four to six months longer) than she had originally anticipated after go-live because *"it did go so badly"* (Interview, IT Manager). In her account, she argued *"every other Trust will get stung by contractors"* (Interview, IT Manager). Similar to other 'early adopter' sites, floorwalkers were also provided to this hospital Trust free by the LSP and NHS CFH to help support users at go-live.

"…we didn't have time (to) go out and recruit because if you go out and recruit it takes three months, four months by the time people, and nobody's got Cerner skills. So what you do you go to agencies (...) and they charge £500 a day (...) so you immediately doubled or quadrupled your costs (...) we didn't pay for the floor workers they paid for all those, BT Health and Cerner and LPfIT [London Programme for IT] paid because we were first of type so we had loads of floor workers but they paid for them to stay longer than expected and then we had trainers probably for another, maybe another four/six months whereas I thought they'd go off site within four weeks, so we had to invest in those" (Interview, IT Manager).

The Director of Planning in this Trust also described how difficult it was to define the precise deployment effort and end point of EHR implementation. According to him, the Trust was still in the deployment stage as they continue to incur start up costs (and are likely to do so for the next five years), despite having gone live with their Millennium system two years prior.

"*... two years in, we're still, one might argue, in the deployment stage so we've still got a further two years that's we've expended since go-live plus the next five years that we're going to expend getting to the point at which we finish the contract doing whatever we do next so (...) I think actually trying to drawn a black line around deployment effort would be kind of quite difficult"* (Interview, IT Manager).

5.4.2 Phase 2: Quantitative results

Local cost data obtained from Trusts

Of these data obtained, only the actual expenditure data (over several years leading up to go-live) from two Trusts were used. Projected costs (e.g. from Business Case documents)

were considered unusable as the interviewees admitted that their compilation had been ‘guess-work’. The data in Tables 5.3 – 5.5 were extracted from reporting: either internal financial reports, or reports to central bodies such as NHS CFH.

These top-line data can be used, albeit cautiously, to illustrate several characteristics of implementation costs:

- Different Trusts with different solutions (or different releases) experienced varying lead-times before go-live
- Different Trusts obtained varying support from NHS CFH and the software vendor. This support affected resources used (e.g. some sites faced no non-pay costs, another negotiated complete indemnification)
- Some Trusts (depending upon technological maturity or size) had no capital expenditure, as discussed.

Table 5.3 contains actual expenditure data from one hospital site, detailing costs incurred over 6 years leading up to their final ‘go-live’. These data included the implementation of iPM (interim solution) as part of their overall NHS CRS costs. The key assumptions underlying these data are as follows:

- iPM majority effort in Financial Year (FY) 2004/05, 2005/06 and 2006/07
- iPM support majority effort in FY 2007/08
- iPM deployment includes initial work with Accenture as well as final deployment effort once CSC had come on board
- iPM deployment also includes upgrade work, work to upload iPM extracts and replacement of the High level Data Model (HDM) with purpose built Data Warehouse integration of iPM with downstream systems and Database System (DBS) roll-out in 2008/09 and 2009/10
- iPM upgrade to Lorenzo Enterprises (LE) 2.2 in FY 2008/09 and 2009/10 also roll-out to A&E
- Lorenzo go-live in FY2009/10
- Lorenzo deployment includes ‘early adopter’ work, plus further deployment effort to support clinical documents, radiology roll-out and pre-work for Pathology.

	2004/05	2005/06	2006/07	2007/08	2008/09	2009/10
Capital						
Services	17	52	55	9	11	11
Building/Infrastructure	350	350	350	175	263	175
Other	31	61	86	42	43	45
Contingency						
Total Capital	***398***	***463***	***492***	***226***	***316***	***231***
Revenue						
NHS staff	253	467	886	534	760	1,555
On-going staff	5	12	27	174	179	187
On-going non-staff						
Total Revenue	***257***	***480***	***913***	***707***	***939***	***1,742***
Total	**656**	**943**	**1,405**	**933**	**1,255**	**1,973**

Table 5.3: Local costs for one site (£000s)

Table 5.4 contains both planned and actual expenditure on personnel incurred by another Site. Key assumptions underlying the planned expenditure data were that:

- All non-pay expenditure would be borne by NHS CFH; there was no capital expenditure associated with the Lorenzo software and hence no capital charges arose
- This site employed staff to project-manage implementation and deployment
- Figures include central and SHA support payments where relevant: the DIF of £1million was obtained by the Trust for deploying software, which had not been superseded by a subsequent release (Release 1.9)
- NHS CFH, the SHA and CSC provide staff to Trusts to ensure effective development and implementation of the software. The cost of these staff is included within the incentive and support payments and shown as a notional income gain for the Trust.

This site did not account for capital costs. However £150,000 was said to have been allocated to Lorenzo early adoption from within an in-house capital renewal programme (total spend £600,000), and from which PCs and other hardware were purchased.

	2008/09	2009/10	2010/11	TOTAL	Planned
Trust	66	857	332	1,255	720
SHA	6	687	361	1,054	
NHS CFH	31	149	56	236	596
CSC	0	0	0	0	
TOTAL	103	1,693	749	2,546	

Table 5.4: Local costs for the second site (£000s)

	2008/09	2009/10	2010/11	TOTAL
SHA	82	526	4	613
NHS CFH	109	652	20	780
CSC	0	294		294
Incentive 1 9	1,000			1,000
Incentive 1.9	250	750		1,000
Total Notional Income	1,441	2,222	24	3,687
Net Project Cost	1,095	-612	-244	239

Table 5.5: Local financial incentives for the second site (£000s)

Interestingly, this shows that this site projected a net surplus from participation in the early adoption programme. These data also show the proportional levels of support (in terms of support staff) that this site acquired. However during the process of implementation a redistribution of workload is apparent, as the final allocations show a large substitution of local resources for NHS CFH resources. This suggests that an underestimate of necessary support beforehand led to a need to increase support in this site as go-live neared. In some sense it may be the case that this implementation was rescued. Moreover, it suggests that local costs during implementation should not be considered piecemeal to have national relevance, if the series of the data is incomplete (i.e. does not include (i) actual expenditure instead of project expenditure and (ii) data covering go-live). In general, this site committed around 50% of the personnel resources locally, with the remaining 50% being provided centrally. This reflects the findings of qualitative data discussed previously.

5.4.3 Contextual findings

In their updated systematic review, Goldzweig et al. remark that there is a dearth of literature that considers contextual factors and process-changes relevant to the implementation of

multi-functional health IT systems.(19;151) In our study we found that these contextual factors are very important. Hospital Trusts were found to have received asymmetric levels of central support during early adoption; some Trusts received more support at acute periods that coincided with the attainment of NHS CFH set go-live targets for different software. In some cases the development of the software was in parallel with implementation; delays in development meant cost overruns, learning loss at hospital Trusts (who then required re-training) and a loss of momentum generally.

The effects of these factors on the timeliness and cost of implementation were substantial, and on our evaluation, were that ordinarily clear relationships between implementation and costs such as scale, baseline levels of personnel and capital/IT, baseline efficiency, etc. were largely obscured by the process itself. However, it is important to note that this does not imply that the technology itself is, *prima facie*, ineffective: our evaluation was of early adoption, which, by definition, entails a learning curve.

5.4.4 Integration of results across Phases 1 and 2

Cost-sharing

During early adoption responsibilities surrounding implementation appeared to be shared between the hospital Trust, the SHA, NHS CFH and the software provider. In principle:

- Software/license costs were borne by NHS CFH (who had currently commercial-in-confidence contracts with the suppliers)
- Testing was the responsibility of the supplier (although some Trusts did their own testing)
- Hardware and local infrastructure were the responsibility of each hospital Trust
- Data backup, integrity and recovery were the responsibility of the supplier
- Training, including floorwalkers, was the responsibility of the Trust (although it appears from the qualitative findings that this was shared with the NHS CFH, SHA and supplier).

There was variation across Trusts, with some finding central resources e.g. floorwalkers, ‘pulled’ from one Trust to another. One Trust, as a result, incurred substantial costs hiring contract floorwalkers. This is a phenomenon that is likely to be observed during a national roll-out, whether centrally-procured or devolved; particularly as consortia or consulting firms will be likely to emerge in a larger market.

The NLOP attempted to organise a training pool, whereby trainers were procured based upon need across hospitals, and then train across sites. However they found that holding a large pool of trainers was insufficiently flexible and costly: the single accommodation site faced the burden of hosting, while transport and local accommodation proved difficult also. Moreover training resources were lost due to scheduling problems, and individual Trusts ended up procuring (and paying for) their own training anyway. With Trusts seeking lower costs through locally integrated procurement, this phenomenon is also still possible during a national roll-out.

As discussed above, one Trust decided to carry out its own testing alongside that provided by CSC. This Trust also had been developing their own software to run on Lorenzo to solve operational problems locally, further generating local testing needs. Since all Trusts can feasibly be in a position to development local technological solutions, there is some potential for this to occur in the future. However, local software development is not perceived to be a necessary aspect of implementation of the NHS CRS. Therefore, costs incurred through further development locally are at the risk of each Trust.

Similarly, one Trust contained their own back-up/disaster recovery systems, at their own cost, despite the availability of central servers and central data back-ups. This was their own decision; however it may be that individual Trusts have their own regulatory conditions that determine whether or not such contingency plans need to be in-house.

For future Trusts, which may have to support implementation costs entirely locally, this suggests that previous experience was based upon some autonomy varying degrees of support centrally. Thus the actual decisions made may not reflect optimal decisions if each Trust were solely responsible for costs. The results for the second site, for example, show that support had to be increased substantially just before go-live; however, local under-resourcing could have been a result of the knowledge that central resources were available.

Costs in a fully-devolved national roll-out

The future information strategy, to be published following consultation on the government White Paper *Liberating the NHS: An Information Revolution* will define the vision and roles of the NHS Commissioning Board and the Department of Health (DH) in setting clear national informatics standards for the NHS.(14) It is likely to propose devolving responsibility for procurement and purchasing of IT systems to Trust level (based upon pre-election commitments to halt and renegotiate NPfIT contracts).(14) This opens up substantial

uncertainty for Trusts around:

- Current prices paid for software licenses (as contracts between NHS CFH and software vendors, based upon expected user-numbers at the SHA level, are not known – either to the Trusts or the researchers). Moreover, prices will vary, as some hospital Trusts will be able to procure as a bloc, enjoying monopsony purchasing, whilst others will not.
- Current prices reflect not only negotiation but also functionality. For example, Millennium is not a single, built product. Higher functionality will be more expensive, however: (i) each hospital Trust may need different degrees of purchased functionality, depending upon the services they provide; and (ii) hospital Trusts will have autonomy over how large a scale of solution they purchase.
- Software providers or NHS CFH provided several distinct services to 'early adopter' Trusts. These included data migration for some circumstances in some NHS CRS solutions, backup and disaster recovery, and varied personnel (including floorwalkers, trainers and change management expertise). As a result, neither future levels nor unit prices of these aspects of implementation can be known.
- As mentioned above, information was obtained that alluded to conventionally understood levels of support. For example, in Table 5.5, the second site appeared to receive approximately 50% support in terms of staffing, from other sources (NHS CFH, the SHA and the software vendor).

NHS CRS solutions, 'big-bangs' and 'soft landings'

During early adoption there were several dimensions of heterogeneity that introduced very different experiences for hospital Trusts.

'Big-bang' versus 'soft landing'

The so-called 'big-bang' implementation (see Chapter 3) is defined as combining the implementation of the NHS CRS application, including all of its functions, and re-designed workflows, simultaneously.(161) The 'soft landing', by contrast, is a phased implementation, ideally wherein each phase is supported by its own training, analysis and go-live – thereby allowing manageable training and process change loads through the organisation. For example, the second site (Table 5.5 above) underwent a 'big-bang' approach when implementing their interim solution (iPM) and subsequent Lorenzo (Release 1.9). This Trust also chose a 'soft landing' approach for certain deployments because it did not require a site-wide implementation. In a study by Culp et al (2006), they also experienced both in a general practice setting.(163) They found that 'big-bang' implementations created practice

chaos, as there was an inability to absorb training and substantial productivity losses. This led them to moving to phased implementations.

An important distinction between the phased and 'big-bang' implementations however, is functionality. Although this was not explored by Culp and colleagues, it is the case that: (i) a phased implementation may be feasible because the system has lower functionality than one requiring a 'big-bang' implementation; this will naturally suggest lower costs in terms of productivity loss and changed workflows; and (ii) a 'soft landing' implementation, of lower functionality, will not necessarily forestall a later 'big-bang' implementation once higher functionality is released. In the case of NHS CRS implementation these are important distinctions, because the software implemented varied in this regard.

First-movers with 'big-bang' implementations – where the 'big-bang' was necessitated by functionality – appeared to suffer the most. Subsequent movers, even with largely the same functionality and 'big-bang' implementation, on the other hand, already benefited greatly from lessons learned by observing the first movers. Unlike negotiated prices, then, there is a first-mover disadvantage with respect to the losses of productivity and workflow, cost over-runs, etc. Other Trusts, for example, suggested that their own 'big-bang' implementation was preferable.

Lorenzo, Millennium and RiO

We found that none of the systems was in functional equipoise with another: for example, implementation of Millennium, similar to Lorenzo's interim solution (iPM), necessitated a 'big-bang' implementation, because it was initiated with functionality that could only be implemented site-wide. Indeed, all Lorenzo sites piloted the beta software in only a few wards initially.

This does not mean, however, that one or the other was more costly. As discussed, first-movers in 'big-bang' (Millennium) implementations experienced significant induced costs; however subsequent movers experience more stable implementation. At the same time, Lorenzo implementations amongst 'early adopters' only delayed a 'big-bang', as iPM required, and before phased implementation of lesser releases had permeated Trust-wide. More importantly, there is some evidence that Millennium only front-loaded a steeper, but foreshortened, learning curve; this learning experience might then be much longer in Lorenzo implementation sites as the software is developed and more applications are integrated into practice over a longer period of time.

The effect is that, for Lorenzo, there is less first-mover disadvantage compared with Millennium, but subsequent movers could suffer greater induced costs relative to those with Millennium. The net effect across a cohort of implementing sites is not currently known, as insufficient Trusts were in the 'early adopter' programme, and comparable implementation of Lorenzo (i.e. to completeness of functionality) has not yet occurred.

Timeline of up-front and recurring costs

The relative scale of start-up costs compared to recurring costs, and the associated duration and distribution of each, is still questionable. This is due to varying delays in implementation and consequent lack of available data: none of the systems, or their implementations, has reached a state of stable maturation. All data should therefore be considered to represent either start-up costs, or potential recurring costs – but not stable recurring costs.

Due to the observed differences between projected and actual start-up costs in the few Trusts with data, there is also no evidence that projected recurring costs could be used reliably – particularly with regard to evolving government policy around NPfIT contracts. This also applies to differences between start-up and running costs between different NHS CRS systems.

5.4.5 The Minimum Data Set (MDS)

One of the main outputs of this evaluation is the MDS (see Appendix 17), which we hope gives a useful steer to Trusts planning to implement the NHS CRS to ensure that they have a robust costing model. It can also be used as an evaluation tool to collect the minimum sufficient information (at hospital Trust level) to contribute to future cost-effectiveness and cost-benefit studies of IT.

We consider hospital Trusts to be multi-output producers: they utilise a wide range of resource at the same time to produce a wide range of outputs, but in a single joint process, rather than in parallel processes. As such, they employ a complex production process. This makes it difficult to isolate and quantify NHS CRS implementation costs in terms of induced costs in a post hoc evaluation. At the same time, the hidden nature of much of the resource use and pricing, through central contract with software suppliers, largely obscures much of the direct system costs. With this tool, we expect that the critical costs incurred during an EHR implementation, including system costs and many induced costs, can be collected.

With adequate trialling of technologies, residual induced costs such as productivity losses due to learning curves and differences in task completion time can also be collected.

The MDS was constructed in a completely secular manner, with respect to the NHS CRS solutions, and it's content validated for all NHS CRS systems, all implementation types (whether phased or 'big-bang') and hospital trust-types (NHS or Foundation; mental health Trusts, teaching etc.; and of varying sizes). For the purposes of a national roll-out of the NHS CRS, we believe that our mixed methods approach was desirable.

In terms of operational feasibility, however, there remains a question over the utility of the tool. In particular, the tool does not overcome the underlying complexity of the production process at hospital Trusts. Therefore, completing the tool in a hospital Trust while it is undergoing NHS CRS implementation is going to be time-consuming, and a technical challenge in itself. We also note that the MDS may be incomplete in measuring implementation costs, specifically opportunity costs of: (i) lost productivity through under-resourced training; and (ii) lost-productivity through learning. We are not aware of data that could practicably be included in the MDS to capture this; however complementary time/motion studies, for example, may be useful.

5.5 Policy implications and recommendations

Our evaluation identified and categorised the potential costs associated with the implementation of the NHS CRS amongst 'early adopter' hospital Trusts, as discussed in Section 5.4 of this report. We also believe that our evaluation has succeeded in detailing the complexities of decision making processes involved in hospital Trusts, and the contextual factors within those that affect the implementation costs of a comprehensive IT system. Any nationwide roll-out requires careful establishment of evaluation criteria beforehand. This has led to the operationalisation of our cost framework in a MDS. This MDS is an evaluation tool, generating the minimum sufficient information to allow Trust-level cost-effectiveness and cost-benefit studies to be undertaken alongside a nationwide roll-out of the NHS CRS.

We strongly recommend that prior to implementation of the NHS CRS nationally this MDS is embedded within the process. This will enable a robust evaluation of implementation costs, including direct, indirect and induced costs.

We also note that there is limited value to centrally-funded and mandated evaluation of any IT systems or their implementation, based upon incomplete information. It is, therefore,

essential that such data includes all data on costs – including commercial and other contracts. These data were not made available for this evaluation, which has limited the conclusions that we could draw.

5.6 Future research

Several previous systematic reviews have commented upon the complexity of the production process within the healthcare system.(19;151;164) However, broad health technology continues to be evaluated either as a technology with narrow reach, or as a technological change within a single-output producer. Our evaluation of the early adoption of the NHS CRS has shown that there is substantial scope for research that captures a system-wide perspective on costs. We believe that data can be generated during the process of implementation – on both benefits and costs – that generates sufficient information for a complex evaluation. Future research should focus on hospital sites where the technology is more embedded to establish the long-term recurring costs which were very difficult to ascertain in the timescale of our project.

The NHS CRS, within NPfIT, is the largest health IT/Informatics programme to have be attempted anywhere in the world. It is also the largest, purposive technological change imposed upon such a complex national system. It is therefore of critical importance that robust programme evaluation be performed. Our MDS is a tool by which the critical costs incurred during NHS CRS implementation can be collected. However, further important work is required to assess the acceptability, technical feasibility and validity of such a tool, as well as the completeness of the data it will provide, particularly with regard to opportunity costs, which are not routinely observable or measurable.

Finally, we believe that, due to the size and scale of the Programme, the process of implementation itself should be explored and used to contribute to evaluation processes and tools, including information sufficiency. This knowledge could also be invaluable to future policymakers and researchers.

5.7 Discussion

Our evaluation has established the cost framework: using microeconomic production models to identify domains of inputs that could be affected by a broad-reaching technological change within a hospital setting (e.g. EHR), followed by a pragmatic search for financial, planning and other resource-use documents from hospital Trusts in order to attempt to

specify inputs within those domains that were employed in implementation. This framework was operationalised in a MDS, which functions as an evaluation tool and generates the minimum sufficient information (at the level of the hospital Trust) to contribute to future robust cost-effectiveness and cost-benefit studies.

5.7.1 The cost framework

Key infrastructure variables were found to be: the degree of IT maturity within the Trust; the EHR products already on the market; the IT hardware budget at the Trust; the requirements by the Trust of the IT application; and the physical requirements of the operational space (e.g. wards, clinics). Infrastructure costs and personnel costs were found to be most substantial. The former were likely to be determined locally and reflect a range of hospital Trust characteristics: scale, level of penetration and current place in what was identified as an IT/hardware renewal cycle. Key personnel costs related to: data migration; testing; network; training and support. Two factors in particular impacted on training costs: the approach taken by trusts and the decisions made around whether or not to back-fill staff.

Key estates costs included IT equipment and space to accommodate activities within implementation, such as: project management, data migration, integration and testing, and training, as well as IT management and clinical/administrative support. Unlike some of the other costs, estates costs are more likely to be directly generated by scale. This means increasing in terms of the scale of the applications (i.e. increasing in complexity as more project management, data migration and other roles are needed) and increasing in the scale of the hospital (principally generating an increase in IT management, clinical and administrative support costs, reflecting a greater number of personnel and computers).

Although miscellaneous costs were generally broad (consumables and training material, for example), the most relevant identified by Trusts overlapped with other domains: servers for data migration and cleaning, interfacing, and rehearsal prior to go-live.

5.7.2 Endogenous cost-drivers

Some of the cost-driving decisions made by ‘early adopter’ Trusts were seen to be endogenous to aspects of the implementation itself, and therefore not representative of a national roll-out of the NHS CRS. The principal financial incentive was the DIF from the LSP. In one of the smaller Trusts, DIF money paid to the Trust was a deciding factor in early

adoption: without that capital, adoption of the NHS CRS would not have been feasible. In another Trust, we found that DIF money, even though it was larger in amount compared to the former example, had not been a factor in the implementation decision. However it was instrumental in the decision to back-fill staff, thereby taking an implementation strategy that would not otherwise have been considered. Therefore, this Trust's personnel costs were large, but also not reflective of their approach without the DIF.

Other incentives were driven by within-implementation pragmatism. Throughout, 'early adopters' enjoyed models of cost-sharing with NHS CFH, their SHA and the software providers. The proportions of these varied by Trust but, in general, Trusts incurred around 50% of the total implementation costs. However there were two exceptions to this: the first was when, during the period, some hospital Trusts became critical to central policy benchmarks on the NPfIT and the NHS CRS. At these times, substantially greater resources were assigned to those Trusts, thereby altering both progress and costs out of the otherwise generalisable framework. The second related to some trusts individually negotiating cost-shares out of the norm.

These factors suggest that both the pace and related cost of implementation were both greater than an autonomous trust might experience, even though the nature of the resources used and the costs incurred will be the same. Also, these Trusts did not have the chance to learn the valuable lessons from the implementations at other Trusts.

In 'early adopter' hospital Trusts for which costs were available, they followed a similar pattern in the periods before go-live: higher initial costs, lower costs and then escalating costs again leading into and during go-live. This reflects front-loading investment and project-initiation costs, with a levelling-off during training and product development and piloting. Go-live then involved site-wide staff at all levels, including project management.

This distribution in timing does not reflect running/ongoing costs of the NHS CRS itself, only the distribution of start-up costs leading up to activation of the NHS CRS on-site. In fact, one site articulated their position that start-up costs were still characterising their experiences, over two years post-go-live, as the system had still to be stabilised across the organisation. This distribution however is understandable and should be experienced elsewhere. Some variation in term of personnel costs will be experienced depending upon the decision made with respect to training (e.g. back-filling staff will likely generate steadily increasing personnel costs throughout).

A precise, proportional comparison of capital costs and labour costs was not available in our data. This largely reflected the lack of financial information, which was also a function of cost-sharing: central contracts (e.g. between NHS CFH and software providers) was commercial-in-confidence. So, too, were levels and prices of resources supplied to Trusts within these arrangements.

In general, however, Trusts all found that personnel costs exceeded capital costs by a substantial factor. However this was potentially an artefact of central contracts for NHS CRS licenses – which, being commercial-in-confidence, were not shared. This is a critical lack of data however, because it prevents extrapolation to a decentralised contracting environment: license costs can be substantial; moreover, NHS CRS product costs are not singular, but reflect the total functional add-ons associated. Therefore some Trusts will pay more than others if they (a) have more staff and/or (b) demand greater functionality; some Trusts will inevitably still purchase software as a monopsonist bloc while others will not, and enjoy lower costs.

The level and variation in these costs is not currently available. What information is available, through interviews and public information, suggests that contracts to providers may have been £36m per deployment in the South of England (covering licenses and deployment support). One interviewee estimated that an independent hospital Trusts purchasing NHS CRS software systems would on average pay £25-£30m, increasing to £50m for a large hospital Trust.

5.7.3 Contextual findings

Although NHS CRS early adoption is a single programme there were, inter alia, intersecting pressures within the Programme, and NPfIT, at the same time. First among these was political pressure applied to the DH and then, in turn, to NHS CFH and NPfIT, as well as software suppliers, to demonstrate progress on deployment of the NHS CRS after it had stalled. Reasons for the delay included: development of systems in situ; and withdrawal of vendors from NPfIT in the South of England. This led to ad hoc allocation of resources in a manner of response mode: this temporarily inflated resources in some Trusts (e.g. supplying extra staff), while also curtailing the resources to other Trusts at the same time. In our evaluation it was impossible to isolate these events (partly due to their dynamism; largely due to no data on central resource and decision-making) and separate their effects from the underlying experience of implementation costs at Trusts.

Three NHS CRS systems were included in this evaluation: Lorenzo, Millennium and RiO. However, during the evaluation different releases, with different functionality, were observed. This means that a given build of Millennium was not likely to be functionally equivalent to a contemporaneous build of Lorenzo or RiO. It also meant that two Trusts, each with Lorenzo but with different releases, cannot be compared directly – such is the impact of functionality on costs of implementation.

In a related way, we observed distinct differences between phased implementation and 'big-bang' implementation. However some critical characteristics of implementation type are important. First, there were not enough of either type to establish an average cost for one or the other. Secondly, a phased implementation (a) is not everywhere feasible (e.g. site-wide implementation of Millennium forces a 'big-bang' implementation) and (b) will not necessarily prevent a 'big-bang' (e.g. Lorenzo without iPM can be piloted and phased in; iPM is still a 'big-bang' implementation). Because 'early adopters' still have not completed site-wide implementation and stabilisation of the NHS CRS for all of the three client solutions, the overall costs also cannot be compared.

Our analysis identified gaps in the literature relating specifically to complex and contextual elements of broad EHR implementation in the healthcare settings. These gaps were also discussed as limiting factors in robust cost analysis of EHR implementation in hospitals, which are complex organisations with multiple, interlinked outputs. In response to this our cost framework was specifically developed in a flexible manner that initially was based upon relevant production theory, then expanded, completed and validated through repeated consultation with hospital Trusts and individuals at all available levels.

5.8 Conclusions

The MDS was identified as the minimum sufficient information for a robust analysis of implementation costs. With the MDS, site-level data on costs in each of the relevant fields can be collected prior to, during and following implementation, including identification of relevant benchmarks in the process. However, such data must be supplemented by information on costs contained within contracts which was not made available to us in this evaluation. This will facilitate cost-benefit and cost-effectiveness analysis of nationwide NHS CRS to be done. Since the NHS CRS is the largest and most complex EHR implementation of its kind in the world this will no doubt prove to be invaluable, both internationally and for future technological growth in England (and the UK), both in the public and private sectors.

