Evaluation of IT modernisation in the NHS

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Executive summary

1. Background

Capturing information accurately, communicating and using it promptly to improve the effectiveness and efficiency of health care, is central to the UK Government's vision to modernise the NHS. It has been widely assumed that these goals will benefit patients, health care professionals, managers and planners in the NHS.

The Government's plans for NHS modernisation have evolved over time, from electronic 'patient' and 'health' records to a unified National Programme for Information Technology (NPfIT) with the creation of Connecting for Health to manage the programme. This evolution included a fundamental policy change from delegation of responsibility for implementing IT modernisation to local NHS organisations, to a policy of centralised specification and procurement.

The size and complexity of national programme make it the largest outsourced IT project from the public sector ever untaken. In view of previous difficulties in implementing large scale health service IT projects, progress in achieving the National Programme became a key focus of interest of this project.

2. Objectives

Following the changes to government policy, our revised objectives were to:

1. Describe the context for implementation of the NPfIT in England, examining actual and perceived barriers, and opportunities to facilitate implementation.
2. Explore how new IT applications are experienced by end-users (NHS staff), describing any impact on working practices.
3. Estimate quantitative effects of implementing specific IT applications proposed by the NPfIT.
4. Review evidence about the cost-effectiveness of IT systems in health care.

3. Methods

The study sample consisted of four NHS Acute Trusts. We used a combination of qualitative and quantitative methods to address our objectives, making comparisons both within and between organisations. We used review methods to summarise existing evidence for objective 4.

A qualitative researcher interviewed a range of stakeholders involved in implementing and using IT applications, and addressed objectives 1 and 2. Two levels of interviews were conducted in three stages. Level 1 interviews (objective 1), took place between July and October 2004 (stage A; n=24); and between February and April 2006 (stage A; n=25). Level 2 interviews (objective 2) took place between January and October 2005 (n=44). Baseline information was also collected for each study site data.

Level 1 interviews investigated (a) the influence of contextual factors (historical or current, facilitators or barriers) on the implementation of IT applications, and (b) the impact of recent Connecting of Health policy changes on implementation processes. Level 2 interviews investigated (a) experiences of NHS staff of specific IT applications (electronic test ordering and browsing, or computerised physician order entry, CPOE; electronic booking; picture archiving and communication systems, PACS), and (b) the impact of these applications on working practices. Interviews were semi-structured on a one-to-one basis and took about one hour. Interviews were taped and transcribed.

We applied a modified grounded theory analytic strategy to present an analysis of processes over time. This strategy combined drawing on the literature on organisational change, and more user-centred sociological theories of innovation adoption and implementation, with themes emerging from the data.

The quantitative research used a quasi-experimental ‘controlled before-and-after’ design to quantify the effects of implementing CPOE and PACS. Indicators were compared between trusts that did and did not implement these IT applications during the period 2000 to 2005, taking into account data for a baseline period prior to implementing changes. Indicators were also compared within Trusts between specialties that did and did not implement the applications during the same period.

To estimate the effects of CPOE, we considered three tests: full blood count, urea and electrolytes, and urine culture. For PACS, we considered three radiological modalities: plain film X-ray, computed tomography (CT), and ultrasound.

Indicators were derived from a large set defined *a priori*, based partly on the NHS Efficiency Map and were classified as primary or secondary depending on the plausibility of a direct causal pathway between implementation and the outcome.

We analysed inpatient and outpatient data from the Commissioning Data Set (CDS) for 2000 to 2005, linked with data about target pathology and radiology tests carried out during the same period. Secondary outcomes were derived directly from the CDS data. Individual patient data were analysed for specialties common to all four trusts. Effects were estimated by multiple regression modelling, calculating robust standard errors to take into account clustering of records within trusts and specialties.

4. Findings

Implementation of the NPfIT did not progress as expected during the study period. Findings from Level 1 of our qualitative study were able to track the impact of this delay on the trusts.

CPOE and PACS applications were also implemented infrequently during the project. Three of four Trusts implemented aspects of PACS system, but only one Trust implemented a 'full' PACS. Two Trusts implemented CPOE but, in one trust, the system was so poor it was hardly used so, in effect, had not been implemented. None of the applications studied were officially compliant with the NPfIT.

Our quantitative and qualitative evaluations of PACs and CPOE were constrained to some extent because implementation of IT applications was not as widespread as expected when the research was commissioned. Nevertheless, our findings provide useful lessons as the roll-out of IT modernisation in the NHS gathers pace.

4.1 Qualitative findings: Level 1 – Implementation of NPfIT at local level

Stage A interviews, with senior managers and clinicians, highlighted four key issues:

(a) Trusts varied in their circumstances, affecting their ability to implement the NPfIT.

(b) The process of implementing the NPfIT was suboptimal, leading to low morale among NHS staff responsible for implementation.

(c) The timetable for implementation was unrealistic, causing uncertainty. Renewing Patient Administration Systems (PAS) was a bottleneck and this rate-limiting step could not be reconciled with targets for implementing substantive IT applications.

(d) Short term benefits of IT modernisation are unlikely to be sufficient to persuade NHS staff to support the programme unreservedly.

These interviews were too early to assess the success of the NPfIT but demonstrated concern among interviews about the process of implementation.

In stage B, senior managers and clinicians felt that the NPfIT is a highly desirable objective. Interviewees were enthusiastic about, and supportive of, the goals of the NPfIT but still had serious concerns, several of which were the same as before.

Continuing uncertainty was making key managerial decisions about IT implementation more difficult, given the current need to make financial savings and achieve efficiencies. Although IT modernisation should facilitate these goals in the longer-term, senior managers still did not know: (a) what the local costs of implementation will be; (b) when a replacement patient administration system compliant with the programme will be available; (c) the timetable for delivery of interim applications; (d) the features of these applications; (e) the likely benefits and efficiencies from new systems.

These uncertainties made it difficult to prioritise local implementation of the NPfIT. Concern was expressed about threats to patient safety from a ‘patch and mend’ approach to maintain existing systems. Trust managers wanted concrete information about implementation timetables, system compatibility with the long term goals of the programme, value-for-money and better communication with Connecting for Health.

4.2 Qualitative findings: level 2 – Process and impact of implementation of PACs and CPOE

We found four factors which influenced the adoption of CPOE and PACS:

(a) The attributes of the application; the speed, ease of use, reliability and flexibility of the application were key issues.

(b