Chapter 6: Availability of clinically important information in outpatient clinics

6.1 Introduction

Electronic health record systems have the potential to improve availability and accessibility to patient records. Missing information can, for example, potentially compromise the quality and safety of care and also introduce inefficiencies in care provision. The original aim of this work-package (WP) was to investigate whether the introduction of the NHS Care Records Service (NHS CRS) in England resulted in an improvement in availability of a variety of clinical records and clinical test results in secondary care settings. We hypothesised that the introduction of the NHS CRS would improve:

- Medicines reconciliation on admission to, and discharge from, hospital
- Availability of clinical records in outpatient settings
- Availability of clinical test results in secondary care outpatient and inpatient settings
- Discharge communication from secondary care.

In light of the substantial delays in the national roll-out of the NHS CRS in general and clinical functionality in particular, it became clear that it would not be possible to address all of the objectives because of the lack of opportunity to obtain “post-implementation” data. It was, therefore, decided to focus on studying the completeness of clinical information in outpatient settings as we had reason to believe that potential changes in response to the implementation of the NHS CRS would be observable within the timescale of this evaluation.

Research on the completeness of medical information in NHS outpatient settings is scarce. Limited information is based on surveys of hospital staff.(48;165;166) The first survey conducted by the Audit Commission involved 225 respondents from 40 hospital Trusts who reported major problems including difficulties in retrieving records for consultation, poor quality of record-keeping within the case-note folder and poor facilities for storage of records. At the time, only 75% of the Trusts surveyed met the 95% benchmark for availability of patients’ medical records at outpatient clinics as set by the Audit Commission.(165) Some improvement was seen in a follow up study in 1999 with an increase in the national average availability of medical records from 96.0% to 97.3% between 1995 and 1999.(48) A more recent study found that missing clinical information affected around 15% of surgical outpatient appointments (95% confidence interval (CI), 12.9, 17.1).(166) These findings are

not directly comparable with the Audit Commission study as a wider range of types of missing information was considered.

6.2 Aims and objectives

We aimed to investigate whether the introduction of the NHS CRS in England resulted in an improvement in availability of clinical records in secondary care settings.

More specifically, we sought to:

- Determine the proportion of outpatient encounters where there was at least one clinically important item of information missing i.e. information required by the clinician at the point of contact with the patient in clinic.
- Determine the frequency with which particular types of information needed by the clinician were missing.
- Determine whether the introduction of elements of the NHS CRS resulted in changes in the proportion of outpatient encounters where clinically important information was missing.
- Identify the contextual background of these findings.

6.3 Methods

6.3.1 Design

We employed a combination of quantitative and qualitative approaches in this WP. We first undertook a cross-sectional study in which we measured the completeness of medical records in outpatient departments in four NHS Trusts prior to the introduction of the NHS CRS and then followed this with a controlled before-and-after study of the completeness of outpatient medical records following the introduction of elements of the NHS CRS in one NHS Trust when compared with a matched control Trust. We in addition undertook a concurrent qualitative study including observations and interviews to support the interpretation of quantitative data (see Appendices 18-20 for information sheets and topic guides).

6.3.2 Setting

Data were collected from NHS sites in England that were working towards implementation of the NHS CRS.

6.3.3 Sample

Recruitment

Members of our research team assigned to the various recruited sites (see Chapter 3) asked senior NHS management if they were willing to participate in this aspect of the evaluation of their outpatient departments. All the sites approached were intending to “go-live” with some elements of the NHS CRS during the timeframe of the evaluation.

We aimed to recruit a broad distribution of sites from different areas of the country, and of the six participating sites approached, four agreed to take part in this out-patient evaluation. All four of these sites participated in the cross-sectional evaluation to assess the frequency of missing data in out-patients clinics.

For the controlled before-and-after study, one Trust implementing an element of the NHS CRS within the timeframe of the study was selected as the intervention site. This implementation had potential to impact on the outpatient department as it replaced iPM with the Lorenzo Patient Administration System (PAS). The elements of this software included:

- Referrals
- Access planning
- Patient Identity
- Personal Demographics Service (PDS)
- Outpatients
- Caseload Management
- On-Link linkage to Picture Archiving and Communication System (PACS) Images
- Interaction with Choose and Book.

One Trust with similar baseline levels of incomplete data in the outpatient department was used as a control.

6.3.4 Data collection

Design and pilot

We developed a questionnaire based on observations and consultations with Healthcare Professionals at a London Teaching Hospital in June 2009 and it was re-piloted later with seven consultants for 133 consultation events at a District General hospital from July to September 2009 (see Appendix 20).

Data collection process

Senior managers at participating sites were provided with information about the outpatient evaluation. Later, meetings were scheduled (if requested) to discuss this aspect of the study in greater detail. The data collection form was designed to make it quick and easy for participants to complete in busy outpatient clinics. Participants were asked to tick the various response options on the form depending on whether clinically relevant information was missing or not. A definition of the terms used in the questionnaire is shown in Table 6.1.

Section	**Examples**
Medical Case Notes	Clinically important medical records
Referral Letter	New patient generated letter via Choose & Book or direct from the GP
Imaging results	X-rays, MRI, etc
Monitoring results	24 hour blood pressure / heart monitoring, etc
Lab results	Blood results, etc
Reports	ECG, rehabilitation notes, etc
Addressograph labels	labels to send off for diagnostics
Other	Operation notes; last clinic notes; letters to GP; history information, etc

Table 6.1: Description of the items described on the data collection form

Data collection took place in the outpatient departments of the participating Trusts between May 2010 and December 2010. If a Trust had more than one hospital site, then the main (adult) outpatient departments were selected.

Clinicians were asked to fill in one questionnaire per patient in each clinic. Data collection took place mainly during morning and afternoon clinics along with an occasional evening clinic. Prior to data collection, the purpose of the study was explained to the clinicians and details provided on what they needed to do. The researcher was available to deal with any questions about the study from the clinicians and members of clinic staff.

Before data collection commenced at each clinic, the researcher noted the clinician in charge, the type of clinic (e.g. urology) and the number of patients expected to attend. Each clinician was given a number of questionnaires equalling the number of patients expected to

attend. Throughout each clinic session the researcher remained close at hand to answer any queries that arose, checking on how the forms were being filled in, providing more forms if extra patients had been added to the clinic as well as observing the processes and activities taking place.

At the end of each clinic the questionnaires were collected and staff asked if any problems had arisen in completing the forms. The total number of questionnaires handed out and returned at every clinic was recorded by the researcher.

For the qualitative study during the data collection process the researcher remained in the outpatient departments making observational notes. At each site, staff were asked if they could be interviewed. Those interviewed included managers of medical records libraries and the outpatient departments, clinicians in the outpatients department and other relevant staff when necessary. The interviews were digitally recorded and the staff received an undertaking of anonymity. The aim of the qualitative study was to explore issues relating the completeness of information in outpatient clinics and the potential impact of implementation of the NHS CRS.

The researcher was informed that the staff in Site X were too busy to fill in a form for every patient; it was therefore agreed that they would fill in the questionnaires when clinically important information was missing and would report on the number of encounters where either there was no missing information or staff had not had time to check. This process was monitored regularly by the researcher throughout the clinic and at the end of the clinic the results were re-checked with the staff.

Data processing

The first step in this process was to input all the data collected into a specifically designed Microsoft Access database which mimicked the form for ease of entry. Each item of inputted data was then checked for accuracy by referring to the original data collection forms. Very few errors were detected and these were all corrected.

The database was then transferred to a Microsoft Excel spreadsheet where the data were anonymised, then exported to STATA Version 10 for further analysis and finally to a PROC GLIMMIX within SAS®.

The interviews were transcribed, anonymised and uploaded on to NVivo8 for further analysis.

6.3.5 Data analysis

The main outcome variable in this study was the proportion of patients with at least one piece of clinically relevant information missing. The frequencies and percentages of this variable were calculated before and after implementation of elements of the NHS CRS. In addition, frequencies and percentages were calculated for specific missing items. These included referral letters, images, monitoring information, laboratory results, addressograph labels, medical notes and other unspecified information. Results were reported for each site and for the entire dataset.

In addition, for those records with clinically relevant information missing, it was established whether information was obtained during the course of the clinic, and whether this caused a delay. The median delay (and inter-quartile range and maximum) due to missing information was calculated. Also, the proportion of patients who required further investigations or another clinic appointment was also calculated if this information was available.

We have provided 95%CI for the percentages of outpatient encounters with missing data. For the cross-sectional study, these are presented for each of the four Trusts. For the two Trusts included in the controlled before-and-after study, the ratio of the odds (OR) of missing data in the two periods have been calculated together with their corresponding 95% CI. Finally, the ratio of these ORs for the intervention and control Trusts have been calculated with 95% CI. As there are differences between clinics within Trusts in the percentages of outpatient encounters with missing data, standard statistical methods based on assumptions of independence of the observations are not valid. Instead, generalised linear mixed models have been fitted using a logit link, with clinics within Trusts fitted as random effects. In the cross-sectional analysis, the method has been used to provide an appropriate inflation in the standard errors, with the CIs centred on the observed proportions. In the before-and-after study sites, periods and their interaction were fitted as fixed effects, together with type of clinic. Analysis was performed using PROC GLIMMIX within SAS®.

Observations and interviews undertaken in outpatient clinics and medical records departments are in the process of being analysed qualitatively. Detailed findings from these will be reported in due course. For this report, we have drawn upon emerging findings insofar as they help to explain the main results of our quantitative analysis.

Sample size considerations

Conventional sample size calculations to achieve pre-determined power to detect changes, either within a site or between intervention and control sites, could not be calculated as there was no information on the extent of between-clinic variation within site, or variation between sites. In practice, the sample sizes were determined by practical consideration of which sites were available for study and the available resources for the surveys. As many clinics within a site as was logistically possible were sampled to minimise the effect of between clinic variation on the precision of the error rate for a site.

6.4 Results

6.4.1 Cross-sectional study of four sites

Table 6.2 shows details of the sites that participated in this study. There was a wide geographical spread of Trusts although three sites were from the North, Midlands and Eastern (NME) cluster and one from the Southern cluster. The sample included smaller district general hospitals and larger urban Trusts. Some were single sites, whilst others had multiple sites although only large outpatient departments were surveyed in each Trust.

A range of outpatient departments at these sites covering many aspects of care including general medicine, general surgery, obstetrics & gynaecology and orthopaedics, were evaluated. A large number of clinicians were involved in the study. The researcher was based in each of the outpatient departments for a period of between three to nine days.

In the evaluation, a total of 2,897 forms were given out to 150 clinics throughout the four Trusts. Of these, 2,537 forms were returned giving an average response rate of 86%.

Site	L	C	X	B
Number of hospitals surveyed at each site	3	2	1	3
Cluster	South	NME	NME	NME
Approx number of beds	700-800	1000-1100	300-400	1000-1100
Number of clinics selected	50	21	39	40
Number of separate types of clinics	22	11	14	17
Clinicians	45	9	36	32
Number of forms given out	758	494	793	852
Number of forms returned	669	441	619	808
Response rate	88.3%	89.3%	78. 1%	94.8%

Table 6.2: Details of the Trusts that participated in the study

Table 6.3 shows the overall proportion of outpatient encounters with at least one item of clinically important information missing. This varied from 7.9% at Site C to 17.6% at Site B. There were instances where more than one item was missing with some patient encounters.

Site	L	C	X	B	Total
Total number of forms collected	669	441	619	808	2537
N (%) with at least one clinically important item of information missing	77 (11.5%)	35 (7.9%)	94 (15.2%)	142 (17.6%)	348 (13.7%)

Table 6.3: Proportion of outpatient encounters with at least one item of clinically important missing information from the cross-sectional study

Table 6.4 shows a breakdown of the types of missing records in outpatient encounters. The most common items not available were:

- Medical notes
- Addressograph labels
- Lab results
- Referrals
- Image results.

Each site had different patterns of types of missing information. For example, there was a relatively high proportion of missing medical notes in Site B (5.2% of all outpatient encounters), and Site L compared favourably with the others having only 0.5% missing medical notes. Site L had the highest proportion of missing image results (4.2%).

Site B had the largest proportion missing labels (3.5%) and Site C had the lowest (0.5%). For the category of 'other items missing' (see Table 6.1), Sites L and C clearly had lower proportions of missing information than the other two sites.

Across all the sites, the proportion of missing monitoring results was less than one in 100 outpatient encounters.

Site	L	C	X	B	Total
N (%) with at least one clinically important item of information missing	77 (11.5%)	35 (7.9%)	94 (15.2%)	142 (17.6%)	348 (13.7%)
N (%) medical notes missing	3 (0.5%)	6 (1.4%)	17 (2.8%)	42 (5.2%)	68 (2.7%)
N (%) with Addressograph labels missing	18 (2.7%)	2 (0.5%)	13 (2.1%)	28 (3.5%)	61 (2.4%)
N (%) with laboratory results missing	14 (2.1%)	16 (3.6%)	13 (2.1%)	15 (1.7%)	58 (2.3%)
N (%) with referral letters missing	15 (2.2%)	3 (0.7%)	20 (3.2%)	11 (1.4%)	49 (1.9%)
N (%) with images missing	28 (4.2%)	4 (1.0%)	7 (1.1%)	8 (1.0%)	47 (1.9%)
N (%) with reports missing	9 (1.4%)	4 (0.9%)	6 (1.0%)	12 (1.5%)	31 (1.2%)
N (%) with monitoring results missing	6 (0.9%)	0 (0.0%)	4 (0.7%)	6 (0.7%)	16 (0.6%)
N (%) with other items missing	6 (0.9%)	2 (0.5%)	28 (4.5%)	36 (4.7%)	72 (2.8%)

Table 6.4: Breakdown of types of missing information in outpatient encounters

Table 6.5 shows that, overall, in nearly a third of the cases where there was missing information this caused delays for the patient in clinic.

Site	L	C	X	B	Total
Did not cause a delay	50 (65.0%)	20 (57.1%)	81 (86.2%)	86 (60.6%)	237 (68.1%)
Did cause a delay (95% confidence limits)	27 (35.1%) (19.4, 54.7)	15 (42.9%) (24.9, 62.9)	13 (13.9%) (4.6, 35.0)	56 (39.4%) (21.0, 61.4)	111 (31.9%) (22.8, 42.6)
Did cause a delay as a proportion of all patients (95% confidence limits)	(4.0%) (2.4, 6.8)	(3.4%) (1.7, 6.7)	(2.1%) (1.0, 4.6)	(6.9%) (3.2, 14.3)	(4.4%) (3.1, 6.1)

Table 6.5: Whether delays were caused by information being missing

The overall percentage of patient encounters with missing information that caused a delay to the appointment is 4.4%. From Table 6.6, it can be seen that the median delay was 10 minutes, although the longest time a patient spent waiting was nearly three hours.

Site	Median	IQR	Maximum minutes delay
L	10	15	45
C	5	8	15
X	10	32.5	90
B	10	10	150
All Trusts combined	10	10	150

Table 6.6: Length of delay for outpatients with clinically important missing information

If an item of information was missing then doctors had an option to order further investigations. Table 6.7 shows that this appeared to be done very rarely (overall, only 1.7% of encounters with missing information).

Site	L	C	X	B	Total
Did not require further investigation	75 (97.4%)	35 (100%)	92 (97.9%)	140 (98.6%)	342 (98.3%)
Did require further investigation	2 (2.6%)	0 (0.0%)	2 (2.3%)	2 (2.1%)	6 (1.7%)
Did require further investigation - proportion of all patients	(0.3%)	(0.0%)	(0.3%)	(0.3%)	(0.2%)

Table 6.7: Whether further investigations were carried out as a result of information being missing

Table 6.8 shows that overall around one patient in 50 required a repeat consultation to be arranged specifically as a result of information being missing.

Site	L	C	X	B	Total
Did not require a repeat consultation	75 (97.4%)	33 (94.3%)	190 (98.5%)	357 (97.8%)	655 (97.7%)
Did require a repeat consultation	2 (2.6%)	2 (5.7%)	3 (1.5%)	8 (2.2)	15 (2.3%)
Did require a repeat consultation – proportion of all patients	(0.3%)	(0.5%)	(0.3%)	(0.3%)	(0.3%)

Table 6.8: Whether another consultation had to be arranged as a result of missing information

Possible reasons why repeat investigations and repeat consultations were not done as a result of information being missing included:

- The clinician felt that the clinic appointment could continue safely without the missing information
- The information was found during the course of the clinic
- A request for further investigations was not marked down by the staff on the data collection form.

6.4.2 Controlled before-and-after study

Site B implemented some elements of the NHS CRS between the time of baseline (cross-sectional) data collection and the follow-up data collection. A control Trust (Site X) was chosen as it had a similar proportion of missing items from the cross-sectional study to that of Site B (intervention).

Follow-up data collection was undertaken at Site B seven months after baseline data collection and four months after the implementation had taken place. A second visit was also undertaken at Site X, six months after the original data collection. At both Trusts, data were collected from similar outpatient clinics at baseline and follow-up.

Table 6.9 compares the second evaluation with the first and it shows that Site B, after the implementation of elements of the NHS CRS, showed no overall change in the percentage of missing items. In contrast, at Site X there was a small reduction in missing items from 15.2% to 11.0%.

Site	B Time 1 Before implementation	B Time 2 After Implementation	Odds Ratio (95% confidence interval)	X Time 1 Control	X Time 2 Control	Odds Ratio (95% confidence interval)	Ratio of ORs (95% confidence intervals)
Total number of forms given out	852	1413		793	1027		
Total number of data forms collected	808	1240		619	907		
Response % rate	94.8%	87.8%		78.1%	88.3%		
N (%) of at least one item of clinically important information missing (95% CI)	142 (17.6%) (12.7%, 23.8%)	223 (18.0%) (15.0%, 21.2%)	0.99 (0.76, 1.29)	94 (15.2%) (10.6%, 21.3%)	99 (10.9%) (8.2%, 14.3%)	1.38 (0.99, 1.91)	0.72 (0.47, 1.10)

Table 6.9: Response rate and proportions of outpatient encounters with clinically important missing information in the controlled before and after study

Table 6.10 provides a comparison of the breakdown of missing items at the baseline and follow-up data collections in the two Trusts. Following implementation of elements of the NHS CRS, Site B had an increase in some areas of missing information. In particular, there was a marked increase in the percentage of missing medical notes from 5.2% to 10.4%, though there was also an increase in Site X. Site B also had substantial increases in the percentage of missing addressograph labels and in the percentage with referral letters missing, while Site X experienced a corresponding decrease (P=0.005 in both cases). There was little change in some of the other types of information missing but the observed relative change was worse for Site B for all variables except missing laboratory reports.

Site	Site B, Time 1 Pre-implementation (n=808)	Site B, Time 2 Post-implementation (n=1240)	Site X Time 1 Control (n=619)	Site X Time 2 Control (n=907)	Ratio of ORs (95% CIs)
Number (%) of outpatient encounters with missing information	142 (17.6%)	223 (18.0%)	94 (15.2%)	99 (11.0%)	0.72 (0.47, 1.10)
N (%) with medical notes missing	42 (5.2%)	129 (10.4%)	17 (2.8%)	43 (4.7%)	0.87 (0.43, 1.77)
N (%) with Addressograph labels missing	28 (3.5%)	55 (4.4%)	13 (2.1%)	5 (0.5%)	0.18 (0.05, 0.59)
N (%) with referral letters missing	11 (1.4%)	33 (2.7%)	20 (3.2%)	16 (1.8%)	0.24 (0.09, 0.65)
N (%) with lab results missing	15 (1.7%)	16 (1.3%)	13 (2.1%)	15 (1.7%)	1.26 (0.42, 3.81)
N (%) with reports missing	12 (1.5%)	15 (1.2%)	6 (1.0%)	3 (0.3%)	0.42 (0.08, 2.20)
N (%) with images missing	8 (1.0%)	13 (1.1%)	7 (1.1%)	1 (.1%)	0.10 (0.01, 1.00)
N (%) with monitoring results missing	6 (0.7%)	9 (0.7%)	4 (0.7%)	2 (0.2%)	0.33 (0.04, 2.61)
N (%) with other items missing	36 (4.7%)	31 (2.5%)	28 (4.5%)	12 (1.3%)	0.76 (0.30, 1.92)

Table 6.10: Breakdown of types of missing information in outpatient encounters in Sites B and X

6.4.3 Emerging findings from the qualitative analysis

Our initial analysis of the qualitative data has identified a number of factors that might explain the findings from our quantitative analysis.

Box 6.1 below highlights the factors that appeared to be associated with the variations found in completeness of clinically important information in hospital outpatient encounters,

Factors associated with high levels of completeness of information	Factors associated with low levels of completeness of information
Electronic case note tracking system used by the majority of hospital staff.	Paper tracking system for the medical notes, not adhered to by all staff
Well-resourced medical records library with potential space for future growth.	Medical records library housed in accommodation too small to meet the current and future needs of the service.
Regular renewal of the folders for the notes; being tougher and stronger than the older buff covers.	Poor quality, shabby folders for paper notes, held together by elastic bands – leading to paper results etc falling out of them.
Preparing the notes for clinic up to seven days in advance of clinics.	Preparing the notes for clinic two days or less in advance of clinics.
Frequent and flexible transportation of medical notes to clinics in other sites.	Lack of a flexible transportation system to send medical notes to offsite outpatient departments
Priority that notes are quickly returned to the medical library.	Medical notes left in wards and offices awaiting discharge summaries etc.

Box 6.1: Factors that appeared to be associated with relatively high and relatively low levels of completeness of information

In terms of the controlled before-and-after study, Site B experienced a number of problems that may have limited any overall improvements in completeness of information for hospital outpatient encounters following implementation of elements of the NHS CRS. Table 6.10 shows that there was a doubling in the proportion of missing medical notes between the baseline and follow-up data collections. Our observations and interviews revealed how problems associated with NHS CRS implementation put an enormous strain on the site's already stretched medical records department and created greater difficulties in finding medical notes for clinics. One illustration of why this happened was that the new system frequently created new clinics that did not exist or doubled the numbers of patients that were supposed to be attending a clinic. Medical records were also collected in advance for these 'clinics', only to be returned and re-filed again, once it became clear that no doctors were available to take the clinic. Patients also needed to be informed of the cancellation to their appointments and provided with new ones. All this added significantly to the workload for records staff and limited their ability to obtain complete information for real clinics.

In contrast, Site X happened to make improvements to its paper systems in between the times of baseline and follow-up data collection. The outpatient staff had set up a system to coordinate the delivery of referral letters, GP letters and other important clinic information to a room in outpatients where it was stored in clinic order before being put in the patients' notes. This may explain the apparent lower levels of missing data at the follow-up data collection.

6.5 Discussion

6.5.1 Key findings

From the initial cross-sectional survey all sites had a proportion of items missing in their outpatient departments but this varied across the different Trusts. The main items missing were the medical notes, labels, laboratory results and referral letters.

The key finding from the controlled before-and-after study was that, in the site that implemented elements of the NHS CRS, there were no improvements in availability of clinically important information in outpatient encounters and for some items the change in availability was significantly worse than in the control area.

6.5.2 Discussion of findings

How sites manage and fund their outpatients departments and their medical records libraries could be a contributing factor when examining the proportion of clinically important items missing in outpatient clinics. For example, our observations and interviews revealed that Site L has an efficient, well-resourced computerised medical records department with an electronic case note tracking system, which was able to trace all paper medical notes across the site. It also worked closely with the outpatient departments on the different sites. This did not prevent some of these items being missing but the numbers of missing notes were significantly less than at other sites.

In Site B there was no electronic tracking case note system and instead they depended on a paper system that was not adhered to by all staff. Also, the medical records libraries were too small for the number of records they housed. The rural area they served provided challenges as there were five sites up to 50 miles apart and inter-site deliveries took place only a few times a day.

As a result of missing information 1 in 50 patients required a repeat consultation. Whilst these numbers are not great this would still create frustration both for patients and staff alike and generate additional demands on a tight Trust budget when several thousand patients are seen in the outpatients department each year.

We were surprised initially to find that there were problems with missing imaging reports (particularly in Site L) where a Picture Archiving and Communications System (PACS) was available. However, our observations and interviews suggest that:

- Many clinicians did not like accessing computers in their clinic and depended on reports being available in the paper notes or expected the nurses to print them out
- The outpatient staff had access to only a limited number of systems and only a few had access to PACS.

Our observations and interviews showed that there were significant disruptions following the implementation of elements of the NHS CRS in Site B, and that these almost certainly had a major role in preventing any improvement in the availability of clinically important information in outpatient encounters. Nevertheless, while there was a worsening in availability of medical records, and some hardware and accessibility problems in the clinics, it was interesting that those items that showed a slight improvement in availability were often due to the computers being used rather than the paper results being available. It is possible that this represents a small improvement resulting from the implementation of the NHS CRS and that there will be further improvements as the system beds in.

6.5.3 Strengths and limitations of this work

We conducted a large cross-sectional study of four NHS Trusts thus providing up-to-date information on the prevalence of clinically important missing information in hospital outpatient clinics. We obtained data on a high proportion (86%) of outpatient encounters, and were able to produce a breakdown of the different types of clinically important missing information. Our analysis of observations and interviews (undertaken concurrently with the quantitative data collection process) enabled us to provide possible explanations for some of the quantitative findings.

Nevertheless, there were some limitations to our study:

- Although six sites were approached to take part in the study, a wider selection might have provided a more generalisable sample for the cross-sectional study

- The four sites that agreed to take part in the study came from only two of the three clusters, and there were no sites from London; the small number of sites involved means that our findings may not be generalisable to the rest of the NHS
- Implementation of elements of the NHS CRS took place in only one site and the lack of benefits seen may have been unique to that site or related to the collection of follow-up data soon after the implementation.

6.5.4 Comparison of our findings with those from previous studies

As noted above, there have been few previous studies of availability of clinically important information in hospital outpatient attendances. Our results showed that clinically important information was missing in a median of 13.7% of outpatient encounters, a similar proportion to that found in a recent study of NHS surgical outpatients,(166) and in a US study of primary care attendances.(167) We have not found any published data on the frequency with which different types of information are missing in hospital outpatient attendances.

6.5.5 Implications of the findings

Having the right information for the right patient in the right clinic is crucial to providing high quality patient care. This study has shown deficiencies in the availability of clinically important information in hospital outpatient clinics. While the generalisability of our findings may be limited, it is likely that clinically important missing information is an important problem in NHS Trusts across England, and one that could be improved with better systems for information storage and retrieval.

While we were able to study the potential impact of the implementation of elements of the NHS CRS in just one site, the findings may be relevant to other Trusts. Wherever possible, potential implementation problems need to be identified in advance with staff being trained to deal with these. Also, in order to deal with any unexpected problems it is important to make sure that extra human resources are available, particularly for medical records departments.

The methods we have used in our study are straightforward and could be used in future studies. They could also be used for the purposes of audit in Trusts implementing new information systems that may have an impact on completeness of information available in hospital outpatient encounters.

6.6 Conclusions

The cross-sectional study of four NHS sites showed that at least one piece of clinical information was missing in around one in seven outpatient encounters; there were apparent differences in availability of information between Trusts.

The controlled before-and-after study showed no evidence of short-term improvement in the availability of clinically important information for hospital outpatient encounters in the one site that implemented elements of the NHS CRS.

Chapter 7: Wider contextual considerations and suggestions for future deployments

7.1 Introduction

This chapter builds on and broadens the discussion of findings introduced in Chapters 4-6. Our final work-package (WP6) was originally envisaged as having no substantial empirical element, rather focusing on integrating the main findings of the research and thereby forming the summative element of our evaluation. However, as our research progressed, this aspect of our evaluation has developed to become an empirical WP in its own right. This is because we had a number of opportunities to gather relevant data relating to the complex contextual circumstances of deployment of the NHS Care Records Service (NHS CRS) from various stakeholders that were not directly linked to case study sites. This has, amongst other things, helped us to gain insights into the various interests of different groups (which need to be aligned (this does not necessarily mean that stakeholders have to agree) to provide a workable solution) and an appreciation of how this might best be achieved.(96;168-170)

7.2 Aims and objectives

We aimed to gain an understanding of the wider context surrounding the implementation and adoption of the NHS CRS and to draw on these to make recommendations for future deployments.

We sought to:

- Integrate the findings from the previous five WPs with the wider macro context of deployments
- Identify wider contextual barriers and drivers for diffusion of the NHS CRS and that have shaped the implementation process
- Relate findings from earlier WPs to the evolving overall objectives of the NHS CRS and, more generally, to the National Programme for IT (NPfIT)
- Draw conclusions in relation to governance and communications strategies relating to implementations of this scale and complexity
- Make suggestions for future deployments.

7.3 Methods

Data were gathered from a range of complementary sources throughout the evaluation period. These included formal and informal conversations with key stakeholders from case study sites (which in part have been covered in Chapter 4), minutes from regular meetings and discussions with a number of senior personnel in NHS Connecting for Health (NHS CFH), discussions in our Independent Project Steering Committee and Project Advisory Board, additional interviews with other stakeholders (e.g. fellow academics, developers, policy makers, Local Service Providers (LSPs), Strategic Health Authorities (SHAs) and independent sector representatives) throughout the evaluation period, and researchers' notes from national and international conferences. We have also studied key wider policy documents, followed press statements throughout the evaluation period and together with colleagues on a related NHS Connecting for Health Evaluation Programme (NHS CFHEP) supported grant, arranged an international conference on the implementation and adoption of electronic health record (EHR) systems, drawing on experiences from other relevant stakeholders (please refer to Appendix 21 for details).

The focus of this part of the evaluation was to gain an insight into the various dependencies between different stakeholder groups and developments, their interests, potential ways forward, and lessons learned. We analysed data in the light of emerging case study findings in order to provide a rich contextual picture of the landscape outwith the immediate environment of implementation (the macro-dimension) that was found to play a more central part in influencing local implementation than we originally envisaged.(20) The following sections will explore selected emerging themes in more detail.

7.4 Main findings

A variety of themes emerged from our research. We summarise these in Box 7.1 below and consider selected examples in more detail below.

Changing political and economic landscape

Uncertainty in relation to future direction

Changes in strategic direction

Parliamentary reviews

Budget savings

Contract re-negotiations

Economic recession

Curtailment of some centrally funded NHS CRS functionality

New coalition government

Re-structuring of the NHS

Termination of LSP contracts

Changes to central leadership structures

National leadership versus local ownership

Eroding integrated approach to communication in the organisation

Decline in strategic national leadership

Merger with the Department of Health's (DH) Informatics Directorate

Perceived "secrecy" in the organisation

Ongoing concerns about security and confidentiality

Concerns relating to security and confidentiality

Access rights of locally stored data and its implications for workflows

Potential security risks of centrally stored data

Media portrayal and impact

Public debate of problems with the Programme and its influence on public attitudes

Potential impact on reputations

Political pressures amplified by the media

Contractual tensions

Contractual re-negotiations over time

Lack of Trusts' autonomy in decision making in relation to implementation strategy and software design

Contract focused too much on delivery as opposed to benefits

Tight delivery deadlines

Perceived lack of contact between developers and Trusts

Secrecy surrounding contracts due to commercial interests results in lack of sharing lessons

Seeing a return on investment

National focus on benefits realisation versus "a lack of clarity on where the biggest benefits of the Lorenzo deployment can be expected"

Long-term future benefits versus immediate benefits

Harder benefits versus softer benefits

Suggestions for the future

Realistic standards for interoperability of systems

To what extent should software solutions be built or designed?

Innovate solutions for healthcare delivery problems; use software solutions only if necessary

Showing progress versus incremental approach

Learning lessons from successful international approaches to EHR implementations

Box 7.1: Main themes emerging from our research relating to wider contextual issues

7.4.1 The changing political and economic landscape

Since the conception of the Programme – over a decade ago – it has been characterised by many changes, not only in relation to strategy, but also by changes in central leadership and, more recently, a reduction in funding in the light of an economic recession.

As a result of the bleak economic climate,(12) centrally funded resources have been increasingly withdrawn and the more advanced functionalities of centrally procured software systems have been excluded from contracts in order to save money. These financial concerns came, as discussed in the opening chapter, on top of the previous problems relating to contractual negotiations which resulted in two LSPs leaving the Programme early and contributed to publicly announced plans of the then opposition parties to 'abandon' the Programme.(12)

Following the formation of the new coalition government in May 2010, a new strategic direction has been mapped out for the NHS. Major re-structuring of the NHS will now take place, this including the abolishment of SHAs and PCTs, placing the responsibility of commissioning local services on GPs, and increasing the number of Trusts with Foundation status.(12)

More specifically, the Programme has been subject to reviews by a variety of governmental, quasi-governmental and independent bodies.(15;91;171-179) Changes have in the main centred on the role of NHS CFH, the scaling back of contracts, increased local input in systems choice, and ongoing concerns surrounding confidentiality and security arrangements. These will be discussed in more detail in turn.

7.4.2 Changes to central leadership structures

Central leadership of the Programme, until recently designated responsibility of NHS CFH, has over time somewhat lost momentum as NHS CFH has been "subsumed" under the DH)'s Informatics Directorate. This lack of clear leadership contributed to the uncertainty about the future of the Programme expressed by many of our interviewees, for example.

"Well I think the jury's really out on it, the, it's interesting that the minister who's now got responsibility for NHS IT is new to the health field or at least, this is Simon Burns, rather he was in health earlier in his career but as I understand has had no, you know, involvement for some years. So to some extent the politicians who are quite vocal in this area such as Steven O'Brian the Conservative MP he's now gone off to, he's a minister in international development and Norman Lamb who was the Lib Dem health spokesman he's I believe the main policy advisor to Nick Clegg so it's some new faces so what is the new government going to do, I think we wait to see" (Interview, Independent Sector).

This has been exacerbated by the frequent changes in top-level management in NHS CFH, which many felt resulted in a lack of coherent strategy and direction "*with the left hand not knowing what the right hand is doing*" (Interview, IT Manager, Site H).

The secrecy surrounding the future strategy and difficulty obtaining information in relation to this not only characterised accounts of stakeholders participating in our project, but also at times rendered it difficult for us to undertake our evaluation.

Over time, NHS CFH made efforts to increase local leadership whilst at the same time maintaining overall responsibility for implementation activities. This resulted in somewhat variable results. The creation of the National Local Ownership Programme (NLOP) (see Chapter 1) exemplifies this as it was set-up to achieve two seemingly opposing aims, namely, the sharing of resources locally through central guidance whilst at the same time empowering local health communities by allowing more input into implementation activities. Stakeholders tended to question whether these differing aims could in fact be aligned, expressed through the paradoxical name of "national-local", which was perceived as an oxymoron by many.(169) "National" here referred to central leadership, which was still present although it was to some extent devolved from NHS CFH to local SHAs. However, individual Trusts still had no input into decision making as they were under the leadership of the SHAs (so the "local" was not really achieved). As a result, some Trusts that were part of the NLOP arrangement felt "pushed into" NLOP, believing that they had not enough time to

consider implementation options and to make their own decisions as to how their local projects were managed and by whom.

"Even though we're now at the local level perhaps it still feels to the acute Trusts like it's being pushed at them which I think why, you know, why there is this sort of resistance and a bit of resentment there, you know, and a bit of, causing a bit of difficulty in actually progressing" (Interview, IT Manager, Site H).

Nevertheless, the reasoning behind the pooling of resources seemed to be understood as many argued that expertise in particular needed to be shared locally to benefit from economies of scale.

Altogether, it seems difficult to find a balance between national leadership and local input as there are trade-offs in both directions. Focusing on national leadership can help with achieving economies of scale, but local organisations may lack input in decision making and are likely to resist. If, on the other hand, one focuses too narrowly on local organisations, then economies of scale are likely to be compromised. NLOP therefore seems to be a touchstone of key questions relating to leadership and devolution related issues encountered throughout the Programme.

7.4.3 Ongoing concerns about security and confidentiality

Despite the acknowledgement that there were significant security issues surrounding paper records, there were ongoing concerns amongst many stakeholders surrounding security and confidentiality arrangements of the NHS CRS, perhaps reflecting similar issues in other governmental sectors as a result of large scale information sharing made possible through Information Technology (IT).(180) There were also concerns expressed surrounding illegitimate access to nationally or locally held personal data, this being exacerbated by worries about the difficulties/inability of patients to opt-out of data sharing arrangements. As one headline reads:(181)

"The implied consent model for the Summary Care Record (SCR) looks set to be scrapped in favour of a simpler consent model following a recommendation from Connecting for Health's advisory group. Implied consent looks likely to be replaced by a model based on 'consent to view', providing a simpler more intuitive way for patients to decide who accesses their record."

Locally, these issues seemed to be the subject of immediate concern, as national arrangements for storing and sharing detailed clinical data were still in their infancy during our research. Discussions locally centred on balancing security and confidentiality with the complex day-to-day service demands and needs of the NHS. On the one hand, security measures such as Role-Based Access Care (RBAC) (see Chapter 4) arrangements were viewed as necessary in order to protect confidentiality, whilst on the other hand some of these arrangements were felt to complicate the implementation and adoption of the NHS CRS as they could often not be worked out in advance and their impact on organisational functioning was therefore difficult to predict. These issues therefore often turned out to be far more complex than originally anticipated. For example, local stakeholders were not clear as to what information would be accessible by whom and with whose consent. In relation to RBAC, for example, there were several suggestions on ways to address these issues emerging from our discussions with NHS CFH and speakers at conferences, which were somewhat based on opposing assumptions in relation to the number of roles balancing access rights with protecting confidentiality. Firstly, it was suggested that organisations could make work group structures as granular as possible, including a hierarchy of access rights. When mapping individuals to workgroups, they could thus initially be assigned to have higher levels of access, which could then be amended gradually once the organisation was confident that workgroup structure was correct. A second approach suggested was to keep the number of potential roles as low as possible, which of course may compromise confidentiality and security, but would mean that access to records would be facilitated resulting in less disruption to the workflow of users.

Nationally, stakeholders tended to be concerned about future arrangements, expressing little enthusiasm for ‘feeding’ national data systems. Here, the main perceived issues were surrounding the risk of cyber attacks, national and international misuse of data held on these records, the general ability of the electronic grid to cope with increasing demands for electricity resulting from these developments, and the need for appropriate fall-back measures if systems fail.(182;183)

Tensions surrounding security and confidentiality have to date been particularly apparent surrounding the Summary Care Record (SCR),(169) but are likely to become of increasing importance in relation to the NHS CRS as the user-base expands and the EHR becomes more integrated.

7.4.4 Media portrayal and impact

Ongoing concerns relating to security and confidentiality of records are two of the many NHS CRS related themes that have been frequently and at times passionately discussed and debated in the media. Many NHS and non-NHS stakeholders felt that the press had contributed to the negative public perceptions of the Programme/NHS CRS as a whole by focusing on delays, spiralling costs and various technical and other problems occurring during implementations.

"I guess the, because a lot of things aren't in our direct control a lot of the bad press if you like impacts us quite heavily yet we don't, it's not in our gift if you like to do a huge amount about it, so some of the delays that have, experienced so far" (Interview, Developer).

Developers expressed concern that the negative publicity had impacted on their reputation (and, in one case, had resulted in a 50% drop in their share prices) and they felt that influencing the news stories surrounding Lorenzo was somewhat out of their control as they were often heavily restricted by the LSP.

News coverage of implementing Trusts varied, and it became clear that those whose progress (or lack of progress) was publicly debated, were under significantly higher public and political pressure to implement. As a result, LSP resources tended to be pooled at these Trusts. Indeed, some implementations were played out in the press as exemplar sites, with their success assumed to either 'make or break' the Programme as a whole and associated software systems, LSPs and developers. As headlines in one paper read:(184;185)

"CSC's future in the £12.7 billion NHS IT Programme is in doubt after it failed to hit a critical end of March deadline to install Lorenzo Regional Care Release 1.9 at University Hospitals of Morecambe Bay NHS Trust."

"A 90-day rescue plan is underway at The Royal Free Hampstead NHS Trust to try and fix a catalogue of 22 major problems with the Cerner Millennium Care Records System installed by BT."

7.4.5 Contracting for health: contractual tensions and new formulae

The relationship between stakeholders involved in implementing and adopting the NHS CRS was defined by contractual arrangements, which have in turn been shaped by national arrangements surrounding leadership.

Effective contracting between NHS CFH and LSPs is clearly an important pre-requisite to successfully delivering the NHS' CRS. However, our research has indicated that the nature of the contract together with competing perspectives and practical difficulties resulting from contractual requirements were significant barriers to systems implementation and adoption. In line with this, some stakeholders argued that such national contracting may in fact be detrimental to the NHS as a whole as it stifles innovation in relation to software development.

"As a separate stream of development what we found was that the National Programme was actually stifling our own innovation to quite a considerable extent actually, only because we had contracted to deliver something which was just enormous, you know, and we had to deliver it so our ability to do really interesting stuff on the edges was destroyed" (Interview, Developer).

All stakeholders found the current contractual situation unsatisfactory, despite a general feeling that over time, relationships between different stakeholders involved in delivering the software had improved and matured as the different parties increasingly got used to working together.

First and foremost, there appeared to be a significant disconnect between the requirements of various stakeholders, most notably between those involved in contracting and those that experienced the consequences of the contractual arrangements including the SHAs, Trusts themselves and users of the IT systems. This was perceived to be due to the fact that the contract left out important functionality (such as social care integration) that was perceived as crucial to achieve the vision of an integrated solution. It also left out the ability for Trusts to customise the software according to their needs and influence deployment timelines in line with organisational readiness.

The fact that the contract was based on the delivery of the technology, and the resulting tight deadlines, was also viewed as inappropriate and some argued that the contract should in contrast have been based on delivering early clinical benefits rather than delivery of extremely ambitious key political milestones. Lack of progress in delivery tended to be viewed as being due to the overly ambitious implementation timelines specified in the contract, including unrealistic expectations in relation to benefits and the time needed for systems to embed. Developers, on the other hand, felt pressurised to deliver and stated that at the time the contracts were signed there was a lack of negotiation with the supplier which they felt left them with "no option", but to sign up to the specified arrangements. Conversely,

some stakeholders questioned why the developer had signed up to these arrangements, which they were clearly not in the position to deliver, resulting in delays in software development and implementation.

The LSP's incentive was perceived to be getting the product into the Trusts and some stated that they *"don't really care about the product itself"*. This also meant that LSPs were perceived to focus on delivery only, and the business change aspects were left to the organisation. As the contracts were set up between NHS CFH, LSPs and software developers (see Figure 7.1), NHS organisations themselves, as a main stakeholder in the contract, felt that the implementation of the NHS CRS was imposed on them as they had no involvement in decision making in relation to implementation and software. This was further complicated by the fact that NHS organisations had no insight into what the contracts contained.

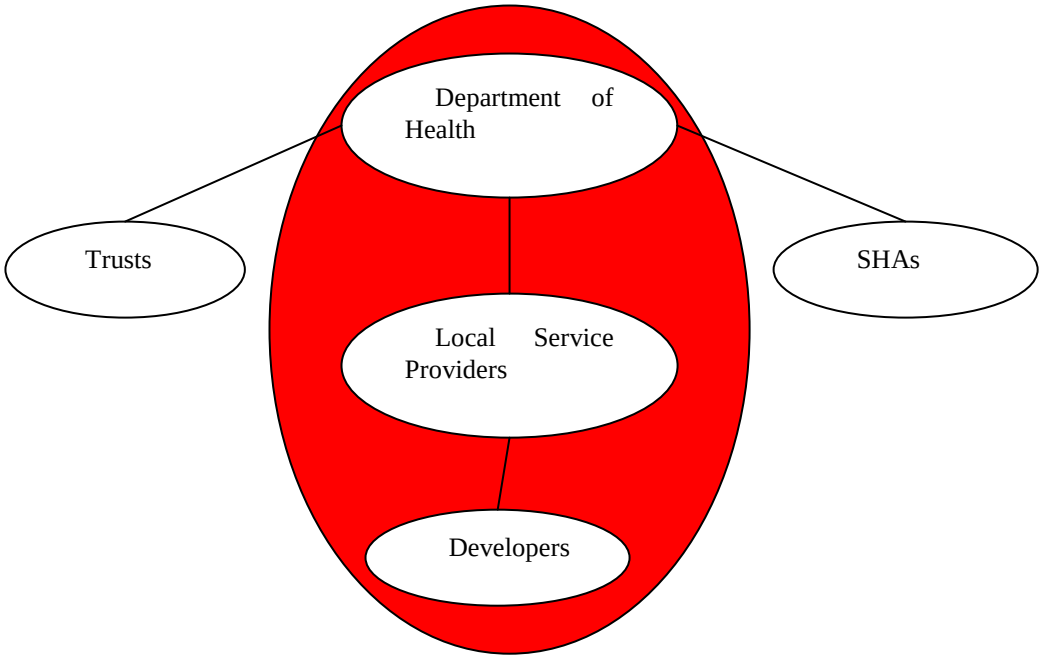


Figure 7.1: A diagrammatic representation of the current contractual situation

It became clear however that, over time, there was a general move towards more flexibility in contractual arrangements in order to better meet local requirements. During the Programme, existing contracts had been revised accordingly, and, as noted above and discussed in Chapter 1, some contracts had been terminated (e.g. with Fujitsu in the South). In the South, the reduced contractual obligations of Fujitsu led to a variety of problems, particularly in

relation to interfacing with existing systems and data migration, which were now the responsibility of Trusts themselves and which, following the departure of the LSP, Trusts now had to pay for.

Secondly, some interviewees felt that the software specification in the contract was not "fit for purpose", which is why it was thought that iSOFT had made the decision of developing a new system from scratch as there was no suitable product on the market. The problem was, however, that this new software did not fit with the specification or timelines set in the contract. These Output Based Specifications (OBS) were perceived to be far too generic. Therefore it was necessary to go through a series of *"design elaboration activities"* after the contract was signed. As requirements of Trusts had not been *"properly baselined"* when the OBS' were written, this meant costly contract re-negotiations with suppliers when they were subsequently changed. Some therefore stated that there should have been some initial flexibility in contractual arrangements as opposed to attempting to define "everything up front" without having a detailed appreciation of the implementation environment.

Thirdly, there was perceived to be a "complete lack of transparency around those contracts" (see also Chapter 5). This was problematic for the end-users (i.e. the Trusts), as a result, in terms of clarity of the scope of the contracts. It was felt that this resulted in uncertainty as to what software would be delivered to them at what time, which made it very difficult for sites to prepare for "go-live".

Developers had their own contracts with service providers and indirectly with NHS CFH, which they felt impacted on communication and inhibited building relationship with Trusts. It also made developers less flexible in relation to software development. Nevertheless, developers felt the LSPs were helping to supply appropriate resources to support the implementation that they could themselves not provide. There was therefore no direct contact between developers and Trusts, which meant that developers' main priority was to act in line with the contractual arrangements they had with the LSP and NHS CFH, and not to support local NHS Trusts in ironing out the many difficulties they encountered during the early stages of implementation.(91;186)

7.4.6 Seeking a return on investment

There were clearly reasons for nationally procuring NHS CRS software solutions, particularly in relation to cost savings through such large scale contracting and anticipated benefits associated with inter-operability of standardised systems.(153;187)

In order to measure progress and incentivise organisations, the implementation of the NHS CRS has therefore been characterised by a focus on “benefits realisation” and associated local and national level measurement activities. However, to date the focus here seemed to be mainly on possible long-term future benefits to the population at large (relating to the vision) at the expense of any tangible short-term benefits to individual users and organisations, which was clearly a concern expressed by many interviewees and in numerous discussions.

Locally, organisations were encouraged to track achieved and potential benefits (or meaningful use metrics as proxies for benefits these were measurable in the early releases e.g. data logs of numbers of accesses) from NHS CRS implementation with the help of a nationally supported Benefits Realisation Framework.(188) However, this was complicated by the fact that, despite a general recognition of the importance of measuring benefits, quantifiable benefits are often difficult to measure in the early stages of implementations. Stakeholders stated that this was particularly true in relation to *“cash releasing benefits”*, whilst *“softer benefits”* were more prominent in the early stages, but these were also more difficult to measure as they were not quantifiable. However, a range of international experiences now indicate that, even when investigating benefits in longer-term EHR implementations, direct net returns on these investments are unlikely to be realised, particularly not in the short-term.(189) This is likely to be exacerbated in a national context due to the complexity and scale surrounding the implementation.

Nationally, and as part of the early vision of the NHS CRS, there was awareness of the potential of making data available for a range of management planning, research and auditing purposes. The Secondary Uses Service (SUS) was set up to build in such opportunities for data collection and processing. During the course of our evaluation, however, this remained more of a vision than a reality as there were only limited clinical data being captured from NHS CRS systems in secondary care, again due to the limited software functionality. The DH was however working with suppliers to build the reporting functionality of applications for existing commissioning data sets. LSPs had a contractual responsibility to make information available for reporting, but although local reporting arrangements were progressing, there was no consensus on what data would be collected nationally and how data from different NHS CRS applications would be consolidated. The political drive for exploiting such data has however if anything been strengthened following the change in government.(12) This is potentially important as it is through such re-use of electronic data –

whether for health planning, public health, audit or research – that there are likely to be major returns on investment.(189)

7.4.7 Where next? Suggestions from near and far

Generally, stakeholders' accounts were characterised by uncertainty as to what would happen to the Programme in the light of the new coalition government and the climate of economic uncertainty. In the following sections, we consider potential ways forward based on our findings and ongoing discussions with key stakeholders. Particularly important in this respect seems to be an increasing focus on standards for interoperability of systems, build and design considerations surrounding potential software solutions and lessons learnt from international approaches to EHR implementations.

However, these developments are characterised by the general tension of some who felt that the Programme needed to show progress, as opposed to others who stated that the original scope of the deployment was "too ambitious" and that a more incremental implementation approach would be preferable.

Standards for interoperability

A key problem that needs to be addressed when considering the implementation of national systems is how interoperability will be achieved. There are broadly two approaches to this. Firstly, large scale procurement and implementation of national solutions which are interoperable; and secondly, implementing systems in local health communities or selected locations that can then be "made interoperable". At this point it has to be noted that there is also the possibility of systems interfacing with each other, which is the case with for example clinical portals. Interfacing means that information can to some degree be accessed from one system to the other but exchange and updating of information across systems is not as integrated. Whilst interfacing of systems is technically easier to achieve, the potential benefits due to a lack of integration are limited.

In relation to interoperability, stakeholders' opinions seemed to differ. Some felt that standardising care to a certain extent was necessary and desirable and that this was achievable only with a national solution, as focusing on local health communities alone would potentially compromise the benefits that might be achieved. However, others were of the opinion that connecting up local health economies was exactly where the focus of efforts should be concentrated as this would bring immediate local benefits, which would in turn motivate organisations and individual users.

Others suggested that the national implementation strategy should find a *"middle ground"* between these two extremes.(190) This could be achieved by creating a national procurement catalogue of approved EHR systems by a variety of vendors and setting standards. Trusts would then be able to choose which software system to implement, increasing local autonomy, whilst at the same time ensuring interoperability. It was felt that it would nevertheless be important to keep a common national infrastructure such as the Spine to connect up Trusts. This would also mean that Trusts could hold a direct contractual relationship with the supplier. This arrangement was also viewed to be in developers' best interests.

Such a middle ground would also allow Trusts to keep existing software systems (which were often perceived as working very well) instead of having to replace it with national (and often viewed as less fit-for-purpose) solutions.

The "meaningful use" criteria employed in the US were mentioned in this context as a potential solution to balance flexibility with standards and with software going through a central certification process to ensure interoperability of systems that allows for exchange of data between systems (we elaborate on this further in the section below).(191)

Build and design considerations

In relation to software design, two differing approaches have characterised the implementation and adoption of the NHS CRS to date: Building software from scratch (Lorenzo) versus customising existing software systems (Millennium and RiO). It seems timely to reflect on these differing approaches when considering potential ways forward. There are benefits and trade-offs in relation to both.

Some of our stakeholders have argued that the initial vision of a truly integrated NHS CRS could only be achieved with entirely new software architecture as none of the existing systems were designed to meet the envisaged specifications. In addition, if software is build from scratch, users can have increased input in software design. However, trade-offs include a lack of software existence which in turn leads to an inability to plan and envisage the system working (or even an inability to criticise it as it is still a vision). Other factors include the length of time that is required to build these systems and the amount of financial resources that have to be invested, particularly when this is being undertaken on a national scale. Many stakeholders have therefore questioned why this approach was taken as opposed to implementing software that exists, and has been shown to work in other

contexts, but can then be adapted to the specific context of use.(192) The counter-argument here is that the implementation of existing software may inhibit “true” interoperability” as these were simply not designed with this specific purpose in mind.

Nevertheless, local implementations of existing systems seem in many ways to be characterised by similar problems as implementations of software still in development, which supports the notion that technology is not paramount when implementing software. It is the interplay between technical and social factors that appears of central importance across clusters. Here, the way technology is integrated (or adapted to integrate) with local needs is crucial.

The question that follows is whether it is ever possible for a national solution adequately to support local needs (and this includes both user and organisational requirements). Here, it is important to keep in mind that the NHS CRS is implemented in a constantly changing NHS with changing needs and increasingly heterogeneous groups of staff, specialties and organisations. It would thus be a challenge to build one system that satisfies all. An approach based on opening the market to an increasing number of accredited commercial suppliers and increasing systems choice for local organisations (as is already happening to some extent) therefore appears to be a sensible way forward. This could help to ensure that systems satisfy local needs and are used in the most effective way, bringing local benefits in the short-term as opposed to attempting to begin with the overly ambitious strategy of delivering large scale national benefits from the start. It is, however, important that such systems are centrally accredited and fulfil certain standards of interoperability. NHS CFH could, it was suggested, play a role in facilitating this.

Comparison with approaches to EHR implementation in other countries

Our international conference on EHR implementation and adoption gave us the opportunity to compare and contrast the approaches being used in England with other parts of the UK (in particular Scotland and Wales), and also parts of Europe and North America. This underscored how the various approaches being pursued in these different jurisdictions have resulted from differences in history, ethos, structure, priorities and scope of health systems; the challenge of scale was also highlighted, particularly in relation to the inherent difficulties in extending approaches being followed in the devolved nation to a population the size of England. It was widely agreed that there is considerable opportunity to share lessons and experiences, as all are striving to achieve the same ultimate end-points.

7.5 Conclusions

This chapter has drawn on both the detailed case studies and a wider dataset in order to provide insights into the wider environment in which the implementation of the NHS CRS has and is continuing to take place. First and foremost, the Programme has been characterised by continuous changes in relation to strategy, funding and leadership. This has been exacerbated by the often publicly debated lack of progress and remaining concerns surrounding security and confidentiality. The (until recently) top-down implementation strategy with centrally procured contracts has clearly influenced the way organisations and users have coped with implementation and adoption as they felt excluded from decision making, including systems choice. Despite efforts in addressing this issue (e.g. through initiatives such as NLOP), the fundamental tension of achieving a balance between local autonomy and implementation of national systems remains. Many have therefore argued for an opening of the market, which is likely to happen in the future. It is, however, important to recognise that this may potentially hamper the achievement of national benefits (such as for example SUS). A certain degree of central leadership is therefore important, and indeed necessary to coordinate implementation activities and set standards.

Chapter 8: Conclusion, discussion and recommendations for policy and research

8.1 Introduction

This report has presented the findings of a longitudinal evaluation of efforts to implement national electronic health record (EHR) systems – the National Health Service Care Records Service (NHS CRS) – into NHS secondary care sites across England. In this, the final chapter, we summarise the main conclusions and draw out key policy and research recommendations. We also reflect on the strengths and limitations of this work, and begin to place this work in the context of international efforts in EHR implementation and adoption.

8.2 Summary of main findings: Integration of findings across work-packages

Our results indicate that organisations that have begun implementing NHS CRS software systems as part of the National Programme for Information Technology (NPfIT), have done so driven by central incentives and multiple visions of better quality and more efficient care, modernised work practices and strategic benefit for their organisations. Many obstacles have, however, hampered both local and national progress.

Locally, these have included the relative immaturity of systems (particularly in the North, Midlands and Eastern (NME) region), a difficulty of the software systems to integrate with existing work practices and a lack of immediate benefits to users, which in turn often led to resistance by NHS staff in using systems that were perceived as generating more work without this translating into improvements in the quality of care, at least in the early stages of implementation (Chapter 4). These qualitative findings are supported by our quantitative work, which indicates that in the period of early use the software did not result in a reduction in the proportion of missing information in hospital outpatient clinics (Chapter 6). Trusts ability to progress implementation and solve problems was restricted by the complex and opaque supply chains, and a lack of authority to act or to configure the software. Trusts also reported disappointment at the lack of clinical functionality, the range of usability issues encountered, and the consequent views expressed by many staff that the introduction of the new software systems interfered with rather than supported them in fulfilling their clinical and administrative roles (Chapter 4). We found that the costs for Trusts implementing the software, despite the national funding of software systems and some aspects of support,

were extremely high (Chapter 5). Personnel costs in support of the implementation, in particular, were much larger than anticipated and had to be compensated for by individual organisations if they wanted to progress the implementations. The Minimum Data Set (MDS) that we developed will, we hope, serve as the basis for a robust evaluation tool to help plan for and assess the costs of future implementations.

Nationally, the strong centrally managed Programme, and its changing management structures, combined with a high political profile and changing economic climate had significant consequences for Trusts (Chapter 7). These issues resulted in a sense of lack of control exemplified by complex contractual arrangements and restrictions in tailoring software systems according to local needs, both of which have contributed to a lack of local progress and considerable uncertainty about the future. Nevertheless, the organisations we studied have in most cases achieved (at least partially) operational systems and at the same time have developed new competencies in implementing complex IT systems as they have over time done their best to make the new systems fulfil both user and organisational demands.

8.3 Strengths and limitations of this work

8.3.1 Strengths

The scale and real time nature of this evaluation of EHR implementation in English secondary and community healthcare settings makes it unique.(4) The strengths of this work include the mixed methods design and contemporaneous multi-faceted longitudinal data capture.(193) This study has also been theoretically grounded, drawing on economic analysis, sociotechnical models of change and organisational learning. The result is that this evaluation has allowed a rich, multi-faceted nuanced appreciation of the implementation and adoption of the NHS CRS. Its theoretically informed research design, data generation and analysis will we hope allow transferability of findings and methods beyond the immediate context of this evaluation.(50;194)

The demonstrated ability of a skilled, experienced, multi-disciplinary research team is also one of the strengths of this research. This team has shown a willingness and ability to reconsider and, where necessary, revise our research approach in the light of changing realities on the ground (Chapter 2). New insights were made possible by the combined involvement of researchers with different methodological backgrounds, skills and experiences. During the conduct of the research we have developed a cadre of researchers

who have been involved in a highly complex evaluation and who as a consequence have emerged with a range of relevant skills and insights appropriate to the study of future health IT implementation efforts.

We used purposive sampling to ensure coverage of the main NHS CRS software systems, and an appropriate mix of secondary care Trusts. This strengthens the credibility and transferability of our findings. The sample includes a range of Trusts, of small and large dimensions, with Foundation and non-Foundation status, teaching and non-teaching, in acute care and mental health, across large geographical distances and in urban centres and representing a range of different implementation strategies. Unsurprisingly, as a result we have a number of different experiences of NHS CRS to report. This diversity of context and data are we believe a strength, particularly in the area of study of EHR where much reported research relates to a single site, often a well resourced centre of excellence.(19)

Very substantial volumes of data were generated and obtained from a variety of sources covering a range of stakeholder perspectives. In attempting to cover the national context whilst still retaining the importance of local contexts, we have drawn on a case study approach. After initial detailed analyses of individual case studies, we then analysed findings across contexts allowing for wider transferable lessons to be drawn. Case study findings as well as wider themes were discussed at length within the research team in data analysis workshops, to check understanding, confirm findings, refine ideas and expand propositions. Throughout the study, these emerging findings were fed back into subsequent fieldwork and analysis. In relation to the main findings and given the timelines we had to adhere to, we believe that we have reached saturation in relation to early implementation considerations, though we are sure that over longer timescales many new issues will emerge as NHS CRS software is (to degrees) adopted into everyday use, extended to more clinical realms, and the data collected therein are exploited in new ways.

A further strength of this study was our ability to provide formative feedback to NHS Connecting for Health (NHS CFH) and to the Trusts we were working with. In most cases the Trusts were very appreciative of our work, interested in our findings and fully able to respond to the analysis we gave them even when it was not directly in line with their own views. Areas of particular interest included emerging concerns amongst staff on the ground and potential early barriers to successful local and national implementations. Indeed, the potential for formative work within such evaluations, and the benefits that can accrue from such an approach, are counted as one of the positive outcomes of this work.

8.3.2 Limitations

First and foremost, our sample may not be representative of the full set of ‘early adopters’ or the wider population of NHS Trusts, the majority of which have not so far participated in NHS CRS implementations. The experiences of the Trusts participating in our research may also not be representative of those Trusts who might join the Programme later, because of lessons that are learned from research such as this. For example, the Trusts we studied incurred some costs and spent time in a trial-and-error process that may not need to be repeated. Equally, ‘early adopter’ Trusts were often the beneficiaries of substantial financial support (Chapter 5) that is unlikely to continue to be available, thereby affecting the true nature of any opportunity costs faced. We have identified, where appropriate, instances in which economic principles and our evidence suggest that ‘early adopters’ experiences may not reflect the likely experience of the remaining Trusts in England.

Our sample has been affected by a number of concerns in the research environment. A key issue has been gate-keeper influence at all levels. This has resulted in restricted access to some stakeholders, including patients and healthcare professionals, often carefully and appropriately “guarded” by Service Leads and IT Managers, and in some instances to Trusts themselves. This may also have been because Trusts were aware of the limited clinical functionality that had thus far been deployed. Furthermore, for Trusts engaged in implementing the NHS CRS and under great pressure and politically charged deadlines, participating in the evaluation was of relatively low priority. Hence limited time and resources were made available to our research. The nature and depth of data collected at different case study sites thus varied. We also faced a general lack of access to groups such as developers and government stakeholders, again, because of the at times politically charged nature of the NHS CRS and prioritisation of resources.

This research environment meant that some stakeholders seemed to hesitate in speaking openly, particularly in relation to what they considered to be sensitive commercial information including costs and contracts. We addressed this by encouraging participants to speak ‘off the record’ (i.e. not recorded and not attributable). For the same reasons, we had difficulty obtaining documentary evidence such as contracts, business cases and minutes from higher-level meetings. One important piece of information that was challenging, if not impossible, to obtain related to the ’go-live‘ dates of Trusts. This had a significant impact on our sampling strategy and led us in some instances to sample Trusts that did not actually eventually go-live during our evaluation, despite original plans. Our picture is therefore necessarily incomplete, which was further exacerbated by the need to focus on a limited set

of analytical techniques due to practical constraints. Nevertheless, we hope that our dataset will, in the future provide ample opportunity for secondary analyses.

Not only is our picture incomplete, but it is affected by our own intervention in the field. Our formative feedback strategy (see strengths above) may have influenced the information they provided back to us as research participants. They might also have changed their local implementation efforts, for instance to address local issues identified by the research team in ways that they would not otherwise have done.(25)

We also recognise that, with respect to the general field of EHR implementations, the transferability of our conclusions may also be limited by the restricted number of software systems within the NHS CRS, which we have focused on. This may become increasingly important if, as expected, the market becomes more open in the future.

To conclude, despite the clear advantages of a large, multi-site evaluation undertaken by a multi-disciplinary team, there are also some important potential limitations arising from this work. First, the volume and range of data and number of researchers collecting these, rendered it challenging at times to keep an overview and to pull findings together. Our diverse backgrounds and experiences meant that data collection techniques and assumptions varied. We must also acknowledge that the qualitative findings and the way they are presented constitute accounts of who we are, reflecting our world-views, interpretations, academic backgrounds and previous experiences. Their content draws upon interpretations and translations of participants' viewpoints rather than "raw" data that "speak for themselves".(57;195) They are thus contingent, constructed or "partial truths", though no less credible for that.(62;195)

Our request for additional funding would have allowed continuation of our research into a longer period of implementation and adoption, but this was unfortunately unsuccessful; our findings thus emerge from relatively short periods in the field (i.e. covering up to 18 months of NHS CRS systems use). This obviously results in lack of insight into longer-term consequences, which may be particularly important in order to allow anticipated and unanticipated consequences to emerge.(189) We thus have an important story to relate, but one that is, unfortunately, only partially complete.

8.4 Relating this work to the broader literature

We have reported on the most substantive and sustained prospective evaluation of the implementation of EHRs ever undertaken and have found evidence of persisting difficulties

being encountered on the ground as a result of nationally procured systems implementation. Most IT implementations in healthcare settings lack robust and sufficiently theoretically informed, mixed methods evaluation as many commentators have previously argued.(110;196-198)

Broadly, our results confirm findings from other evaluations of the introduction of EHRs into healthcare settings, be it primary or secondary care.(199-202) This is particularly true in relation to repeatedly identified facilitators and barriers to successful implementations in the complex healthcare setting including technical, social, and organisational factors, as well as the complex interrelationships or "fit" between these.(203-207)

However, our findings have also provided a deeper insight into the complexities surrounding the national implementation of EHRs. Local deployments in NHS sites were heavily influenced by wider contextual factors, the impact of which intensified over the period of our evaluation. In addition, we have developed a more fine-grained understanding of how implementing national electronic health record systems has major impacts locally, not only on organisational functioning, but also workflows of individuals, locally incurred costs and proxy measures of patient safety.

Some of our findings can be applied to other settings such as primary care, particularly in relation to macro-environmental influences. Others, on the other hand, reflect the complex and disintegrated nature of the secondary care environment, where many different staff groups work-out the technology in more complex ways than in other settings.

8.5 Relating this work to broader IT and policy developments

Our research has indicated that despite major concerns with the details of the implementation, there remained widespread buy-in into the central vision of the Programme and EHRs and, more generally towards moving healthcare services from a paper-based into a digital-record based era. There is, however, considerable uncertainty in relation to the future strategic direction of the implementation of the NHS CRS in secondary care settings (Chapter 7). Plans have been announced, but the implications for the future IT strategy and implications for NHS CRS deployments in particular are, at the time of writing, uncertain.

The plans that have been announced are likely to encourage competition from different software systems suppliers and confirm the move away from an entirely top-down nationally-led implementation approach. Whilst this approach may also allow early local benefits to be

realised, it is also likely to bring a new set of challenges, particularly in relation to standards for systems interoperability. It should also enable more local input in implementation activities and system choice, which in turn could facilitate local problem solving and engagement.(186) This is in many ways the approach that was planned before the Programme was conceived. Back then many parties argued that there was a greater need for integration and interoperability to bring the desired large scale benefits. But there was a general feeling that if funding to deploy systems would be devolved to Trusts, this would not necessarily result in sufficient IT investment be made.(208) Therefore, it was felt that a central solution would be more appropriate. Both of these issues remain of concern in relation to any future strategy.

At present, the general strategic direction seems to have moved somewhere between the two, with some local input and choice, but still to some extent guided nationally.(209) This more devolved strategy would encourage capacity building at local level – a strategy aligned with the more general policy of devolving responsibilities and power in the NHS, made evident, for example, through the increasing number of Trusts obtaining Foundation status (currently 129 out of 251).(210) These Trusts have considerable autonomy and are accountable directly to the Department of Health (DH). An increasing number of these Foundation Trusts have, over the period of our evaluation, decided to implement systems outside the Programme.(211) Thus, Foundation Trust status in combination with a national implementation strategy is counter-intuitive. It means that Trusts are on the one hand encouraged to be independent, whilst on the other hand, restricted to use nationally procured systems. In addition, the new strategic approach has to date been largely untested and will need careful planning and flexibility to suit the evolving needs of the NHS.

It is therefore important to recognise that the implementation of the NHS CRS is in itself situated within the larger and constantly evolving structures of the NHS, the DH and the government. The IT strategy has significant implications not only on the way care is been delivered, but also on whether and how its outcomes are aligned with those intended with other existing strategies. Our research indicates that it is the combination of change reforms supported by IT strategies that can maximise the chances of successfully implementing new systems. Two disjoined reform strategies would have undesired consequences with stakeholders finding it difficult to prioritise and creating a feeling of lack of direction. Similarly, our research findings indicate that some of the core patient-centred reforms envisaged for the NHS are only likely to be achieved on the back of successful implementation and adoption of interoperable NHS IT systems.(12)

What is needed is a clear description of this wider strategic approach (i.e. IT strategy aligned with other NHS policy reforms), with detailed plans and specific incentives for systems integration, standards etc., which are agreed and defined in consultation with NHS stakeholders and the public. Policies are bounded by existing infrastructures. Aligning the interests of such a disparate group of stakeholders is likely to prove particularly challenging in large, increasingly fragmented and competitive health systems of the kind that is now found in England.(170) In the case of NHS IT, the National Programme, and NHS CRS implementations contributed to the building of a yet to be finalised national infrastructure (e.g. N3 and the Spine), with contracts with suppliers coming to an end in 2015.(212) There seems to be a decision to be made as to its continuation or termination. But the choice is conditioned on an interplay between future policy and existing infrastructure, with the one being both a means and an outcome of the other.

8.6 Lessons learned and implications

In our evaluation of the NHS CRS, we found some success stories as well as several problematic situations, complexities and lessons to be learned. These lead to implications for policy. However, it has to be noted that our evaluation of the NHS CRS is not an evaluation of the entire NPfIT. Many success stories of the NPfIT can be accounted, such as the implementation and adoption of Picture Archiving and Communication Systems (PACS, which brought immediate perceived benefits), NHS Mail, and the building of both national (Spine, N3) and local infrastructures as well as the development of standards (e.g. the interoperability toolkit).(213) In addition, the Programme has helped to develop health informatics expertise within the NHS (although there is still a need to build on this).

Policy makers have already started to shift the focus to more local efforts to procure and implement electronic health records, these being driven by the changes in outlook of the coalition government, the planned changes to the NHS in England and also reflecting the current economic climate.(12;16) In the light of this evolving policy landscape, and drawing on our research and broader international experiences, we have a range of recommendations, which we have summarised in Box 8.1.

- There will always be a need for flexibility and an ability to respond to evolving needs.
- Concurrent policy initiatives need to support electronic health records implementation.
- There is a need to focus on getting NHS CRS systems working in sites where implementation has begun. On a related note, funding needs to be continued for sites that have already committed to implement NHS CRS.
- Careful consideration needs to be given to intellectual property rights in relation to future developments – the NHS as a whole should benefit from systems developed by them (e.g. Lorenzo).
- A governance structure is needed to develop standards, set quality benchmarks, create incentives, liaise with suppliers, and develop expertise. This structure should facilitate local engagement in key decisions.
- There is a need for more local ownership – systems should be implemented out of a perceived need, whilst complying to centrally determined standards for interoperability.
- We now need to move away from technology driven models of implementation towards a recognition that technology is an enabler of improved organisational and care processes.
- There is a need for a more transparent commercial architecture which encourages the emergence of a larger range of software systems and service providers working through smaller contracts. This landscape should be centrally regulated and incentivised.

Box 8.1: Summary of key policy recommendations emerging from our work

8.6.1 Policy implications for the English NHS

In the short-term, the sites in which NHS CRS implementation has already begun should be supported in their choice to maintain their system if they wish, or to change to other software systems, not necessarily in line with the historic NPfIT strategy. Funding for this stream of the Programme needs to be continued for the sake of the Trusts committed to the NHS CRS software systems. This support may need to be over extended periods of time and should have realistic timescales. Efforts should furthermore focus on the implementation of clinical software modules (such as ePrescribing), so that there is an opportunity to establish whether

these do in fact once used translate into the desired improvements in the quality and safety of care.

Funding is also needed to retain, and build on the very substantial and hard won knowledge and skills already developed in individual sites and across the NHS. The considerable work by Trusts and NHS CFH in informing the design of the Lorenzo NHS CRS system should be seen as, at least in part, the intellectual property of the NHS, which the NHS as a whole should benefit from. This work should not be lost; it will require careful consideration of intellectual property rights in relation to any future developments (e.g. international markets).

In the longer term, it is important that some 'top-down' responsibilities are retained in order to ensure that electronic health records are implemented in an integrated way. We recommend a hybrid governance structure that will encompass the input of both an NHS wide, public, accountable central authority as well as considerable local involvement in decision-making and implementation strategies. Building on other international models, we envisage the role for one or more NHS-wide bodies (such as NHS CFH, the DH's Informatics Directorate or the newly established NHS Commissioning Board) to include coordinating and facilitating development of common and open technical standards (including support for some aspects of software certification), setting quality benchmarks which Trusts can use (e.g. for usability and safety), creating incentives for inter- and intra-organisational learning, liaising with supplier communities, and developing expertise and drawing together specialists. The exact role of this governance structure will need to be negotiated.

Independently from the setting-up of central or NHS-wide bodies, it is essential that implementation activities are locally owned and driven. In particular, organisations should not be encouraged to replace existing systems that are working for them; development of EHRs should rather stem from perceived needs and a well articulated and understood case for change within the local health economy. Locally driven implementations should align with nationally set standards to achieve, in the longer-term, a joined up healthcare delivery model and the overall vision underpinning the NHS CRS. We recognise however that this balance is likely to prove extremely challenging to achieve, as there are some major trade-offs which need to be considered. These include, above all, the risk of potentially conflicting local priorities resulting in insufficient drive and funding for such developments, problems with systems interoperability, and entrenchment of local work practices rather than the 'transformation' of healthcare nationally.

A consequence of this should be a move away from technology-driven models of 'implementation' (e.g. the focusing on putting computers on desks, trolleys or even into the hands of clinicians) and reflect increased attention to Trusts operational needs and business priorities, their work practices, and potential for beneficial change in work process. The findings from this evaluation suggest the need to refocus attention around 'adoption'. Adoption should not be seen as a discreet period of change driven by the arrival of a new technical system, but as an on-going and most likely lengthy collective 'working-out' in which technology is seen and used as an enabler of improved care and decision-making processes, rather than an end in itself. As adoption, change progresses and requirements for systems' functionalities are also expected to change. Contracts with system suppliers in general should not assume a linear implementation model, but a flexible one that can be amended suit to emerging demands.

There is also an opportunity to work to align the strategies of the NHS and a wider variety of commercial software suppliers and service providers. A stronger and more transparent commercial architecture could be of great benefit to all parties, but must not repeat the customer–supplier disjunction of the NPfIT. We expect to see such a market emerge with a larger range of software systems and service providers and working through smaller contracts. This would require providers to demonstrate compliance with agreed interoperability standards that have been built 'bottom-up', but have achieved a minimum level (benchmark) of usability, clinical safety and validity as well as service quality measures in relation to pragmatic clinical practices and business processes.

8.6.2 Implications for the international community

Our experiences of studying the English experience offers a number of potentially transferable lessons for ongoing international efforts to implement electronic health records. First and foremost, there remain important drivers for the long-term the implementation of integrated EHRs, these including in particular the potential for increased accessibility, which is important considering the major advantages associated with digitised data in relation to facilitating audit and research. However, the procurement of national systems in England had several consequences for organisations and individual users. Procurement reflecting the centralisation of the process was undertaken to save costs and ensure an integrated approach, but this meant that implementation timelines were being driven according to political timeframes in line with the procurement arrangements. We therefore advocate that the basis on which these systems are chosen should lie in assessing their potential for improving clinical care processes. Procurement decisions should not be based primarily on

unrealistic assumptions of achieving cost-savings or even returns on investment, but rather on introducing clinical functionality early so that these systems are used. In other words, the value these systems add should be based on clinical and not financial or political arguments as measurable benefits will take a long time to materialise.

The English experience has also illustrated that the primary initial concern of national strategies should not be systems integration, but instead focus on ensuring that systems are used locally and bring some benefits to organisations and users before they are connected on a larger scale. In this context, building national systems from scratch is unlikely to result in success as the focus on systems interoperability and standardisation means that local customisation is compromised from the start by procuring a "one-size-fits-all" system. This will need to be coupled with a realisation that the main benefits of these systems are likely to accrue in the longer term, from both local re-invention and secondary uses of data for management and research purposes.(189) That said, there is, as noted above, an important need to agree and enforce standards for interoperability.

Strategically, it is further important that any health informatics policy is integrated with concurrent policy initiatives and reflects the dynamic environment in which it is taking place. In England, this has to some extent be achieved (e.g. by gradual movement towards a more localised approach), whilst on the other hand it was (and still is) hard to adapt nationally set arrangements to evolving needs (e.g. contracts with Local Service Providers (LSPs)). The consequences of these are often still hard-felt on the ground. Admittedly, it is difficult to achieve this balance as the NHS is itself continually changing. It is, for instance, becoming increasingly prone to becoming 'privatised', which is in itself at odds with any nationwide transformation of the service, 'top down' or otherwise.

Conversely, it is also important to balance changes in strategic direction with keeping a central tenant of working towards a coherent vision without changing this to an extent that leaves stakeholders confused and uncertain about the future.(12) For example, although the overall "vision" of an "information revolution" discussed in the government's White Paper, *Equity and Excellence: Liberating the NHS*, is to an extent predicated on people having: *"… an accurate record of their care, available to them electronically"* there is no formal mention of the NPfIT or indeed the NHS CRS suggesting that the focus of attention has shifted and that these very substantive initiatives may in key circles be viewed as history by the coalition government.(12) In addition to the shifting nature of aims over time, it is also apparent that these did never match the vision of seamless integration with the actual implementation strategy. There is thus a need to reflect on the national approach to implementing EHR

systems. On one hand, systems were nationally procured to ensure interoperability, but on the other hand, they were not conceived as a single national solution as a range of different suppliers was involved. The degree of integration and interoperability across systems, although open to speculation, may therefore never have been realised even if the national implementation would have proceeded according to plan.

8.7 Implications for future research

There are a range of implications for future research that can be drawn from our experiences. Most importantly, there is, we believe, still a need for more independent longitudinal evaluations of IT initiatives, following implementation efforts over substantially longer periods of time. Such studies allow insights into the way technologies become embedded (or not) and are made to work in and across organisations.(169;207;214;215) Similarly, detailed studies of Trusts (and sites in other countries) where EHR systems have become established and are in every-day use could inform future policy and delivery methods, and the ways in which it may be possible to maximise the realisation of benefits and returns on investment. This will require funding bodies to allocate the required resources.

Future studies should also examine the transformative power of EHR in changing (or not) clinical practices and healthcare professional roles and in conditioning new forms of patienthood and a re-conceptualisation of healthcare delivery models and healthcare as such.

Research is similarly needed into the often neglected processes of transition from paper to electronic records, or between one generation of electronic systems and another. As in this study, this turns attention to the extended processes of change (changing) and the ways in which the active users of new systems work-out how to appropriate the various affordances of any given technology into their work practices and processes of patient care.

A focus on cross-country international research in relation to technology innovation and implementation and adoption processes and overall visions, could help inform future UK developments. In particular, the understanding of international experiences could inform the complex choices and trade-offs faced in EHR implementations between, for instance: security and confidentiality; interoperability and localisation; and standardisation and customisation.

There is furthermore currently a lack of attention surrounding the ways in which large-scale electronic data systems in the health service can be managed and maintained in the long-term (including disposal and security arrangements). This will require considering the whole lifecycle of electronic information.

Issues that future research will also need to resolve are related to the ethical and legal concerns surrounding research into EHRs, particularly into the potential implications when evaluating commercial products (libel). This has, for example, been a cause of concern for our research team, which has led us to seek expert legal advice in this respect.

Introducing technologies into healthcare environments clearly requires relationship building between suppliers, patients and carers, clinical and administrative users, professional bodies and healthcare providers. This has so far received limited attention and is also likely to help addressing issues surrounding clinical engagement. Research can help to guide these multiple interests towards a productive dialogue. There may also be a need to learn from other industries where this has been realised.

Overall, we would argue that EHR-based innovation in healthcare should not be conceived of as essentially technically driven (i.e. founded on the inherent properties of in EHRs or any other technology), but should be characterised by new ways of working that appropriate technologies and seek new ways of delivering better care. Detailed work process mapping and user centred design, combined with exploring options for innovation in the way care is delivered, should be central to future investigations. Fundamental to this view is the understanding that automation without redesigning services will just magnify existing problems.

8.8 Conclusions

The initially anticipated “full integration” of NHS CRS software systems by December 2010 is still far from being realised. While RiO has achieved a relatively wide installed base, there have in contrast been very few implementations of Lorenzo software and those of Millennium are still behind the original schedule. The implementations in acute settings (Lorenzo and Millennium) have not only been on a smaller scale than originally planned, but also with more limited functionality. Rich clinical functionalities have so far not been implemented.

Yet, the NPfIT – and especially the NHS CRS – remain as visionary IT endeavours that may long be remembered in the history of health policy and health informatics. Although our work

has clearly shown that many users, managers, service providers and implementers have been sorely bruised by the initial experiences of attempting to implement a comprehensive national EHR system, history may – particularly if we at this important juncture now make the right calls – be more forgiving.

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Contributorship

Dr Maryam Ali (MA) joined the evaluation team in April 2009. She was responsible for coordinating meetings for the London team and also for helping to initiate research in the Southern cluster, both in relation to the collection of data and also learning about its history from secondary sources. She also helped with establishing contacts with case study sites in the South. MA contributed to data analysis and interpretation, participated in meetings and workshops, and helped with drafts of publications as well as the preparation of reports. She contributed to the institutional section of this report.

Professor Anthony Avery (AA) contributed to the writing of the original bid, particularly Work Package (WP) 5. He led the Nottingham team during the study and had overall responsibility for successful completion of WP4, and the WP5 study on examining completeness of information in hospital out-patient clinics. He was a member of the Project Management Group and contributed to the team meetings and commented on drafts of the report.

Professor Nicholas Barber (NB) contributed to design of the funding application and subsequent project; design of individual studies, interviewing, analysis and authorship.

Dr Tony Cornford (TC) contributed to the writing of the original bid, particularly WPs 1-3. He led the London School of Economics team during the study and had overall responsibility for successful completion of WPs 1-3. The theoretical dimension of this project is based on his work on information systems. He contributed to the design of individual case studies, participated in data collection, and led the analysis across case study sites. For the report, he coordinated the writing and was the author of sections of Chapter 4, executive summary and Chapter 8. He contributed to overall analysis and policy implications, reviewing and commenting on drafts of the report. He was a member of the Project Management Group.

Kathrin Cresswell (KC) was involved in writing the grant proposal and setting up the project. She was grant-holder as well as Project Co-ordinator and therefore involved in every aspect of the study. She led on writing the final report and was also lead researcher on three case studies and overall lead researcher in the North Midlands and Eastern cluster.

Dr Sarah Crowe (SC) assisted with the recruitment of hospital sites, and was responsible for WP4 contributing to all aspects of data collection, analysis, and interpretation. She also collected data for WP6 and contributed to the overall synthesis of key findings across sites.

Dr Bernard Fernando (BF) was a grant-holder on this project and contributed to Steering Group meetings.

Professor Ann Jacklin (AJ) was a grant-holder on this project and contributed to Steering Group meetings.

Dr Yogini Jani (YJ) evaluated the pilot of RiO ePrescribing at Site M, developed and piloted tools for medication reconciliation and missing information in medical records, reviewed and commented on the final report; contributed to the writing of Chapter 6; commented on and piloted the CLICS survey, and contributed to writing, reviewed and commented on the case study for Site M.

Dr Ela Klecun (EK) contributed to writing the grant proposal and was one of the grant-holders. She contributed to data analysis cross-sites and overall policy implications. She wrote a number of sections in Chapter 4 and reviewed other sections. She designed the survey tool CLICS (with TC and VL), and distributed it in Site D (with VL).

Dr Valentina Lichtner (VL) participated in recruitment of sites; carried out data collection in Site N, O and P, and with interviews of different stakeholders in relation to integrated clinical pathways; designed the survey tool CLICS (with TC and EK), pilot it (with YJ) and distributed it in Site D (with EK); contributed to data analysis cross-sites and overall policy implications; was responsible for writing sections of Chapter 4 and contributed to the writing of the Executive Summary and Chapter 8, as well as reviewing and commenting on all sections; she was the author of Case Study P, and contributed to the case study of the South. The drawing on the cover is hers.

Kate Marsden (KM) was the lead researcher on WP5. She wrote the first draft of Chapter 6 and contributed to the case studies in Sites B and X; she also reviewed and commented on the final report.

Zoe Morrison (ZM) was a researcher on this project and contributed to data collection and the writing up of the case study for Site X.

Dr James Paton (JP) was a grant-holder on this evaluation and a member of the project's Steering Group.

Dr Dimitra Petrakaki (DP) participated in the recruitment of three sites in the South (R, F and a site that ultimately did not participate); carried out data collection for WPs 1-3 in Sites C, R, F and BB, conducted all interviews with patients in Sites B and H; helped in data collection in Site B; contributed to data analysis cross-sites and overall policy implications. She was responsible for writing a number of sections of Chapter 4; contributed to the writing of executive summary and Chapter 8 and contributed to Chapter 3. She was the author of the case studies of Sites C and R, the case of patients and she contributed to the case study of the South.

Professor Robin Prescott (RP) was a grant-holder on this project and a member of the Steering Group. He advised on all statistical considerations and undertook the statistical analysis for WP5. He was also involved in report writing.

Dr Casey Quinn (CQ) was a grant-holder on this evaluation and a member of the Steering Group, with particular responsibility for the health economics aspects of the project. He contributed to data collection, analysis and the writing of Chapter 5.

Dr Ann Robertson (AR) contributed to the management of the project, to recruiting participating sites and individuals and to all aspects of the evaluation's data collection, analysis and dissemination, including being the lead researcher for two of the reported case studies.

Professor Aziz Sheikh (AS) was the Principal Investigator for this evaluation. He conceived the idea for this evaluation, led the writing of the grant proposal, chaired the Project Management Group, Steering Group and Project Advisory Board, and convened the Independent Project Steering Committee. He oversaw all aspects of data collection, analysis and interpretation, and writing up of this report and study publications. He is the study's guarantor.

Dr Amirhossein Takian (AT) participated in the recruitment of four sites in London and one site in the South. He was the lead researcher in Sites D, E and M in the London cluster; carried out data collection, analysis and interpretation for WPs 1-3; facilitated WP4 in Sites D, E and M (carried out by SC and CQ) as well as CLICS at Site D (carried out by VL and EK); contributed to data analysis cross-sites and overall policy implications; was the lead

researcher for WP5 until June 2009; developed and piloted tools for medication reconciliation and missing information in medical records in Site A and another NHS setting (with NB,YJ and TA), he was the lead author of Chapter 3; contributed to Chapter 4, as well as reviewed and commented on all sections. He was the author of the case studies of Sites D, E and M.

Dr Katerina Voutsina (KV) collected data from secondary sources to provide a historical account and a comprehensive report of the special contingencies which have met in the process of implementation and adoption of the NHS Care Records Service (NHS CRS) in the Southern cluster. She contributed to the story and the case study of the South. She also reviewed and commented on the final report.

Dr Justin Waring (JW) was a grant-holder on this evaluation.

Glossary

Access control	A system that allows to control access to data held on a particular computer system
Acute Trust	A Trust that provides secondary care services
Adoption	The process of starting to use a new technology either on an individual or a group level
Accident and Emergency (A&E)	Part of the hospital that provides initial care for patients with acute problems.
Architecture[1]	The selection, design, and interconnection of the hardware of a computer system
Approval to Proceed (ATP)	The formal approval to begin the go-live in the 'early adopter' phase.
Audit trail	Chronological recording of organisational activities often used for review of organisational performance
Authenticated[1]	The confirmation following user authentification that the end user is actually the person he/she purports to be
Bandwidth[1]	An industry standard term to measure the amount of data you can send through a network or modem connection. The more bandwidth, the more information that can be transferred at one time
Benefits realisation	The process of achieving benefits of a particular project as detailed in the business case
'Big-bang' implementation	The whole organisation moves to a new system at the same time
Broadband[1]	A telecommunications medium composed of a bandwidth high enough to transmit high quality voice transmissions and a wide band

	of frequency. Television, microwave, and satellite transmission are all example of this medium. This is used mainly in relation to Internet access
Business case	A document outlining the reasons for initiating a particular project in an organisation
Business change	Initiating organisational change that affects the way the business operates
Business as usual	A state the organisation achieves after implementing change that is characterised by enabling the organisation to function as was the case before the change
Bottom-up change	This is localised change that originates from those at the coalface rather than change initiated by management
British Telecom (BT)	BT is the LSP for Cerner Millennium and also provides the Spine and N3 functionality.
Care pathway	Standardised patient management practices based on best available evidence for patients with particular conditions as they progress through the healthcare system
NHS Care Records Service (NHS CRS)	The electronic health record planned to be introduced as part of the NPfIT. This is planned to allow access of to health records across care settings and consists of the summary care record (planned to be shared nationally) and the detailed care record (to be held locally).
Case	An NHS institution in which NHS CRS (RiO, Lorenzo or Cerner) was, has, or is planning to be implemented, where we undertook data collection. This refers to the Trust and may also include its immediate environment (e.g. management, implementation team members, other Trust staff including users of

	the technology), may also include the local primary care organisation and have several sites (e.g. hospitals) within it
Cerner Millennium	Electronic Health Record software produced by Cerner in the US and implemented through BT in the UK as part of the National Programme. It was originally an American billing system.
Change Control Notice (CNN)	National contract re-sets
Change Management	A managed approach to introducing change
Choose and Book (C&B) [1]	One of NPfIT's headline deliverables. An e-booking system operating across the NHS to give patients more choice and control over hospital appointments
Clinical documentation (CDC)	Documenting care procedures, treatments and future plans. NHS CRS software allows this to be done electronically through Clinical Documentation forms.
Clinical information system [1]	Refers exclusively to the information regarding the care of a patient, rather than administrative data, this hospital-based information system is designed to collect and organise data
Cluster	A grouping – in the context of the National Programme, this refers to a geographical grouping of areas that implement different EHR software. They include London, the South and the North, Midlands and Eastern (NME) region of the country. The term was initially used by NS CFH but later replaced by 'geographical region'.
Coding	The process of structuring information for statistical analysis purposes. This is often not visible to the end-user.
Computerised (electronic) decision	Software applications that integrate patient

support systems (CDSS) [1]	data (input) with a knowledge-base and an inference mechanism to produce patient specific output in the form of care recommendations, assessments, alerts and reminders to actively support practitioners in clinical decision-making
Compatibility[1]	Refers to the ability of two pieces of hardware (a personal computer and a printer, for example) to work together. Standards, published specifications of procedures, equipment interfaces, and data formats are essential to decreasing and possibly eventually extinguishing incompatibility.
Computer network[1]	An interconnection of a group of computers. Networks may be classified by what is called the network layer at which they operate according to basic reference models considered as standards in the industry.
Computerised medical record[1]	This involves transferring paper documents into a computer system. This is done either through handwriting or transcription and is transferred into digital form with image scanning, optical character recognition scanning, or hybrid systems of these
Computer Sciences Corporation (CSC)[1]	The LSP for the North West and West Midlands Cluster and North East and Eastern Clusters, delivering software developed by its main subcontractor iSOFT.
Connectivity[1]	The ability to send and receive information between two locations, devices, or business services
Customisation	The ability of a user or organisation to tailor a system to their needs.
Data[1]	In computer science, data is any information in a form suitable for use with a computer. Data is often distinguished from programs.

Data cleansing	Going through data and removing incorrect data
Data migration	Transfer of data between two systems e.g. from iPM to Lorenzo
Data quality	Refers the data's fitness for purpose including completeness, validity, consistency, timeliness and accuracy.
Department of Health (DH)	A central governmental body managing the NHS in relation to both funding and strategic direction.
Deployment verification period (DVP)	A minimum of 45 day "deployment verification period" (DVP) throughout which the software, management and the impact on the organisation is assessed. To assess the success of the new solution against a set of pre-defined verification criteria (both technical and non-technical). This stage represents the transition of support from the project team to the data centre support and help desk teams.
Developer	Those that produce the software and as part of this write and manage the code including iSOFT (Lorenzo), CSE Healthcare (RiO) and Cerner (Millennium).
Detailed care record (DCR)[1]	All notes taken from a patient by healthcare professionals can be considered as the patient's detailed care record. The degree to which this record is accessible by a healthcare professional depends on whether they are providing the patient with care, their role in the treatment given and the patient's own wishes
Download[1]	The process of transferring files or software from another computer to your computer
Early Adopter	Trusts that pilot Lorenzo in a clinical environment and work with the developers (iSOFT) and the LSP (CSC) to make it fit for

	clinical use by feeding back any arising problems. They get a Deployment Incentive Fund" (DIF) of £1 million issued by NHS CFH and are part of the so-called Lorenzo Early Adopter Programme (LEAP). In the context of the current project, we will use the term 'early adopter' in a broader sense to refer to organisations that were amongst the first to implement the NHS CRS systems as part of the NPfIT.
eHealth[1]	A relatively recent term for healthcare practice which is supported by electronic processes and communication. The term is inconsistently used: some would argue it is interchangeable with healthcare informatics, while others use it in the narrower sense of healthcare practice using the Internet. The term can encompass a range of services that are at the edge of medicine/healthcare and information technology
Early Implementer	Or 'fast follower'. These are Trusts that implement after the 'early adopters' of Lorenzo. The Deployment Incentive Fund of £1 million issued by NHS CFH, is not provided to 'early implementers'.
Electronic health records	Also referred to as Electronic Patient Record. This is a compilation of patient information in digital format that can be shared between care settings. May also have additional functionality.
Electronic patient record (EPR)[1]	The EPR concept grew out of the CPR concept and, for a while, was the main term used. Now, some consider this term synonymous to the CPR term; however, an increasing number of individuals state that the EPR vision differs from the CPR

Electronic prescribing (ePrescribing)[1]	The use of computing devices to enter, modify, review and output or communicate prescriptions
Error[1]	An act of commission (doing something wrong) or omission (failing to do the right thing) that leads to an undesirable outcome or significant potential for such an outcome
Foundation Trust	Currently there are 129. These Trusts have increased responsibility and are accountable directly to the Department of Health.
GP2GP[1]	Part of NPfIT. Enables patients' EHRs to be transferred directly from one practice to another
Handhelds	A portable device with the capability to hold Electronic Health Record software.
Healthcare professional	Refers to clinical staff only such as doctors, nurses, allied health professions etc.
Health informatics—or medical informatics[1]	Is the intersection of information science, computer science and healthcare
Implementation	The process of introducing a new system within an organisation (from planning through to routine use).
Implementation team	Those individuals within a Trust that manage the implementation of a new system locally.
Information Technology (IT)[1]	Defined by the Information Technology Association of America (ITAA) as "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware." IT deals with the use of electronic computers and computer software 581to convert, store, protect, process, transmit and retrieve information, securely
Integrated Clinical Pathway (ICP)	Used in different contexts with different meanings. From a technical perspective, in

	the context of the NHS CRS, it was used to refer to automated workflows along a patient's journey of care, that integrate clinical and administrative work.
Interface[1]	The connection between two devices; applies to both hardware and software. May also refer to what is visualised on a screen – what the user will see and use to interact with the software (see also user interface)
Interim system	An electronic system with basic functionality, installed as a first step towards the final Electronic Health Record solution designed to deliver some early benefits to Trusts but planned to be substituted by the final solution eventually. Includes iPM.
Infrastructure	The existing organisational systems present on top of which a new system is introduced. This may include hardware or existing systems such as Wi-Fi.
Interfaces	Providing a connection between two different systems so that the display allows the user to interact with both systems in a more integrated way.
Interoperability	Systems' ability to work along side each other in an integrated way. See also 'compatibility'
Issue Management Process (IMP)	'Early adopter' sites of Lorenzo would get new builds of the system on a regular basis and test them in the testing environment before they went live to the live environment. During this process they collected any issues that emerged either from the testing or from the actual use of each build. These issues were then prioritised and kept by each 'early adopter' site in a log and were collectively managed by 'early adopter' sites, NHS CFH,

	CSC and SHA through what they called the Issue Management Process (IMP). These issues would be reported to CSC, which would then report them to iSOFT in order to be fixed. The process however was not as smooth as presented here.
iPM	The interim PAS supplied by the CSC. This eventually gets replaced with the Lorenzo PAS.
iSOFT	The developer of Lorenzo, managed through CSC.
Legacy system	An old system that is still used despite newer ones being around.
Legitimate relationships/role based access (RBAC)	Security of accessing Electronic Health Records in England is based on legitimate relationships. This means that only users who have legitimate relationships with particular patients have the authority to access their records.
Local Service Provider (LSP)	These hold contracts with NHS CFH are responsible for delivering solutions on the ground
Lorenzo	Electronic Health Record software produced by the Computer Sciences Corporation and implemented through BT in the UK as part of the National Programme. It was originally an American billing system.
Mental Health Trust	A Trust that provides mental health services
National Health Service (NHS)	The National Health Service (NHS) in the UK was established in 1948 with the aim to provide “free” national care for all. Funding is obtained from the taxpayer and managed by the Department of Health. The NHS England functions independently from the NHS Scotland and the NHS Wales.
National Local Ownership Programme	NLOP was set up by the DH in order to

(NLOP)	increase local ownership, share risk and pool resources (financial, expertise, support etc.) locally that relate to the implementation of NPfIT components. The shared funds were planned to be held by local SHAs and distributed to individual Trusts on an "as needed" basis.
National Programme for IT (NPfIT)[1]	Is responsible for procurement and delivery of the multi-billion pound investment in new information and technology systems to improve the NHS
Network[1]	A set of nodes, points or locations which are connected via data, voice, and video communications for the purpose of exchanging information. Interconnected telecommunications equipment used for data and information exchange. Consists of different types, LAN, MAN, and, WAN being examples
NHS Connecting for Health (NHS CFH)[1]	Supports the NHS to deliver better, safer care to patients, via new computer systems and services, that link GPs and community services to hospitals
NHS number	A unique identifier for any given patient in England used to find associated patient records
Output-based specification (OBS)[1]	Each prospective supplier to the National Programme must meet rigorous technical requirements. These are set out in an output-based specification
Patient Administration System (PAS)	A basic electronic system in a hospital that hold patient demographic details and can manage admissions
Personal Demographics Service (PDS)	Holds patient demographic information and patients' NHS number. It is a component of the Spine, which means that this information

	is planned to be shared nationally.
Picture Archiving and Communications System (PACS)[1]	One of NPfIT's headline deliverables. A system capable of acquiring, transmitting, storing, retrieving, and displaying digital images and relevant patient data from various imaging sources and communicates the information over a network.
Pilot	A small scale preliminary test to see if something works, before rolling it out of a larger scale.
Primary Care Trust	A Trust that provides primary care services
Process mapping	Analysis and outline (typically in a flow chart) of a business process resulting in a visual outline of the steps involved to accomplish a particular task.
Product Specialist	Those with intimate knowledge of the product (e.g. the software).
Program[1]	Set of instructions that detail a task for the computer to perform. In this sense, data is thus everything that is not programme code.
Project Initiation Document (PID)	A written plan of an organisational project. Typically follows a structured format outlining present and future states, anticipated benefits, anticipated resources and an approximate timeline.
Requests and results (R&R)	Functionality that allows electronic requests and receiving of results in hospitals. Typically these include radiology, endoscopy and pathology.
Roll-out[1]	The period and activities of progressively going live in each cluster starting with the 'early adopters'. This is backed by the user training by the NHS LSPs.
Secondary Uses Service	Collection of data held in electronic health records on a national level and using this data for reporting of national trends and

	statistical analysis.
Server	Software programme that is the basis for other computer programmes. This can take the form of holding files, managing printers or network traffic.
'Soft landing'	Deploying systems on a small scale running the clinical process in parallel with existing systems and paper initially.
Software build	Different versions of the software released by the developer. These typically present an improvement on the previous version.
Software fixes	Minor changes made to the solution by the developer to respond to emerging local issues. Also called patches.
Software releases	Different components of the software with increasing capabilities. These are designed to be implemented sequentially in order to promote stepwise change.
Spine[1]	The name given to the national database of key information about a patient's health and care and forms the core of the NHS Care Records Service. It will include patient information like NHS number, date of birth, name and address, and clinical information such as allergies, adverse drug reactions and major treatments.
Standards (interoperability)	Software requirements necessary for achieving interoperability between systems.
Standardisation	Complying with a certain standard.
Strategic Health Authority (SHA)	At a local level the English NHS is managed through 10 Strategic Health Authorities (SHAs) and Trusts, whose responsibility it is to ensure that national plans are implemented locally and that local needs are reflected in policy developments.
Summary Care Record (SCR)[1]	A key element of the NHS Care Record

	System. The General Practice summary will be the main or only active part of the SCR; in time it will be supplemented by other contributions. Over time, a SCR will be built up from selected information in a patient's Detailed Care Record. The SCR can be seen by authorised healthcare professionals treating patients anywhere in England, if patients wish them to.
System upgrades	Software typically performs better after an upgrade than it did before an upgrade.
Testing environment	Testing particular software in an artificial environment to determine how it performs before deploying it.
Top-down change	This is hierarchically imposed change initiated by management.
To-take-out medication	Part of the prescribing functionality in the NHS CRS. This is medication that the ward orders electronically from the pharmacy that then dispenses it for the patient to take home. Also known as TTA (To Take Away).
Trust board	A committee in a Trust that has decision making powers.
Trust site	Refers to hospitals/healthcare organisations within the Trust
Trust staff	Refers to all Trust staff including IT, admin, and all other staff, this also includes healthcare staff
User authentification[1]	The process of ensuring an end user is actually the person he/she purports to be.
User interface[1]	The graphic and design components of a Web page that directs users on how to access the information contained in that Web site
Virtual private network (VPN)[1]	A communications network using a tunnelling protocol through another network, dedicated

	for a specific network
WES criteria	Software and hardware criteria specified by CSC that the Trusts need to comply to in order for Lorenzo to work successfully in the specific setting.
Workflow	A chain of steps/activities involved to accomplish a particular task.

[1] These definitions have been adopted from the NHS CFHEP 001 report available from: http://www1.imperial.ac.uk/resources/1636368E-DDEE-42A0-85AC-BDE9EC3B9EA1/

Appendices and supporting material

Appendix 1: Work-package aims and objectives

Original Aims and objectives

The main original aims of our proposed project were to inform the roll-out of NHS CRS with a view to ensuring that this is successfully used and has the maximum chances of introducing benefits whilst minimising harm. In doing so, we were planning to:

- Identify benefits and negative impacts of the new system across a variety of dimensions that were reflected in our work-packages
- Liaise with NHS CFH throughout the project in order to inform both local implementation and national roll-out of the NHS CRS.

The call for proposals presented some indicative research questions, which we have incorporated in six complementary work-packages described below. More generally, we saw these work-packages (WPs) as closely related and, where appropriate, as sharing theoretical approaches, field work activities in data collection, and analytical themes.

The specific objectives that we proposed to focus on were to:

<u>WP1: Implementation, deployment and organisational learning</u>

- Identify and document the implementation strategy in use and its justification, and the balance of planned versus emergent change supported.
- Identify the stages through which implementations proceed, both planned and actual, and the criteria used to progress between stages.
- Identify assimilation gaps and the strategies used to address them
- Identify relevant activities and deliverables at each stage (process and outcomes)
- Assess how safety, patient care and organisational context is incorporated in to implementation activity
- Identify examples of organisational learning and the development of new competencies (technical and evaluative)
- Feedback all the above to support the continuing roll-out of NHS CRS.

WP2: Stakeholder attitudes, expectations, engagement and satisfaction

- Explore key stakeholders' (i.e. including patients/carers, healthcare professionals and managers) attitudes and expectations of the NHS CRS in secondary care before it is introduced
- Explore their early experiences of the NHS CRS
- Explore their perceptions once the system has become established and, where applicable, once they have become experienced users of the new system
- Feedback all the above to support the continuing roll-out of NHS CRS in secondary care.

WP3: Organisational consequences: organisational workflow, professional role and data quality transformations

- Explore how human resource transformations occur in terms of evolving professional roles and remits
- Explore how workflows transform
- Investigate the impact of NHS CRS on the IT literacy of the staff involved
- Understand the changing IT training needs of healthcare professionals
- Investigate the impact of introduction of NHS CRS on data quality.

WP4: Assessment of costs of NHS CRS implementation

We seek to:

- Assess exceptional introduction per-provider costs
- Assess annual (recurring) per-provider costs
- Develop evaluation frameworks to assess the impact of NHS CRS on costs
- Validate cost categories with local providers and with NHS CFH
- Make recommendations about a core dataset for NHS CRS evaluation post-implementation.

WP5: Assessing error, safety and quality of care

- Investigate whether the introduction of the NHS CRS results in improvement in medicine reconciliation on admission to, and discharge from, hospital
- Investigate whether the introduction of the NHS CRS results in improvement in availability of clinical records
- Investigate whether the introduction of the NHS CRS results in improvement in availability of clinical test results in secondary care outpatient and inpatient settings.

WP6: Organisational consequences and implications for future IT deployments and evaluations

- Summarise and integrate the findings from the previous five Work Packages
- Identify barriers and drivers that shape the implementation process and drive the diffusion of NHS CRS within the health community
- Relate findings to the overall objectives of the NHS CRS and NHS CFH – e.g. for seamless care, efficiency gains, error reduction, guideline adherence, disease surveillance etc.
- Assess the degree of transformation of the healthcare system that NHS CRS and associated projects may lead to
- Draw conclusions in respect of governance and communications strategies related to implementations of this scale and complexity
- Identify relevant target audiences for this research, and their specific needs and interests
- Prepare reports and other materials relevant to these audiences and from which they can draw in future work.

Appendix 2: Ethical approval for this evaluation

	Document Description	**Document file name**	**Author**
1.	**Documents relating to application to Ethics Committee for approval for this evaluation**		
1.1	96 page document submitted for ethics approval	SheikhNHSCFHEP005finalversion216thMayconfidential with appendix removed	Kathrin Cresswell
1.2	Letter re: review of application, confirmation of committee hearing date	Valid App 17-09-08	Miss Sandra Burke, East London and the City Research Ethics Committee 1
1.3	Letter re: documents submitted for consideration.	Not within remit 09-10-08	Miss Sandra Burke, East London and the City Research Ethics Committee 1
1.4	Initial Study registration proforma for registration with UK National Institute for Health Research (NIHR) Clinical Research Network (UKCRN) 28th February 2008.	UKCRN Clinical Studies Portfolio – initial study proforma	
1.5	Second Study	UKCRN Clinical Studies Portfolio – initial study proforma	

	registration proforma for NIHR UKCRN 26th September 2008.		
1.6	Response from NIHR UKCRN 14th October 2009.	UKCRN Response letter confirming study eligible	Dr Sam Taylor, Portfolio Lead, NIHR Clinical Research Coordinating Centre
2.	**Documents relating to PhD**		
2.1	Application for ethical approval	RecForm_ReadyForSubmissionv5PhD	
2.1	Ethical approval letter	Ethical approval letter 02-04-09	A T Tucker, Senior Research Ethics Administrator, East London and The City Research Ethics Committee 1

Appendix 3: Research and development approval documents by site

No.	Site	Document file name
1.	A	Hon.contract – Ann Robertson (Honorary Appointment letter)
2.	B	Site B permissions email 03-03-09
3.	B	Site B Caldecott Guardian approval email 30-03-09
4.	B	Site B site access docs
5.	C	Site C access approval email 06-04-09
6.	C	Site C permission from board Minutes_EAProjectBoard_20.03.09
7.	C	Site C Caldecott guardian approval email 20-04-09
8.	H	Site H access approval email from PCT 24-07-09
9.	H	1302 - non-NHS LoA SBPCT-P [K.Cresswell] 04.01.10
10.	H	Site H 1302-14067_NHS_RM&G_Permission_Letter_SBPCT_10-12-09[1]
11.	H	1302 - RM&G Permission Letter SBPCT-P 04.01.10
12.	P	Trust P-Letter-Of-Access-p1 (Access approval letter)
13.	P	Trust P-Letter-Of-Access-p2 (Access approval letter)
14.	P	Trust P-Letter-Of-Access-p3 Completed honorary contract request form including researcher CV.
15.	P	Trust P-Letter-Of-Access-220110 (Access approval letter)
16.	Q	Site Q - email 20-01-10
17.	Q	Site Q - Trust approval letter 16-07-10
18.	X	Site X – Permission email correspondence

Appendix 4: Summary of individual case studies

Title	**Case Study of Trust A**
Study period	Between February 2009 and November 2010
Region (Cluster)	London
Type of Trust (attributes)	Large, multi-site, urban, acute NHS Trust
Number of sites	5 hospitals (3 acute hospitals)
Systems implemented under NHS CRS Programme and timeline	This Trust is to implement Millennium under the Programme's New Delivery Model for London. The staged, first implementation phase, due to start at the end of March 2011, is planned to include order communications, then a Trust-wide Patient Administration System, clinical documentation, care planning, medicines management and maternity systems, plus additional Cerner tools (MPages). The deployment of further Millennium functionality is planned during a follow-on, second, staged phase.
Early Adopter/Fast Follower	Still to deploy
Research method	30 interviews were conducted, 26 with a range of Trust implementation team, clinical and administrative staff, and patients and carers, and 4 with Cerner and the Local Service Provider, BT. Additional data were gathered through attending Trust meetings and collecting Trust documents.
Work-package(s)	WP1, WP2, WP3
Key Contributions	Site A is a relatively new and evolving organisation, following a major merger in 2007 and subsequent innovations. Hence its NHS CRS implementation plans have been strongly influenced by external factors – delays and changes to the London Programme – and internal factors – the changing organisation. The repeated revisions and delays to this Site's deployment plans can be seen to have incurred frustration and staff disengagement on the one hand but, with hindsight, have also allowed this organisation valuable extra time in which to prepare more thoroughly for the imminent implementation.

Title	Case Study of Trust B
Study period	Between February 2009 and November 2010
Region (Cluster)	NME
Type of Trust (attributes)	Large acute Trust providing care in a predominantly rural, geographically scattered and disparate community.
Number of sites	3
Systems implemented under NHS CRS Programme and timeline	This was the first English acute Trust to pilot Lorenzo. It has begun implementing Release 1 as a 'soft landing', running the system in parallel with existing paper systems, in one surgical ward at the end of October 2008. This was followed by go-live at another surgical ward at the end of April 2009, and an orthopaedic ward in June 2009. At time 2 interviews, the Trust had moved to using R1.9 which replaced iPM with the Lorenzo PAS in all areas and locations except A&E. This was the first implementation of R1.9 in an acute setting, a Trust-wide undertaking with a user base of 3,500.
Early Adopter/Fast Follower	Early Adopter
Research method	Interviews with a total of 58 Trust staff including users and implementation team members were conducted. Complementary to these, Trust and press documents as well as researcher field notes and observation notes allowed gaining an insight into the specific context of implementation. We also conducted 5 interviews with patients and collected 2048 questionnaires.
Work-package(s)	WP1, WP2, WP3, WP4, WP5
Key Contributions	The implementation has not been without challenges. This has become particularly clear over time, as the user base and the software functionality increased and the national strategy has evolved. The focus of this case study is the exploration of a seemingly paradoxical attempt to implement non-existent software on a large scale in a complex acute setting, exploring the implications for stakeholders on the ground as well as for the Programme as a whole. It is argued that the most important factor contributing to the lack of progress and problems perceived by users are basic issues with stability and usability of the software

	with development being constrained by national contracts. Technical issues encountered have in turn have impacted on social dimensions such as attitudes, engagement, motivation and ultimately on the perceived success of the Programme as a whole.

Title	Case Study of Trust C
Study period	May-August 2009 and March-June 2010
Region (Cluster)	NME
Type of Trust (attributes)	Large acute Trust providing care to over 1 million people in the community
Number of sites	2
Systems implemented under NHS CRS Programme and timeline	The Trust implemented Lorenzo Release 1 (LR1) by following a 'small scale' approach. LR1 went live in March 2009 and was used for ordering X-Ray requests and reporting results for post-operative hip and knee joint replacements for out-patients and elective inpatient cases. By June 2010 LR1 was being used Trust-wide for uploading VT assessments for inpatients and for reporting. In December 2009 the Trust initiated the Clinical Documentation Project, which intended to digitalise the hip and knee pathway before moving to other pathways within the Orthopaedics and other departments.
Early Adopter/Fast Follower	Early Adopter
Research method	Semi-structured interviews with 23 Trust staff, including users and implementation team members, and Trust-related documents.
Work-package(s)	WP1, WP2, WP3
Key Contributions	We found that configuration was a political process during which interpretations of different groups of people were continuously exchanged and negotiated. In doing so they brought about constant changes in the assumptions inscribed into CRS. Cultures (national and organisational), work ethics (business and professional) and knowledge (or lack) of business processes were important enablers and constrainers of configuration. LR1 brought about some subtle yet important changes in healthcare professionals' work. It conditioned computerisation of work practices, users' informatisation and standardisation of their conduct, influenced the extent to which they can exercise discretion and provided visibility over their and peers' work.

Title	Case Study of Trust D
Study period	December 2009- December 2010
Region (Cluster)	London
Type of Trust (attributes)	Medium acute Trust providing all areas of care located in an urban and affluent area in Great London with 520 beds, 3000 staff, and 320,000 caring population
Number of sites	2
Systems implemented under NHS CRS Programme and timeline	First London acute Trust to go-live with LC1 upgrade of Millennium in London after the NHS CRS was put on hold due to a problematic deployment of LC1 in another first of type Trust. The hospital went live on the final day of November 2009, the very latest that director general of informatics, at the DH, said that Local Service Providers (LSP) BT and CSC were given to make "significant process" with their strategic systems under the National Programme for Information Technology (NPfIT).
Early Adopter/Fast Follower	Early Adopter
Research method	34 semi-structured face to face interviews with various stakeholders at different levels inside and outside the Trust including LPfIT, Cerner, and BT; content analysis of over 900 pages of hospital documents; and 22 hours of field observations. Distribution of the Clinical Computer Systems Survey, to gather users' feedback on Millennium, and more generally assess dimensions of use and usability of hospital clinical systems.
Work-package(s)	WP1, WP2, WP3, WP4
Key Contributions	Multiple perceptions and visions of the NHS CRS were revealed, resulting in stakeholders' multiple views about EHRs. The role of the experienced leadership was crucial to move the implementation of NHS CRS forward. From the outset, the senior management of the hospital described the NHS CRS as a means of change management and "*as a vehicle for improving the hospital performance".* The strategy was not "*thinking too much about IT, rather making sure that the IT is robust underneath*". The hospital paid particular attention to organisational learning and focused on '*here and now'* rather than potential, future benefits.

	The hospital negotiated for a meaningful local configuration of the NHS CRS. The main problems were inadequate software, disintegrated NHS IT, and local resistance. The senior management was clear that it might take them at least 10 years to adopt an EHR system and to realise clearly discernible benefits.

Title	Case Study of Trust E
Study period	May 2009- December 2010
Region (Cluster)	London
Type of Trust (attributes)	Large acute Trust providing all areas of care located in an urban and affluent area in north London with 900 beds, 5000 staff, and 700,000 caring population
Number of sites	1
Systems implemented under NHS CRS Programme and timeline	"First of type' acute Trust in England to go-live with LC1 upgrade of Millennium, which was the first version of Millennium with Spine connectivity. The hospital went live in June 2008 with PAS, Maternity, A&E (Firstnet), Surginet (theatres), order communications, and live bed management on Millennium. The Trust will also be first acute Trust to implement e-prescribing module of Millennium in London.
Early Adopter/Fast Follower	Early Adopter
Research method	27 semi-structured face to face interviews with various stakeholders at different levels inside and outside the Trust including LPfIT, Cerner, and BT; content analysis of over 750 pages of hospital documents; and 19 hours of field observations.
Work-package(s)	WP1, WP2, WP3, WP4
Key Contributions	Multiple perceptions and visions of the NHS CRS were revealed, resulting in stakeholders' multiple views about EHRs. The Trust considered the NHS CRS as another big IT project and felt confident to move it forward. This led to overestimating the capabilities at the Trust level and underestimating the required level of preparation prior to go-live. The vision to the NHS CRS was linear and the role of human and cultural factors to adopt EHRs was overlooked. The Trust put the NHS CRS business case with minimum insight and information, as it was pushed to switch to LC1 half way through the implementation, which had been planned for LC0. Users were reluctant to get engaged with the solution which resulted in many workarounds. Even though the Trust experienced a very problematic and costly NHS CRS implementation, lessons learned at Site E proved to shine the way

	for follower adopters in London.

Title	Case Study of Trust G
Study period	Between October 2009 and October 2010
Region (Cluster)	London
Type of Trust (attributes)	Large, multi-site, urban, mental health NHS Trust
Number of sites	5 main service delivery units
Systems implemented under NHS CRS Programme and timeline	This Trust has implemented the web-based, mental health application from CSE Healthcare (formerly CSE Servelac), and upgraded from RiO version 4 to RiO version 5. In the course of the remainder of the Programme, the Trust is due to receive 15 (London-wide) configuration releases to update the system.
Early Adopter/Fast Follower	Early adopter of basic version of RiO (version 4)
Research method	This was a less in-depth case study, with data sources including 6 interviews with Trust staff (implementation team and clinical staff) and 2 interviews with the Local Service Provider, BT, plus Trust documents.
Work-package(s)	WP1, WP2, WP3
Key Contributions	Site G gives some insights into the frustrations and challenges perceived by some of those receiving RiO mental health systems through the Programme, despite RiO often being presented as a "success" of the London Programme by others, and some insights into a Trust's support needs when undergoing a major IT-system upgrade. It highlights a perceived need for far greater openness about "failures" and sharing lessons learned in order to avoid future repetitions of similar problems.

Title	Case Study of Trust H
Study period	Between July 2009 and July 2010
Case	Trust H
Region (Cluster)	NME
Type of Trust (attributes)	A large urban Primary Care Trust commissioning both regional and specialty services.
Number of sites	1
Systems implemented under NHS CRS Programme and timeline	Ten healthcare professionals were the first individuals to ever use the newly developed Lorenzo R1 in a clinical context on the 3rd of September 2008. This was initially planned to be a three month pilot of the system but is, as of October 2010, still ongoing. The rest of the podiatry team started using Lorenzo in May 2010 and was until then still using paper systems.
Early Adopter/Fast Follower	Early Adopter
Research method	Interviews with a total of 24 Trust staff including healthcare professionals and implementation team members were conducted and analysed in combination with over 600 pages of Trust documentation, researcher field notes, observation notes and articles in the media. We also conducted 28 interviews with patients.
Work-package(s)	WP1, WP2, WP3, WP4
Key Contributions	This small scale and resource-intensive implementation gives an insight into issues surrounding sustainability and scalability of implementation approaches. It illustrates that, whilst significant efforts can help to integrate the software with existing work practices locally, implementation success is not only characterised by sociotechnical considerations in the micro environment but also by the potential of transferability to other settings as well as sustainability in terms of resources, which in turn impacts on local arrangements.

Title	Case Study of Trust M
Study period	May 2009- November 2010
Region (Cluster)	London
Type of Trust (attributes)	A large mental health and social services Foundation Trust providing all areas of mental healthcare and social services with some 1,800 staff who work in over 110 teams spread out into 34 sites across the two boroughs located in an urban area in north London that serves 515,000 population.
Number of sites	2 hospitals and 4 community centres across two boroughs
Systems implemented under NHS CRS Programme and timeline	7th (out of 10) mental health Trust that went live on RiO in London and 1st London Trust who went live with RiO 5.1 which had Spine connectivity. The Trust went live in two main phases in December 2008 and September 2009. The Trust will also be the first mental health Trust to implement e-prescribing module of RiO in London.
Early Adopter/Fast Follower	Fast Follower
Research method	48 semi-structured face to face interviews with various stakeholders at different levels inside and outside the Trust including LPfIT, CSE Health International, and BT; content analysis of over 1100 pages of hospital documents; and 26 hours of field observations.
Work-package(s)	WP1, WP2, WP3, WP4, e-prescribing (ep) pilot
Key Contributions	Given a general poor history of EHRs in mental health sector, arrival of NHS CRS was well welcome at Trust M. Although the project management and leadership of the Trust were praised because of their insight towards the Programme, the overall professional competence of the managers might have been limited to general IT project experience. Compared to acute trusts and other mental health trusts in London that moaned a great deal about NHS CRS and mainly experienced pain, Site M was perceived to have had a smooth and continuously improving implementation of RiO. Our evaluation found that the Trust was determined to make RiO work in the organisation and did not dream that it would deliver many short-term benefits. Modest expectation, appropriate infrastructure and preparedness;

	continuous analysis to address issues and shortages plus a clear desire from the leadership to make EHRs work all contributed to a successful implementation of RiO at Site M. ePrescribing was also perceived to be beneficial for patients' safety and to have the potential for reducing error. However, it was at a very early pilot stage when we evaluated the module.

Title	**Case Study of Trust P**
Study period	January - August 2010
Region (Cluster)	South
Type of Trust (attributes)	Large acute Foundation Trust (teaching hospitals), providing care in a geographically scattered community
Number of sites	5
Systems implemented under NHS CRS Programme and timeline	The Trust was planning to implement Millennium with Fujitsu but the implementation never began.
Early Adopter/Fast Follower	n/a
Research method	Focus on the integrated stroke pathway and the use of information and technology for the pathway. Data collected through observation and unstructured interviews. Documents available on the Web were consulted to inform analysis of history of the Trust and the wider context.
Work-package(s)	WP1, WP2, WP3
Key Contributions	The case study offers: • Insight into how a stroke pathway unfolds in practice in an acute setting, and the use of, and needs for, information and technology for clinical and administrative work; challenges of workflow automation; needs for reporting functionalities. • Insight into the processes of technology adoption and use: beyond the software interface, to the combination of hardware, space, and people; the difficulty of replacing communication with computerisation; transformations in the nature of work; and possible issues of 'image' computers project to colleagues and patients. • Questions on the meaning of the term pathway, used to signify the whole (the entire flow) and/or its parts (e.g. a Thrombolysis set of paper forms), as well as the whole in prospect (e.g. the care plan) or in retrospect (e.g the care provided).

Title	Case Study of Trust Q
Study period	Between December 2009 and November 2010
Case	Trust Q
Region (Cluster)	NME
Type of Trust (attributes)	Mental Health Trust providing day care, in-patient care and community services (including services in patient's homes) over a large geographical area.
Number of sites	3
Systems implemented under NHS CRS Programme and timeline	Trust Q was the first mental health Trust to use Lorenzo and the fourth Trust to ever use Lorenzo software. It went live on the 28th September 2009 with Lorenzo R1 and deployed to all five community teams of one of their services. The deployment of R1 was viewed as a pilot deployment before the other Trust services went live. There were initially about 140 end users (the largest user base of Lorenzo R1 anywhere), which is still accurate as of November 2010.
Early Adopter/Fast Follower	Fast Follower
Research method	Interviews with a total of 20 different Trust staff including users and implementation team members were conducted and analysed in combination with Trust documentation, researcher field notes, observation notes and media articles.
Work-package(s)	WP1, WP2, WP3, WP4
Key Contributions	National arrangements have impacted on the progress of local implementation activities and use of the software. The Trust had, despite adequate local resourcing and motivation to proceed, initially succeeded in implementing the software on a relatively large scale. However, over time it became apparent that the progress of implementation remained relatively static, and that users were getting increasingly frustrated with software that was not perceived as fit for purpose in its current state and led to significant changes in work practices with several unintended consequences. Fundamentally different assumption between organisational stakeholders may have contributed to a lack of progress.

Title	Case Study of Site R
Study period	February 2010 -November 2010
Region (Cluster)	South
Type of Trust (attributes)	Site R constitutes along with another hospital an acute Trust that provides services to 250.000 people in the community
Number of sites	2
Systems implemented under NHS CRS Programme and timeline	The Trust implemented Millennium Release 0 by following a 'big-bang' approach. Millennium R.0 went live in March 2007. It offered PAS and some clinical and administrative functionality. After 18 months the Trust merged with another hospital and decided to opt out of Millennium implementation and turn to an upgraded version of their previous PAS, a solution that all other hospitals within the Trust used.
Early Adopter/Fast Follower	Early Adopter
Research method	Semi-structured interviews with 5 Trust staff, including IT, management and clinical implementation team members, Trust-related documents and articles from the media.
Work-package(s)	WP1, WP2, WP3
Key Contributions	The Site provides interesting insights into critical aspects of managing NHS CRS implementation. These aspects were related to the design of the software, the delivery mechanisms of the software and the management of the implementation primarily at an inter-organisational level but also at an intra-organisational level. Specifically, some outstanding issues were related to the lack of Trust's choice concerning software solution, limited functionalities of the software, difference between the assumptions embedded in the system about clinical work practices and actual clinical work practices, top down decision making process, prioritisation of outcomes over processes, command and control culture, rigid and undisclosed contractual restrictions and a culture that obstructed knowledge sharing between adopter sites.

Title	Case Study of Trust X
Study period	May 2010 and December 2011
Region (Cluster)	NME
Type of Trust (attributes)	Small acute Trust providing care in a predominantly rural, geographically scattered and disparate community.
Number of sites	1
Systems implemented under NHS CRS Programme and timeline	Early Adopter site developing use of Lorenzo R1.0 for clinical documentation within one speciality and in relation to some pathology services. Although the system fulfilled the 'go-live' contractual criteria for implementation in September 2010 paper records continue to be used in parallel. Developments planned for more extensive pathology 'Requests and Results' functionality were planned for February 2011 but are now intended for end March/ early April 2011. The current user base is small (*n* = <40) and there is low awareness or curiosity regarding the system amongst non-users. Dates for migration to R1.9 are not currently decided.
Early Adopter/Fast Follower	Early Adopter
Research method	Longitudinal case study involving two separate visits to gather data on-site. The first visit (T1) took place in May 2010, the second (T2) in December 2010. During both T1 and T2, two researchers simultaneously conducted qualitative interviews (*n* = 27) and observations together with a quantitative study of case note availability. In addition, documentary analysis of Trust, software provider and press documents has been conducted.
Work-package(s)	WP1, WP2, WP3, WP5.
Key Contributions	Lorenzo software at this site has been studied with regard to the adoption of electronic health records (EHRs) and the National Health Service Care Records Service (NHS CRS). Work to introduce Lorenzo would be described more accurately as development rather than adoption. Whilst there was significant local evidence of both the capacity and desire to implement EHRs, software functionality was very limited, was felt to have taken far in excess of the time intended and to have required an unanticipated degree of service user input. Issues with the pace and quality of

	software engineering contributed to a significant lowering of expectations of Lorenzo in the provision of EHRs and resultant benefits to clinical care. During T1 it was very much discussed as a focus for the future whereas during T2 it was described as only one component of local EHR provision. Development of Lorenzo appeared driven by regional and national procurement and contractual obligations. There was a notable lack of senior engagement in the Lorenzo project, with only isolated examples of local leadership and no evident local strategy. There was no evidence of Lorenzo positively impacting upon clinical care nor patient experiences and outcomes. Over the course of the study, technical difficulties and a lack of strategic direction were further compounded by a changing economic and political climate. This was apparent in a sense of uncertainty regarding financial support for Lorenzo and concern amongst staff that efforts to date would not be pursued to fruition beyond the current financial year. In summary, this small study illustrates a continued motivation amongst more junior staff to successfully introduce changes to their working practice that will improve patient care. A lack of systems capability, the time taken to develop systems, lack of leadership, clear strategic direction, staff awareness of the system and financial uncertainty have contributed to staff prioritising technical solutions that will deliver more immediate and expedient local improvements in preference to that sourced through regional procurement and defined by national strategy.

Appendix 5: Interview topic guide: Work-Packages 1-3: NHS Connecting For Health, SHA and LSP staff

Interview guide for representatives of the LSP, Software developers and SHAs

Please note that some themes of this guide may not apply for all LSPs, Software Companies and SHAs due to the different nature of the software or service being provided.

Interviewee's Background

Job role

Length in service

Implementation

Challenges that the LSP/Software houses/SHA faces concerning the development and implementation of CRS software

Methodology followed for CRS software development

Testing process: steps, problems reported

Process of addressing issues that Early Adopter sites raise

Strengths and weaknesses of CRS software

Resources LSP has dedicated to early adopter sites

Software outsourcing

Perceptions

Role of LSP//Software houses/SHA in the Programme

Achievements from the adoption of NHS CRS software in early adopter sites

Issues/difficulties they faced from the adoption of CRS software in early adopter sites

Collaboration and communication process between different stakeholders (SHA, CFH, Trusts)

Consequences of the political and economic context on the NPfIT and CRS

Contract: issues and obstacles

Lessons that can be transferred to future implementation sites/practices

Evolution of CRS in the future

Standardisation and/or localisation of the implementation process: views, rationale, benefits and disbenefits.

Appendix 6: Interview topic guide: Work-Packages 1-3: Healthcare professionals and managers

Interview Guide for Healthcare Professionals (and other users of the systems)

Note that sections in italic are common with section in Implementation Team Interview Guide.

Interviewee's Background:

- Current position in the organisation
- Relation to CRS

Background about the current status of CRS*:*

- Software
- Release
- Functionality being used & future upgrades [T2]
- Location of use and users (ward, clinics, departments etc)
- Previous systems that CRS software replaced and other current systems
    - What systems did you have prior to CRS? What for?
    - Are there any systems in place for patient management, like vital sign monitoring; or is there going to be?
    - What is the level of integration of existing systems, e,g together and with CRS[T2]

[Some users – mostly the super users – have been involved in the implementation process. In this case, we also use the questions from the Implementation section]

Use of NHS CRS software:

- Previous systems that NHS CRS software replaced
- How the interviewee uses the system
- Changes in the way you use the system [T2]
- Training received and ongoing support
- IT literacy and skills – your own – your team etc.
- Tasks carried out through the system
- Frequency of use/ conditions of use
- Initial, current and ongoing problems and concerns

- Changes that the user would like to see happening in the system
- Role-based access & access to the Spine [T2]

Changes that the system has brought about:

- New tasks that have been added
- Old tasks that have been eliminated
- Same tasks done in a different ways
- Workarounds
- Modes of collaboration with other healthcare professionals
- Modes of interaction with patients
- Preparation of (new) standard operating procedures (T2)

Consequences of the NHS CRS on:

- Quality of Healthcare
- For Patients & patient pathways
- Healthcare professionals
- Trust
- Local Community
    - Connection to and collaboration with GPs and PCTs [T2]
- Changes in your expectations [T2]

Perceptions

- NHS CRS in the future (local and national level)
- What would you do differently?
- Is it necessary?
- Is it worth it
    - Benefits that you realised so far
- What is it all about?

  Is the NHS CRS an end or a means for other changes

Appendix 7: Interview topic guide: Work-Packages 1-3: Implementation Teams

Interview Guide for Members of the Implementation Team

Interviewee's Background:

- Current position in the organisation
- Relation to NHS CRS

Background to the current status of the NHS CRS:

- Software
- Release
- Functionality being used & future upgrades [T2]
- Location of use and users (ward, clinics, departments etc)
- Previous systems that NHS CRS software replaced and other current systems
    - What systems did you have prior to NHS CRS? What for?
    - Are there any systems in place for patient management, like vital sign monitoring; or is there going to be?
    - What is the level of integration of existing systems, together and with NHS CRS[T2]

Implementation/Adoption:

- Decisions that were made (Who? What criteria?)
    - What were the reasons behind NHS CRS/moving to Millennium/Rio/Lorenzo
    - The way the business case was prepared; who participated, how approved? And changes to that?
- Who involved in implementation (groups and people)
    - IT literacy
- How
    - Steps that were followed
    - Methodology
        - Factors that influenced the implementation process (e.g. history, delays)
        - Changes in the implementation strategy [T2]
        - Issues of local configuration
- When (timeline)
- Incentives offered or given

- Resources used(human resources, financial)
    - Changes in resources [T2]
- Training provided and ongoing support
    - The method for training, real data or virtual – right software version? Was any material provided? Who provided, What form?
    - What is the Trust's strategy for new staff who need to use NHS CRS? Training, induction, SmartCard, etc.
- Management of data.
    - Where are data kept and how are they managed? [T2]
- Collaboration within the organisation and across organisations:
    - Software developer- LSP- NHS CFH- Trust:
        - Interests (differences and similarities)
        - Mechanisms to encourage collaboration; how do you work together?
        - Issue management process (who, how, what problems, mechanisms to resolve problems, examples of issues) [T2]
        - Teething, current and ongoing problems
        - What might be done differently?
        - Awareness and Views about the contract
        - Changes in the level of involvement of each organisation [T2]
    - Early Adopters
        - Feelings for being early adopter
        - Mechanisms to facilitate collaboration among early adopter
        - Lessons learned as used as input; as provided as output
        - What can & cannot be learned & why?) [T2]

Consequences of the NHS CRS on:

- Quality of Healthcare
- For Patients & patient pathways
- Healthcare professionals
- Trust (management, strategy)
- Local Community
    - Connection to and collaboration with health economy (GPs and PCTs) [T2]
- Changes in your expectations [T2]

Perceptions

- NHS CRS in the future (local and national level)

- What would you do differently?
- Is it necessary?
- Is it worth it?
- Benefits realised so far
- What is it all about?
- Is NHS CRS an end or a means for other changes

Appendix 8: Interview Topic Guide: Work-Packages 1-3: Patients and Carers

Interview Guide for Patients and Carers

The following guides can be used for interviewing patients and/or their carers. The guide includes themes to be discussed rather than specific questions. The interviewer is expected to adjust some of these questions depending for instance on the setting where the interview takes place i.e. waiting rooms, wards and the condition of the patient.

Background:

Patient/Carer

Location of the interview

Specialist/clinic they are seeing

Views:

Personal views about the process and quality of healthcare they receive (draw upon recent and past experience).

Impression of whether hospitals are paper based, electronic or both. Functions for which paper and technology are being used.

Perceptions about major changes that have taken place in the delivery of healthcare in the last few years.

Feelings about having an electronic record as opposed to paper record.

Awareness of NHS CRS: source of information and understanding of it.

Expected benefits from electronic records.

Concerns about electronic records (safety, confidentiality etc).

Opportunities that electronic records may provide to patients, healthcare professionals & Trusts.

Impact that CRS may have on their relationship with healthcare professionals.

Appendix 9: Project Information Sheet

Evaluating the adoption of the NHS Care Records Service in Secondary Care

The introduction of electronic health records into NHS hospitals is a very important policy development that is being pursued through NHS Connecting for Health. We seek the opportunity to work with you and your Trust to evaluate the adoption of the NHS Care Records Service (NHS CRS) in your hospital. This independent research is funded by the NHS Connecting for Health Evaluation Programme and is being conducted by a team of independent academics and clinicians from the Universities of Edinburgh, Nottingham and London.

Through the various elements of this project we expect to learn some salient lessons about the implementation and adoption of this important organisational transformation. We are particularly interested in the attitudes, expectation and experiences of healthcare professionals and IT personnel involved in all stages of the implementation of the new technical systems that are being procured and introduced as part of the NHS CRS. We want to enquire about their experiences of identifying these systems and setting them to work, and to study the consequences (actual and projected) of the new electronic health record on the safety and quality of care provided. We consider care pathways as a useful platform to evaluate the transformational change that CRS may bring across different NHS settings. To this aim, we will focus on stroke pathways, as a particularly relevant exemplar for the analysis of NHS CRS used for coordination of care. We are also interested in assessing the cost to Trusts of implementation.

To ensure we develop a rounded understanding of the issues relating to implementation of NHS CRS in particular Trusts, our researchers expect to undertake anonymised interviews with approximately six healthcare professionals (including doctors, nurses and allied healthcare professionals) and six other hospital-based administrative, IT and managerial staff. We will seek some patient input to the study depending on the situation in a particular Trust. When appropriate we will wish to interview some persons more than once so as to capture the changing situation. The project has also developed a survey instrument the Clinical Computer Systems Survey (CLICS) to assess systems in use by clinical staffs including doctors, nurses and pharmacists.

We are very aware of the pressurised hospital environment and will therefore make every

effort to minimise any disruption or time commitments for your staff, but taking part in this study will take up a small amount of management, clinical and administrative staff's time. We will aim at keeping this at no more than two hours for any individual over the course of the project.

We believe that there are a number of potential benefits for your Trust and staff participating in this evaluation:

- Your Trust will have a detailed and real-time insight into how the new system is being received on the ground and what steps might be undertaken to facilitate local implementation.
- This research will allow you opportunities to feed back to NHS Connecting for Health and the wider health policy community.
- The project team may also help to keep you up-to-date with the latest developments in relation to the national implementation of the NHS Care Records Service.

This study has now been adopted by the UKCRN, further details of which are available at

http://public.ukcrn.org.uk/Search/Portfolio.aspx?titleAcro=&chiefInvStudyCoord=&isrctn=&UKCRNStudyID=7540&ResearchSummary=&SearchType=Any.

Appendix 10: Participant consent form

An evaluation of the adoption of the NHS Care Record in secondary care
HEALTHCARE STAFF INTERVIEW CONSENT FORM

Please tick all the boxes and give this form back to the receptionist. If you don't feel able to all the boxes, or if you change your mind at any point, we will not include you in the research.

	Tick
I have read the information sheet dated [please insert] and asked any questions I want, which were answered to my satisfaction (Please note that the information sheet gives the names of people you can contact to discuss the study)	
I have been informed of the objectives of the study, my role within it, and the tasks I am expected to undertake	
I understand that I will be participating in a study to investigate my perceptions and experiences of the NHS Care Records Service	
I understand that I am free to withdraw from the study at any time and without giving a reason for withdrawing	
I have been reassured that the procedures adopted by the researcher to ensure my anonymity as a participant will be maintained	
I understand that the research team will agree to erase my contribution to the audiotape of the interview should I request this	
I have been provided with the contact details of the research team and have details of the complaints procedure that I can use if I wish to	
I am happy to be quoted (for example, when the research is published) so long as my name isn't mentioned. *[if not happy to be quoted, leave blank]*	
I agree to participate in the study	

Name of participant (capitals):
……..……

Signed: …… Date: ……..

I would prefer a face-to-face/telephone interview ***[please delete as appropriate]***

I agree to be contacted again for a follow-up interview (please tick) ☐

Please return to: *Insert name and contact details of relevant researcher*

Appendix 11: Sample list of documents collected

This list provides samples of the types and nature of the documents collected and analysed during this evaluation.

Site A

Annual Report 2009-10
Annual Report 2008-9
Annual Report 2007-8
Business Plan 2008/9-2009/10
Business Plan 2009/10-2010/11
Management Structure Chart Document
AHSC Vision Document
CQC Performance Rating Summary
PALS Information Leaflet
Declaration of Compliance Document
Quality Accounts 2009-10
Consultation on Foundation Trust Application
Response to Foundation Trust Application
Board Meeting Minutes Feb. 2009
Board Meeting Minutes April 2009
Board Meeting Minutes June 2009
Annual General Meeting July 2009
Board Meeting Minutes Nov. 2009
Board Meeting Minutes Feb. 2010
Board Meeting Minutes April 2010
Board Meeting Minutes Sept. 2010
Board Meeting Minutes Jan. 2011
Trust News (360 Degrees) Jan. 2011
Trust News (360 Degrees) Jan. 2010

Site B

Deployment History Timeline
Electronic Patient Record Next Stage Business Case
Lessons Learnt Document
Lorenzo Newsletter
Pathology Catalogue
Project Initiation Document – Lorenzo R2
Site B Project Initiation Document (PID)

Site B Trust Electronic Patient Record Next Stage Business Case Board March 09

Site C

Site C EA Risks 2008-06-18
Site C Version Of Local Cost Reporting Tool
Business Continuity Plan 180309 - Revised V03
EPR CAG Tor (Electronic Patient Record Clinical Advisory Group Terms Of Reference) March 2010 V1.1
GD CAG (Going Digital Clinical Advisory Group) Meeting Notes 2010 11 05
Lessons Learned Report
Local Cost Reporting Tool
Local Safety Agreement Milestone Sign-Off Recommendation For Deployment Go-Live ATP
Lorenzo Release 1 Clinical Documentation Project
Minutes – Project Board – 04.07.08
Minutes – Project Board – 14.05.09
Minutes – Project Board – 17.04.08
Minutes – Project Board – 17.09.08
Minutes – Project Board – 17.12.08
Minutes – Project Board – 20.03.09
Minutes – Project Board – 20.08.08
Minutes – Project Board – 20.11.08
Minutes – Project Board – 21.02.08
Minutes – Project Board – 22.05.08
Minutes – Project Board – 23.01.09
Minutes – Project Board – 25.03.08
Minutes – Project Board – 26.02.09
Minutes – Project Board – 26.03.09
Project Initiation Document – Lorenzo R1
SHA NIMM (National Infrastructure Maturity Model)
Y&H_14122010

Site D

CRS Action Log v0-3.xls
Benefits Review Plan v0.3 Draft.doc
Returning to BAUv0-3.doc
CER201000114 UK Roadmap Placemat - CCN3
CRS Phase 1 Audit Final Report
Weekly Service Management Dashboard
Costs summary

CRS Board minutes
CRS Finances
CRS Performance Test
Daily Performance Report
Divisional Training Stats
CRS Communication Plan
User Guides
CRS Highlight report
Report Milestones

Site E

070305-Lessons Learned
Actions Lessons Learnt
Activity And Finance Report
Appendix 2_2007.18 Trust Resource Requirements
Appendix 2_Training Plan V2
Appendix 4_Actions Lessons Learnt
Appendix B_Activity And Finance Report
Appendix B1_Timing Of The Care Records Service
Appendix C_Action List Lessons Learnt 14_01_08
Appendix F_CRS Financial Report March 2007
Benefit Paper_Nov07
Benefit Realisation Strategy _Nov07
Benefit Register V1.0
Benefit Register_Dec07
Benefits Paper And Register
Benefits Realisation Strategy
Benefits Strategy Approach (Benefit Realisation Strategy)
Business Continuity And Cutover Status
Business Continuity Plan
Business Transformation Report
Cerner Advisory Group Meetings: Agenda And Notes.
Cerner Foundation Reports And Feedbacks
Cerner Gold Meetings: Agenda And Notes
Champion Users Reports
Change Management Strategy
Clinical Engagement Strategy
Clinical Improvement Workplan
Clinical Workshop Updates

Clinical Workstream Overview
Correspondences With Users For Feedback And Recommendation
CR1_APR_0102 [name] 2007 18 Upgrade
CRS Communications Strategy
CRS Deployment High Risks & Issues
CRS Expenditure Report
CRS Expenditure Report Month 12 2007-8
CRS Expenditure Report Month 8 2007-8
CRS Expenditure Report Oct 2007 (Final)
CRS Financial Report
CRS Full Risk Register
CRS Interface Recovery Plan
CRS Key Dates Mar 07
CRS Key Dates Report
CRS Programme Board Meetings: Agenda And Notes
CRS Programme Review Meetings: Agenda And Notes
CRS Project Framework
CRS Project Organisation
CRS UK-User Group Presentations
CRS Workstream Meetings
Floorwalking Plans
Lessons Learned Presentations
Project Plan Reports
Project Status Report At Various Stages
Resources Assessment Reports
CRS Training Approach
Risk Assessments And Risk Issues
Service Management Status Updates
Shortcut To CRS Expenditure Report
Terms Of References Board
Timing Of CRS
Training Plans
Training Update 170707
Training Update Aug07
Various Presentations For Programme Update For Different Groups Of Participants

Site G

Trust Business Plan 2010 report RiO London – roadmap
Quality Account 2009/10 & Priorities 2010/11 Report

Update on the RiO v5 Implementation, 2009 Report
Annual Report 2009-10
Annual Report 2008-9
Policy document: Health Records
Policy document: Information Governance
Policy document: Risk Management
Operations Board Minutes 2010
RiO Mental Health Solution Document
RiO-CCN3 London Document
RiO London Roadmap

Site H

090210 NLOP HR Subgroup Minutes
090317 NLOP HR Subgroup Minutes
090421 NLOP HR Subgroup Minutes
Agenda July 09 Lorenzo 1 V0.2
Evaluation Interim Report
IMT Leads Minutes 090112 V0.2
IMT Leads Minutes 090317 V0.1
IMT Leads Minutes 090421 V0.2
LRC Deployment Units
NLOP Board Briefing Paper (Agenda Item 3)
NLOP Board Briefing Paper (Agenda Item 4)
NLOP Board Briefing Paper (Agenda Item 5)
NLOP Board Briefing Paper (Agenda Item 5) Review
NLOP Board Briefing Paper (Agenda Item 5) Training
NLOP Board Briefing Paper (Agenda Item 6)
NLOP Board Briefing Paper (Agenda Item 6) Finance Subgroup
NLOP Board Briefing Paper (Agenda Item 6) Paper
NLOP Board Briefing Paper (Agenda Item 6) Smoothing Changes
NLOP Board Briefing Paper (Agenda Item 7) Chunk Projects
NLOP Board Briefing Paper (Agenda Item 7) Host Organisation
NLOP Board Briefing Paper (Agenda Item 7) Interim Extension
NLOP Board Briefing Paper (Agenda Item 7) LIG Monies Paper
NLOP Board Briefing Paper (Impact Of Delay Paper)
NLOP Board Briefing Paper (SHA Briefing Paper)
NLOP Board Minutes 071008 V0.3
NLOP Board Minutes 090220 V0.3
NLOP Board Minutes 090625 V0.3

NLOP Board Minutes 111208 V0.2
NLOP Board Minutes 120608 V0.1
NLOP Board Minutes 200808 V0.3
NLOP Central Team Transition V0.2
NLOP Change Advisory Board
NLOP Cost – Benefit – Risk Paper
NLOP Finance Subgroup Minutes 20090107
NLOP Finance Subgroup Minutes 20090217
NLOP Finance Subgroup Minutes 20090521
NLOP Phase 1 Assumption
NLOP Resourcing
NLOP Workshop All A Feedback
NLOP Workshop B Trust Overlap
NLOP Workshop C Trust Benefits
NLOP Workshop D Timescales And Smoothing
Pro And Con's Of Going It Alone
Project Status Reports X 2
Site H Project Initiation Document (PID)

Site M

090727 Highlight & Transformation Report
Action Logs X1
Benefit Plan By BT, Oct 10 X 1
Board Agenda 28 Jul 09
Business As Usual X 1
Annual Report
CCN3 X 2
Consultancy Reports X 3
CRS Board Docs X 22
CRS Update X 13
Enc 4 High Level Plan5 (Go-Live Schedule)
Enc 5 Rio Risk Register
FBC Benefit Update 081223
Finance X 2
General Documents X 12
Lessons Learnt
Minutes Of 26 March 2009 Meeting Of The Foundation Trust
Minutes Of [name] Rio Go-Live Meeting May 6
Performance X 5

Progress Reports X 16
Project Initiation Document V1.2 191108
Rio Board Meetings (Board Agenda 22 Oct 09)
Rio Board Meetings (Board Agenda 28 July 09)
Rio Board Meetings (Board Agenda 4 Dec 09)
Rio Board Meetings (Board Agenda 4 Sep 09)
Rio Compliance Status Reports (PER-PD3-0051)
Rio Compliance Status Reports (Stage 3b)
Rio Full Business Case (V1.0.5 Draft)
Rio Issues Register (V 2.0 CI)
Rio Risk Register (V2.4 CI)
TB Header X 13
User Guides X 22
Visio-[name]High Level Plan 7 (Go-Live Schedule)
Work Stream X 13
As Is Process Map1_Vfinal
As Is Process Map2_Vfinal
As Is Process Map3_V0.4final
To Be Process Map_V1.4
Rio Eprescribing Benefits Baseline Plan_Vfinal
Rio Eprescribing Pilot Introduction_Final
Rio_Triage_Webit_V1
E-Prescribing Demo Agenda 19072010
Frequently Asked Questions 1.3
Rio Eprescribing Pilot_PID_Final
Rio Eprescribing Outpatient Agenda_V5.4-1.0
Rio Eprescribing Pilot_Formal Participation Letter
Rio Eprescribing Pilot Training Manuals 1 and 2
Rio Eprescribing Pilot Training_Agenda
Rio Eprescribing Pilot Baseline Reports_V1.0

Site P

Benefits Mapping_Ver0.6
Is CRS Efficient?
Mappings Summary For Evaluation
Relative Importance And Complexity
Trust Information Leaflet On Hospital Redevelopment
Meeting Summary Of Innovation Workshop 31st March 2009
Our 'To Do' List For 2009/10

Measuring Patient Safety - Powerpoint Presentation

Site Q

Site Q Deployment Verification Reports X 2
Site Q Lessons Learnt Report
Site Q Project Initiation Document (PID)

Site R

BCP Plan For Cutover
Business Continuity Plan For Downtime Procedures
CERNER Installation And SEMAHELIX Downtime [CONFIDENTIAL]
Change Report For PID
Clinical Risk Of Untimely Haste In “Go-Live” Of Care Records Systems (CRS) In The NHS Connecting For Health Programme [CONFIDENTIAL]
Lessons Learned Report
NHS Governance And Cerner Millennium R0 [CONFIDENTIAL]
Nursing Handover Notes On Semahelix [CONFIDENTIAL]
PID
Risk Register
Some thinking about CRS and a way ahead for the NHS CRS Project [CONFIDENTIAL]

Site X

Site Map Of [name]
Lorenzo Regional Care Information Booklet (Includes Benefits DVD)
Lorenzo Regional Care Information Pack - Short Document, Coloured Printout
Lorenzo Regional Care Information Pack - Long Document, Product Details And Deployment Process
Training Flyer Advertising Courses
It Skills Self-Assessment Form
It Skills Information Document
Benefits Of Lorenzo
[name] Pathology Training Approach
Information Pack Lorenzo
The Lorenzo System Starter Pack (Powerpoint Presentation)
[Clinic name] Clinical Documentation Go-Live Starter Pack
Powerpoint Presentation Regarding Business Change From LSP
News Article From British Journal Of Healthcare Computing & Information Management
Email From Programme Manager To Project Board
Supporting Information For Locally Produced Discharge Summary System.

Notes From Medical Records Department

Other Sources

The Information Commissioner's Office: The NHS Care Record Guarantee
The King's Fund; Windmill 2009: NHS Response To The Financial Storm
Impact Study: Report On The Socio-Economic Impact Of Interoperable Electronic Health Record (EHR) And Eprescribing Systems In Europe And Beyond
London Programme For IT: Connecting Care Across The Capital, Benefits Statement 2007/ 2008.
Hayes, G, 2009: Independent Review Of NHS And Social Care IT.
Copy Of Local CRS Business Case VFM Tool.Xls
NHS CFH NHS IM&T Investment Survey 2008.Pdf
The National Programme For IT In The NHS: Progress Since 2006.
Several Sets of Minutes from our meetings with Connecting for Health
Several sets of press documents

Appendix 12: Survey instrument: Work-Packages 1-3 CLICS

CLICS • Clinical Computer Systems Survey
A survey for all clinical staff across different NHS services

This survey asks about the use you make of clinical computer systems.
It is also an opportunity for you to provide feedback on these systems.
Participation to this survey is anonymous.
The survey should take you approximately 10 minutes to complete.

Other NHS services and Trusts are or will also be participating in this survey.
The use of this survey in [SITE NAME] has been agreed with [NAME AND ROLE].

Text in red in square brackets is to be customised for each site

How to complete this survey:

- You have been asked to participate in this survey as you are involved in patient care at [SITE NAME]. Please answer all questions in this survey with respect to *this* [NHS service/site].
- We understand not all questions may be applicable to all clinical or professional roles or all NHS services and Trusts; please feel free to select *'Not Applicable'*, or '*I don't use it'* if a question does not relate to your role or job.
- Please also feel free to write additional comments at any point.
- You can either complete the survey online at https://www.[Trust-customised-link]/ or print out this questionnaire and return it by post to the address below.

This survey is part of a wider project investigating the adoption of the NHS Care Record Service in England. More information on the project can be found at http://www.nhs-crs.org.uk/. If you have any questions about this survey, please feel free to contact the research team at the London School of Economics.

Anthony Cornford, Ela Klecun, Valentina Lichtner
Information Systems and Innovation Group, Department of Management
London School of Economics and Political Science
Houghton Street, London, WC2A 2AE
Tel. (0)2079556239 - v.lichtner@lse.ac.uk

- - - - - - - - - -- *fold here, place in a window envelope and return to the address below* - - - - - - - - - - - - - - - -

Anthony Cornford
Information Systems and Innovation Group
Department of Management
London School of Economics and Political Science
Houghton Street,
London WC2A 2AE

1. Thinking about your [NHS service/Trust/hospital], to what extent do you agree with the following statements?

		Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
a	The computer systems are fast enough	☐	☐	☐	☐	☐
b	I can get technical support for computer related problems within reasonable time	☐	☐	☐	☐	☐
c	The log-in procedure to our computer systems hinders the provision of care	☐	☐	☐	☐	☐
d	The computer systems are worth the time and effort required to use them	☐	☐	☐	☐	☐
e	The computer systems provide me with the patient information I need, when and where I need it	☐	☐	☐	☐	☐
f	My ideas for improving the computer systems are sought and welcomed	☐	☐	☐	☐	☐
g	I would like more training on the computer systems I use	☐	☐	☐	☐	☐
h	The use of computer systems sometimes results in unintended patient care activities (e.g. unintended administration of drugs, or duplication of a diagnostic test)	☐	☐	☐	☐	☐
i	The use of computer systems supports patient centred care (e.g. treatment options individualised on the basis of patient history or monitoring of body state)	☐	☐	☐	☐	☐

2. Do you have any comments on any of the above? (Optional)

3. Thinking about your [NHS service/Trust/hospital], to what extent do you agree with the following statements?

		Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
a	Computer systems help move patients through the service quicker, with fewer delays	☐	☐	☐	☐	☐
b	The information recorded in the clinical computer systems is usually complete and accurate	☐	☐	☐	☐	☐
c	The computer systems ensure that access to patient records is appropriately controlled	☐	☐	☐	☐	☐
d	The computer systems support adherence to Trust protocols	☐	☐	☐	☐	☐
e	Computerisation improves the accuracy of identification of patients	☐	☐	☐	☐	☐
f	Because of computer systems, patient data is less secure	☐	☐	☐	☐	☐
g	The clinical computer systems offer an appropriate level of alerts, suggestions and/or guidance during the process of care	☐	☐	☐	☐	☐
h	The computer systems have reduced my professional autonomy	☐	☐	☐	☐	☐

4. Do you have any comments on any of the above? (Optional)

5. [Up to three Question of Trust choice - answers can be Agree/Disagree range below, or Yes/No/Don't know/NA. Alternatively, 1 open question with free text answer]

		Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
a	[Question to be customised (max 2 lines)]	☐	☐	☐	☐	☐
b	[Question to be customised (max 2 lines)]	☐	☐	☐	☐	☐
c	[Question to be customised (max 2 lines)]	☐	☐	☐	☐	☐

6. [Do you have any comments on any of the above? (Optional) - Question to follow Q5 if Q5 is not an open question]

7. Is any area or service in your [Trust/Hospital] particularly innovative in use of computer systems? (Briefly explain why this is innovative - e.g.paperless, real time, fully integrated, networked) (Optional)

8. Does the following apply to your [NHS service/Trust/hospital]:

		Yes	No	Don't know
a	Most clinical systems are integrated with [Name of system in Q10.a] (e.g. able to access demographics and hospital number)	☐	☐	☐
b	Inpatients have an electronic patient record holding detailed clinical data	☐	☐	☐
c	Data drawn from computer systems are used in infection control programmes	☐	☐	☐
d	NHS Smartcards are used to connect to some of the computer systems	☐	☐	☐

9. Do you have any comments or additional information on any of the above? (Optional)

10. In your current role, do *you* use any of the following computer systems – if available:

		Available, I use it	Available, I don't use it	Not available	Not applicable
a	[Name of local system with PAS functionalities - e.g. eCARE Logic, Rio, Patient Centre, etc.]	☐	☐	☐	☐
b	[Name of system in Q10.a] reporting functions (e.g. to extract summary data for a group of patients)	☐	☐	☐	☐
c	Orders - for pathology tests	☐	☐	☐	☐
d	Reporting - for pathology tests	☐	☐	☐	☐
e	Orders - for radiology	☐	☐	☐	☐
f	Reporting – for radiology (e.g. PACS)	☐	☐	☐	☐
g	Reporting – for tests ordered in primary care	☐	☐	☐	☐
h	Electronic Prescribing – for outpatients	☐	☐	☐	☐
i	Electronic Prescribing – for most inpatients	☐	☐	☐	☐
j	Electronic Prescribing – for TTO (To Take Out) medicines	☐	☐	☐	☐

11. In your current role, do *you* use any of the following computer systems – if available:

		Available, I use it	Available, I don't use it	Not available	Not applicable
a	Scheduling system – for managing resources (e.g beds, scanners, use of theatres, etc)	☐	☐	☐	☐
b	Scheduling system – for managing work (e.g. prioritising dispensing, tests, etc)	☐	☐	☐	☐
c	Scheduling system - for outpatients appointments (e.g. Choose and Book)	☐	☐	☐	☐

12. Do you have any comments or additional information on any of the above? (Optional)

13. In your current role, do *you* use computer systems to:

		Yes	No	Don't know	Not applicable
a	Record patient care information	☐	☐	☐	☐
b	Record patient care information -- with the patient/at the bedside	☐	☐	☐	☐
c	Prepare a treatment or care plan	☐	☐	☐	☐
d	Exchange information with other clinical roles	☐	☐	☐	☐
e	Make internal referrals	☐	☐	☐	☐
f	Generate letters (e.g. in outpatient clinic, A&E)	☐	☐	☐	☐
g	Generate discharge summaries	☐	☐	☐	☐
h	Undertake audits of care	☐	☐	☐	☐
i	Access online patient records held by other institutions	☐	☐	☐	☐

14. In your current role, do *you* use computer systems to:

		Yes	No	Don't know	Not applicable
a	Inform your evidence based practice (e.g. using Map of Medicine, trust formulary, BNF online)	☐	☐	☐	☐
b	Support clinical handover	☐	☐	☐	☐
c	Support communication with patients (e.g. printing materials, sharing data on a screen, sending emails…)	☐	☐	☐	☐
d	Regularly exchange information with primary care (e.g. by email, website, linked systems)	☐	☐	☐	☐

15. Do you have any comments or additional information on any of the above? (Optional)

16. Your professional background

☐ Doctor ☐ Nurse ☐ Midwife ☐ Pharmacist ☐ Other (please specify): _____

17. Your grade

Medical:	Nursing/Midwifery/Pharmacy:	☐ Other (please specify):
☐ F1 & F2	☐ Band 5	_____
☐ Specialist trainee	☐ Band 6	
☐ Specialist Registrar / Clinical Fellow	☐ Band 7	
☐ Consultant	☐ Band 8	
☐ Other (please specify):	☐ Other (please specify):	_____

18. Your main role and area of practice (Optional)
(e.g. Sister/Orthopaedic ward; Ward pharmacist/Paediatrics, Consultant/Gerontology etc.)
(please specify): _____

19. How long have you been working in this NHS service?
☐ Less than 1 year ☐ 1 - 5 years ☐ More than 5 years

20. How many years of clinical practice do you have?
☐ Less than 5 years ☐ 5 - 10 years ☐ More than 10 years

21. Your level of computer skills
☐ Low ☐ Average ☐ High

22. Your age range
☐ Less than 25 ☐ 25 – 35 ☐ 36 – 45 ☐ over 45

23. Your gender
☐ Male ☐ Female

24. Do you have any further comments or ideas about this survey? (Optional)

Thank you for completing this survey. Your contribution is very much appreciated.

Acknowledgements and References
Questions 10, 11, 13a, 13f and 13g are based on the 'Clinical 5' as described in the Health Informatics Review Report, July 2008, page 26.
Question 1d is borrowed from Laerum and Faxvaag, 2004, Q.G1

Department of Health (2008) *Health Informatics Review Report* - Ref. 10104.
http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_086073
Laerum, H. and Faxvaag, A. (2004) Task-oriented evaluation of electronic medical records systems: development and validation of a questionnaire for physicians. BMC Medical Informatics and Decision Making, 4(1): 1. http://www.biomedcentral.com/1472-6947/4/1

Appendix 13: Information sheet for CLICS

CLICS • Clinical Computer Systems Survey
A survey for all clinical staff across different NHS services

Brief summary and research protocol

v. 4 Feb. 2010 - *Revised draft document prepared at LSE. Internal document, not for publication.*
All comments to: Valentina Lichtner - v.lichtner@lse.ac.uk

This survey is part of a wider project investigating the adoption of the NHS Care Records Service in England. More information on the project can be found at http://www.nhs-crs.org.uk/

Introduction

Clinical Computer Systems Survey (CLICS) was developed by the London School of Economics in collaboration with the University of Edinburgh, the School of Pharmacy, the University of Nottingham and Imperial College, in the context of the research project An Independent Evaluation of the Adoption of the NHS Care Records Service in Secondary Care (NHS CFHEP 005 project).

CLICS is a survey tool to investigate the use and usability of electronic patient records and related clinical systems, and the user experience with these, including attitudes and opinions.

The survey design is based on a sociotechnical view of the adoption of clinical information systems. This view is expressed in four constructs: 'computerisation', 'usability and safety', 'clinical and organisational management' and 'patient journey' (see Appendix 1).

CLICS also reflects the ambitions for IT in the UK, specifically the 'Clinical 5' as described in the Health Informatics Review Report, July 2008 - the key elements of a strategic IT system in clinical context:

- A Patient Administration System (PAS) with integration with other systems and sophisticated reporting;
- Order Communications and Diagnostics Reporting (including all pathology and radiology tests and tests ordered in primary care);
- Letters with coding (discharge summaries, clinic and Accident and Emergency letters);
- Scheduling (for beds, tests, theatres etc.);
- e-Prescribing (including 'To Take Out' (TTO) medicines). (Health Informatics Review Report, July 2008, p26)

While the Health Informatics Review recommends the Clinical 5 for secondary care, we found that they can also be applicable to other NHS services, such as Mental Health community services.

Clinical work is often based on inter-disciplinary teams and clinical systems are used by a variety of roles. Thus, CLICS has been explicitly designed as a survey that can be answered by doctors, nurses and pharmacists, and possibly other members of the clinical team.

Finally, the questionnaire was designed to be short and not too time consuming: it prints on to 4 sides of an A4 paper, making it a manageable paper version, though an online delivery it is envisaged in most settings, via a url link circulated by email.

CLICS is distributed across different NHS Trusts to enable a comparison across contexts.

Scope of this survey

CLICS is targeted at clinicians in different NHS Trusts: primarily doctors, nurses and pharmacists, in both acute and community settings.

Method for distribution within each setting

The following is a brief protocol for distribution of CLICS within the different Trusts:

- The launch and distribution within the setting is to be agreed with the Trust/NHS service site.
- A customised online and PDF version will be created for each Trust participating in the survey. Each Trust will be assigned its own different web address (URL) to access the online version of the survey. A demo version is available online at: https://www.survey.bris.ac.uk/lsewebsite/clics-demo/
- The survey can be completed online and/or by printing the PDF file attached to the email (retuned by post); if appropriate to the local context, CLICS questionnaire on paper could also be distributed and collected on site.
- The online version will remain available for 3 weeks from launch. A reminder email will be sent on week 2.
- Participation in the survey is anonymous and the survey should take no more than 10 minutes to complete.
- Results in aggregate form will be shared with the participating organisation. The survey captures the richness of clinical IT used in the Trust, from computerisation, to usability,

safety, management and patient journey. Both qualitative and quantitative results will be included in the report to the participating organisations.

- No participating Trust will be identifiable in overall comparative analysis.

Incentive:

Participation to the survey qualifies for UKCRN accruals. More information can be found on http://public.ukcrn.org.uk/Search/StudyDetail.aspx?StudyID=7958

References

Department of Health (2008) Health Informatics Review Report - Ref. 10104. http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_086073

Appendix 14: The 12 core principles of the NHS Care Record Guarantee

1. "When we receive a request from you in writing, we must normally give you access to everything we have recorded about you. We may not give you confidential information about other people, or information that a healthcare professional considers likely to cause serious harm to the physical or mental health of you or someone else. This applies to paper and electronic records. However, if you ask us to, we will let other people see health records about you. Wherever possible, we will make your health records available to you free of charge or at a minimum charge, as allowed by law. We will provide other ways for you to apply to see your records if you cannot do so in writing. We will provide information in a format that is accessible to you (for example, in large type if you are partially sighted).
2. When we provide healthcare, we will share your record with the people providing care or checking its quality (unless you have asked that we limit how we share your record). Everyone looking at your record, whether on paper or computer, must keep the information confidential. We will aim to share only as much information as people need to know to play their part in your healthcare.
3. We will not share health information that identifies you (particularly with other government agencies) for any reason other than providing your care, unless:
   - you ask us to do so;
   - we ask and you give us specific permission;
   - we have to do this by law;
   - we have special permission for health or research purposes; or
   - we have special permission because the public good is thought to be of greater importance than your confidentiality.

   If we share information without your permission, we will make sure that we keep to the Data Protection Act 1998, the NHS confidentiality code of practice and other national guidelines on best practice. There is more information about existing guidelines at: www.dh.gov.uk/en/Managingyourorganisation/Informationpolicy/Patientconfidentialityandcaldicottguardians/index.htm
4. Under current law, no-one else can make decisions on your behalf, about sharing health information that identifies you. At the moment, the only exceptions to this are parents or legal guardians, or people with powers under mental health or other law. You can appoint someone to have a lasting power of attorney to make decisions for you if you lose the ability to make decisions for yourself. You can decide what rights that person has in making decisions about your care record. If you do not appoint anyone, a senior

healthcare professional involved in your care may consider it to be in your best interests to share information. This judgment should take account of the views of your relatives and carers, and any views you have already recorded. For medical research or other purposes, the Ethics and Confidentiality Committee of the National Information Governance Board for Health and Social Care can give special permission to share any health information that could identify you.

5. Sometimes your healthcare will be provided by members of a care team, which might include people from other organisations such as social services or education. We will tell you if this is the case. When it could be best for your care for your health information to be shared with organisations outside the NHS, we will agree this with you beforehand. If you don't agree, we will discuss with you the possible effect this may have on your care and alternatives available to you.
6. Usually you can choose to limit how we share the information in your care records which identifies you. In helping you decide, we will discuss with you how this may affect our ability to provide you with care or treatment, and any alternatives available to you.
7. We will deal fairly and efficiently with your questions, concerns and complaints about how we use information about you. All Trusts have a Patient Advice and Liaison Service (PALS) which can answer questions, point people towards sources of advice and support, and advise on how to make a complaint. We will have a clear complaints procedure. We will use what we learn from your concerns and complaints to improve services.
8. We will take appropriate steps to make sure information about you is accurate. You will be given opportunities to check records about you and point out any mistakes. We will normally correct factual mistakes. If you are not happy with an opinion or comment that has been recorded, we will add your comments to the record. If you feel you are suffering distress or harm as a result of information currently held in your record, you can apply to have the information amended or deleted.
9. We will make sure, through contract terms and staff training, that everyone who works in or on behalf of the NHS understands their duty of confidentiality, what it means in practice and how it applies to all parts of their work. Organisations under contract to the NHS must follow the same policies and use the same controls as the NHS does. We will enforce this duty at all times.
10. We will take appropriate steps to make sure we hold records about you – both paper and electronic – securely and only make them available to people who have a right to see them.
11. We will keep a record of everyone who accesses the electronic information the NHS Care Records Service holds about your diagnosis, care and treatment. You will be able

to ask for a list of everyone who has accessed records that identify you, and when they did so. There may be times when someone will need to look at information about you without having been given permission to do so beforehand. This may be justifiable, for example, if you need emergency care. We will tell you if the action cannot be justified.

12. If we find that someone has deliberately accessed records about you without permission or good reason, we will take action. This can include disciplinary action, ending a contract, firing an employee or bringing criminal charges. We will tell you if this happens."

Quoted from (130)

Appendix 15: Interview topic guide: Work-Package 4

Interview Schedule

Informed about the purpose of the interview; Are you happy for the interview to be recorded? Is there anything you'd like to ask me before we begin the interview?

1. To start with, it would helpful if you could tell me a little bit about yourself. What is your particular role?
2. Can you briefly explain what is currently happening around the implementation of (Lorenzo, Millennium, RiO)?
3. Why did your Trust choose to become an early adopter?
4. Regarding the implementation, what is the timeline?
5. What would you say have been the costs so far?

    Prompts:

    - Hardware; Software; Data Migration
    - Training; Personnel; Estate;
    - Networking; Interfacing; Other costs.

6. What would you say have been the benefits so far (if any)?

    Prompts:

    - Perceived 'current' benefits
    - Perceived 'future' benefits
    - Disbenefits?

7. What does the functionality currently allow you to do?
8. What are the reasons for not achieving the benefits?
9. Any benefits measurable?
10. What is the single, most important piece of advice you could give to future implementation sites for them to benefit from what you have learned from your experiences?
11. Is there anything we have not discussed that you would like to bring to my attention?
12. Any documents / information that were relevant to our discussion and that you think would be useful for our study?
13. If for any reason, I need to contact you again, would you mind?

Appendix 16: Minimum Data Set Cost Framework Work-Package 4

INFRASTRUCTURE							
Infrastructure refers to key IT architecture required to implement EHR.							
E.g. Printers, PCs, scanners.							
		PRIOR TO IMPLEMENTATION *(Readiness preparation)*		**START UP COSTS**		**RECURRING COSTS**	
Domains	**Categories**	**Units**	**Specification**	**Units**	**Amount (£)**	**Units**	**Amount (£)**
Hardware	Standard Personal Computers						
	Computer on Wheels						
	Wall-mounted computers						
	Keyboards (Infection Control)						
	Tablet PCs						
	Printers						
	Wrist-band Printers						
	Paper Printers						
	Label Printers (Mobile)						
	Label Printers (Fixed)						
	Scanners						

	SmartCards & peripherals						
	Servers						
	Domain control (log in)						
	Printers						
	Software application						
	Power source						
	Power sockets (per PC)						
	Data sockets (per PC)						
	Cabling						
	Switches (network electronics)						
	Batteries, docking						
Maintenance and support (Hardware)	(see personnel)						
Software	Additional applications						
	Project management software						
	Change management software						
	Reporting software						
	e-learning application						
	Data quality dashboard						
	Discharge summary application						
	Business continuity application						
	Corporate dashboard						
	Integration engine						

	Training database						
	Data warehouse (enhancement)						
	Operating system (e.g. windows)						
	Disaster recovery system						
	Service desk system						
	Anti-virus						
	Licenses						
	Machine licenses (per computer)						
	Intermediate systems						
Maintenance and support (Software)	(see personnel)						

PERSONNEL							
Personnel are all staff costs related to EHR and implementation of EHR, including training.							
E.g. Project management, floorwalkers, IT trainers.							
		PRIOR TO		**START UP COSTS**		**RECURRING COSTS**	

		IMPLEMENTATION					
Domains or Roles	**Examples of Roles**	**Units**	**Band / Amount (£)**	**Units**	**Band / Amount (£)**	**Units**	**Band / Amount (£)**
Project management team	Project Executive						
	Programme Lead / Manager						
	Senior Project Lead / Manager						
	Project Lead / Manager						
	Project Administrators						
	Finance Lead						
Change management team	Change Lead / Manager						
	Organisation Development Lead / Manager						
	Business Change Analysts						
	Benefit Lead						
Training team	Training Lead / Manager						
	Trainers						
	Floorwalkers						
	e-learning developer						
	ETD Lead						
	Staff backfill						
	Doctors						

	Nurses						
	Admin						
Data migration & Integration team	Data Migration Manager						
	Data Migration / Entry Group (Coders, Keyers)						
	Data Quality/Assurance lead						
	Interface expert						
Configuration & testing team	Build manager						
	Product specialists						
	Software developers						
	EPR advisors						
	Test manager						
	Test script manager						
	Testers						
	Quick test/Load runner analyst						
IT service management/operations team	Service-desk Manager						
	Service-desk operators						
	IT engineers						

	Application support						
Business transformation team	Communications Lead / Manager						
	Issues Management Lead / Manager						
	Business Continuity Lead / Manager						
	Risk Lead / Manager						
	Cutover Manager						
	Caldicott Guardian						
Registration authority team	RA Lead / Manager						
Clinical team	Medical Director						
	Clinical Lead						
	Pathology Lead						
	Radiology Lead						
	Pharmacy Lead						
	Nursing Lead						
	Champion users						
Administrative team	Back Office Manager						
	Back Office Staff						

Overtime (e.g. Rehearsal)							

ESTATES							
Estates costs are costs incurred while installing an appropriate environment for EHR.							
E.g. Wi-Fi or network wiring, server rooms.							
		PRIOR TO IMPLEMENTATION		**START UP COSTS**		**RECURRING COSTS**	
Domains	**Categories**	**Units**	**Band / Amount (£)**	**Units**	**Band / Amount (£)**	**Units**	**Band / Amount (£)**
Project management estate	Project management room						
	Project management room furniture / fittings						
	Desks						
	PCs						
	Printers						
	Wall-mounts						
Training estate	Training rooms (Inc. lecturer theatres,						

	training buses)						
	Training rooms furniture / fittings						
	Desks						
	PCs						
	Printers						
	Wall-mounts						
Data migration/integration estate	Data migration / integration room						
	Furniture / fittings						
	Desks						
	PCs						
	Printers						
	Wall-mounts						
Configuration / Testing estate	Configuration / testing room						
	Furniture / fittings						
	Desks						
	PCs						
	Printers						
	Wall-mounts						

IT service management/operations estate	Data migration / integration room						
	Service desk furniture / fittings						
	Desks						
	PCs						
	Printers						
	Wall-mounts						
Change management / Business transformation estate	Change management / business transformation room						
	Furniture / fittings						
	Desks						
	PCs						
	Printers						
	Wall-mounts						
Clinical / administrative estate	Clinical / administrative room						
	Furniture / fittings						
	Desks						
	PCs						
	Printers						

	Wall-mounts						
Storage space	Server storage space						
Wi-Fi network	Secure wireless network installation						
	Cabling						
	Router						
	VPN Connectivity						
Wards	Furniture / fittings						
	Nursing stations (Refitted)						
	Desks						

OTHER COSTS & MATERIAL							
Other materiel costs are costs incurred for materials-use during implementation							
E.g. Training material, consumables.							
		PRIOR TO IMPLEMENTATION		**START UP COSTS**		**RECURRING COSTS**	
Domains	**Categories**	**Units**	**Specification**	**Units**	**Band / Amount (£)**	**Units**	**Band / Amount (£)**

Data migration (Inc. data cleansing)	Server						
Interfacing							
Rehearsal (go-live)	(See personnel)						
Consumables	Catering (incl. staff)						
	Toilet consumables						
Training materials	Printed materials						
	Manuals						
	Fan folds						
Other training	Transport						
	Accommodation						
Routine service provision	Cleaning						
Miscellaneous	Security						
	Parking						

Appendix 17: Information sheet for Work-Package 5: Case note availability study

NHS CFHEP 005 EVALUATION OF THE ADOPTION OF THE NHS CARE RECORDS SERVICE IN SECONDARY CARE

The availability and completeness of Outpatient Clinical Records

Summary

The overall aim of WP5 is to investigate whether the introduction of the NHS CRS in England results in an improvement in availability of clinical records and clinical test results in secondary care outpatient settings. This study aims to assess outpatient case notes working with clinicians and clinic staff in a variety of outpatient settings.

Availability of clinical information at outpatient clinics

All NHS Trusts are required to monitor the availability and quality of medical records as this is one of the NHSLA standards[9]. Standards for documentation in medical records set by the Royal Colleges are used as the basis for audit of the structure and quality of documentation in medical notes.

In 1995 the Audit Commission published a study of hospital health records based on a survey of 225 respondents from 40 hospital Trusts[10]. This study "Setting the Records Straight" reported major problems including difficulties in retrieving records for consultation, poor quality of record-keeping within the casenote folder and poor facilities for storage of records. This was at a time when many Trusts did not have any form of electronic case note tracking. The Audit Commission made several recommendations and set a benchmark of 95 per cent availability of casenotes at clinics. At that time as many as one in six sets of casenotes were not available at the start of clinic. An update to the 1995 study was published in 1999[11]. Tables 1 and 2 below summarises the key findings of both studies.

Table 1 Availability of Casenotes at Out Patient clinics

	1995	1999
AVAILABILITY OF CASENOTES AT START OF OUTPATIENT CLINICS		
Benchmark of 95%	75% met the benchmark	84% met the benchmark
Clinics achieving 99% or better for availability of casenotes at start of clinic	18%	50%
ELECTRONIC CASE NOTE TRACKING		
	Implemented in only a few Trusts	62% of Trusts used casenote tracking; a further 18% were planning to introduce it in the next 12 months

A similar survey of 49 hospitals published in 2008 reported that out of over 2 million outpatient appointments, 54,000 were conducted without the clinician having access to the

9 NHSLA Risk Management Standards for Acute Trusts Primary Care Trusts and Independent Sector Providers of NHS Care 2009/2010 NHS Litigation Authority

10 *Setting the record straight* A study of hospital medical records. Audit Commission, November 1995.

11 *Setting the record straight* A review of progress in health records services. Audit Commission Update, November 1999.

patient's full record[12] . Non-availability was self-reported by the organisations surveyed and ranged 5-19%.

Table 2 Time taken to retrieve case notes

TIME TAKE TO RETRIEVE CASE NOTES 1995	% casenotes	% of time taken to find notes
Where case notes are when required for clinic		
Filed in the library	64%	30%
Elsewhere in Trust but recorded	31%	61%
Not traced	5%	9%

Aims/Objectives

The overall aim of our study is to investigate whether the introduction of the NHS CRS in England results in an improvement in availability of clinical records and clinical test results in secondary care outpatient settings. To undertake this study we will work with a minimum of six Trusts across England who use paper and/or electronic records.

The key objectives include measuring:

- The proportion of outpatient encounters associated with completely missing records;
- The proportion of outpatient encounters associated with partly missing records.
- The frequency with which particular elements needed by the clinician were missing.
- The overall assessment of the completeness of the clinical records

Method

1) An observational study in outpatient clinics. The Trust will receive an initial visit from a researcher to plan the work with a staff member from the Trust. This visit will identify which clinics to be used, will talk to the senior clinicians involved, the senior nurse and, if necessary, will speak to the appropriate medical records staff and clinic staff.

2) The observational study will take up to three days. During those three days up to five or six clinics will be surveyed. The researcher will then visit the Trust again an agreed number of weeks later to undertake a similar survey again for three days. We are looking to use general medicine and general surgery clinics within this assessment along with some speciality clinics. We are looking at clinics using either or both paper and electronic records.

3) During the assessment healthcare professionals will be asked to report on the availability of the medical records at the time of consultation.

4) In addition there will be survey of the clinic managers/ administrators to gain valuable background information for each clinic and to establish pre-existing levels of computerised records.

5) The researcher will report back to the Trust on the results of the data analysis and the survey undertaken.

[12] Gainsbury S. (2008) *Missing: The notes of more than a million outpatients.* Health Services Journal, 22 May p5

Appendix 18: Interview topic guide for Work-Package 5: Case note availability study: First interview

An Independent Evaluation of adoption of the NHS Care Records Service (NHS CRS) in the NHS

INTERVIEW GUIDE FOR OPD AND MEDICAL RECORDS STAFF

To provide you with some background to this evaluation: We are a multidisciplinary team working across several universities evaluating the adoption of the NHS Care Records Service in secondary care in England. There are 5 Work Packages and I am working on Work Package 5.

Anonymity and confidentiality is important and I want to assure you that all of this interview data will be anonymised and treated in strict confidence. It will not be possible to identify you in any reports or publications arising from the evaluation research.
We would like your honest views, whether they are positive or negative. If there is a question you feel you cannot answer, we can skip that question and similarly if there is anything that you feel that I have missed out and you would like to comment on then please do so.
Is there anything you'd like to ask me before we begin the interview?

To start with, it would helpful if you could tell me briefly a little bit about yourself. How long have you worked at [insert Trust/hospital name] and what is your current role?
[Probe - Name / How long worked in that position / How long have been in NHS / What is your background]

Can you tell me about the process in Outpatients / Medical Records for collecting the medical notes and getting them to the clinics?
[Probe – what role do you play?]

How well does that process work in your view? Are there any problems?
[Probe – request examples of problems encountered]

Are there any missing items at all? / missing medical notes?
[Probe – request examples]

How do you deal with the problem of missing items?

[Probe – request examples of dealing with the problems]

How would you view the relationship between the Medical Records department and Outpatients?
[Probe - what challenges arise in working together?]

How can that process be improved in your opinion?

Some functions of the new NHS CRS will be implemented at some time. Are you looking forward to it?
[Probe – acceptance of change, knowledge of developments, explore attitudes]

How do you anticipate your role will change when that happens?
[Probe: specific aspects of job clearer/easier/faster/safer and e.g., timeliness/helpfulness]

Does this affect your attitude to your own work?

Thinking beyond your own work role, what hospital-wide changes do you believe will result/are resulting/have resulted from the new system/s

- in the ways in which the hospital staff's work is organised?
- in the ways in which patients' care is delivered?
- in the safety of patient care? [Probe]
- in the quality of patient care? [Probe]

What kind of other electronic systems do you currently have in outpatients?
[e.g. Results Reporting, PACS]

Overall, how would you describe your attitude towards the goal of a national, (or even a local) electronic patient record service?

What are your thoughts on the most appropriate way to work towards that goal?

What do you believe would help to facilitate the roll-out of the CRS nationwide the most?

What do you believe is the biggest barrier to a nationwide roll-out of the CRS?

Is there anything we have not discussed that you would like to bring to the attention of the evaluation team?

How computer literate do you think you are?

Any other issues you would like to comment on?

Thank you for taking part in this interview. We greatly appreciate your giving your time. Do you have any questions for me before we close?

Appendix 19: Interview topic guide for Work-Package 5: Case note availability study: Return Interview

INTERVIEW GUIDE FOR OPD AND MEDICAL RECORDS STAFF – POST IMPLEMENTATION

Thank you for agreeing to be interviewed

I would like to assure you (once again) that all data supplied in this interview will be anonymised and treated in strict confidence. It will not be possible to identify you in any reports or publications arising from the evaluation research.
We would like your honest views, whether they are positive or negative. If there is a question you feel you cannot answer, we can skip that question and similarly if there is anything that you feel that I have missed out and you would like to comment on then please do so.
Is there anything you'd like to ask me before we begin the interview?

To start with can you tell me your work title and where you are based?
[Probe-Name? / How long worked in that position? / How long have been in NHS? / What is your background?]

Last time we spoke about the processes of medical notes within the OPD. Have there been any changes as a result of implementing the NHS CRS system [..] since then? Can you tell me how that has affected you and your work?
[Probe – what it means for them, has it changed any ways of working in the OPD / Medical Records.]

What positive changes, if any, are you experiencing? / Do you anticipate your own role changing as a result of the introduction of the new system/s?
[Probe: specific aspects of job clearer/easier/faster/safer?]

What negative changes, if any, are you experiencing? / Do you anticipate changes in your own role as a result of the introduction of the new system/s?
[Probe: specific aspects less clear, more difficult/slower/less safe?]

Has this increased the number of missing items in the medical notes or are there fewer items missing?

What day-to-day support was provided during the changeover period?

What day-to-day support is currently available now?
[Probe: e.g., timeliness/helpfulness]

Were you involved in any away with the development of the system?

Have the patients made any comment about the new system?
[Probe – whether positive or negative or indifferent]

What kind of training did you receive? How useful was it?
[Probe – whether trainer came down to the department, floorwalking, quality of training, knowledge of trainers]

What do you do if you have a problem with the system now?, Who do you contact?

How is all this affecting your attitude to your own work?
[Probe - improved way of working / more stress]

Have the changes affected your working relationships with colleagues?

Have the changes affected your working relationships with Medical Records / Outpatients?
[Probe – better relationship as easier to get the notes or less need for the notes, or worse relationship as more time taken to get the notes]

Looking back, how would you change the way the system was implemented?
[Probe - What would you have done differently, if anything?]

Are there any other changes that have happened since I was previously here?
[Probe – management changes, policy changes, other technological changes etc]

Any other issues you would like to comment on?

Thank you for taking part in this interview. We greatly appreciate your giving your time. Do you have any questions for me before we close?

Appendix 20: Survey instrument: Work-Package 5 case note availability data sheet

An Independent Evaluation of adoption of the NHS Care Records Service (NHS CRS)

THIS DOCUMENT IS TO BE PINNED ON TOP OF THE PATIENT NOTES

1- Was *all* the information (notes, investigations, etc) you needed available when the patient was seen? Yes ☐ No ☐

If the answer to question above is *yes*, please stop here.
We thank you very much. Otherwise, and if the answer is *no*, please continue.

2- Is the patient new to this clinic? New ☐ Follow-up ☐

3- Please indicate which parts of the records were unavailable:	Unavail	Availa	Not
3.1- **The referral letter**	☐	☐	☐
3.2- **Images** (e.g. X-rays, MRI, etc.)	☐	☐	☐
Please specify.....			
3.3- **Monitoring results** e.g. 24 hrs blood pressure, 24 hrs heart monitoring, etc)	☐	☐	☐
Please specify.....			
3.4- **Lab Results** (e.g. blood results.)	☐	☐	☐
Please specify.....			
3.5- **Reports** (e.g ECG, rehabilitation, etc.)	☐	☐	☐
Please specify.....			
3.6- **Addressograph labels** (stickers)	☐	☐	☐
3.7- **Complete medical notes**	☐	☐	☐
3.8 **– Other:** please specify	☐	☐	☐

4- Was the missing information obtained during the course of the clinic? Yes ☐ N ☐

5- Did the lack of information availability result in any of the following consequences:

5.1- Delays to the consultation? Yes ☐ No ☐ Cancelled ☐

5.1.1- If yes, by how long (please estimate delays in minutes).....

5.2- Ordering another investigation? Yes ☐ No ☐

5.3- Repeating consultation as a result? Yes ☐ No ☐

5.4- Or any other decision that you made.

Appendix 21: Work-Package 6: International EHR conference programme

This conference was held on 26th October 2010 at One Great George Street, Westminster, London SW1P 3AA.

8.30 - 9.00	Registration & Coffee/Exhibition
9.00	**THE NHS CARE RECORDS SERVICE: MAIN FINDINGS FROM NATIONAL EVALUATIONS** CHAIR: Prof. Matthew Swindells, Chairman, British Computer Society (BCS Health) SPEAKERS: Prof. Trisha Greenhalgh, Principal Investigator, Summary Care Record Prof. Aziz Sheikh, Principal Investigator, Detailed Care Record
10.30	Coffee & Exhibition
11.00	**NATIONAL PERSPECTIVES** CHAIR: Prof. Tony Avery, University of Nottingham SPEAKERS: Dr. Simon de Lusignan, St. George's Hospital - University of London (NHS England) Dr. Martin Murphy, Welsh Assembly Government (NHS Wales) Dr. Brian Robson, Medical Director, Quality Improvement Scotland (NHS Scotland)
12.15	Lunch & Exhibition
1.00	**THE STATE OF PLAY INTERNATIONALLY** CHAIR: Dr. Sarah Crowe, University of Nottingham SPEAKERS: Prof. Denis Protti, University of Victoria (Canadian perspective) Prof. David Bates, Harvard School of Public Health (U.S. perspective) Dr. Karl Stroetmann, Empirica Communication & Technology (E.U. perspective)
2.30– 3.00	**DEBATE: APPROACHES TO EHR DEVELOPMENT & IMPLEMENTATION**

	MODERATOR: Prof. Denis Protti, University of Victoria SPEAKERS: Prof. Dipak Kalra, University College London (Top-down) Prof. Ken Eason, Loughborough University; The Bayswater Institute (Bottom-up)
3.00– 3.05	Poster Prize
3.05– 3.25	Coffee & Exhibition
3.25	**PANEL DISCUSSION: SUCCESSFUL IMPLEMENTATION OF EHRs** CHAIR: Prof. David Bates, Harvard School of Public Health PANELISTS: Prof. Chris Johnson, University of Glasgow Prof. Jeremy Wyatt, Warwick University Prof. Ken Eason, Loughborough University; The Bayswater Institute Ms. Heather O'Brien, Director of Information Systems, Royal Free Dr. Claudia Pagliari, University of Edinburgh Dr. Josip Car, Imperial College London
4.25	**INNOVATION, SHARING AND INFORMATION:** **REDISCOVERING LOST VALUES** CHAIR: Prof Aziz Sheikh, The University of Edinburgh SPEAKER: Prof. Aidan Halligan, Director of Education, University College London Hospitals; Chief of Safety, Brighton & Sussex University Hospitals
5.00	CLOSE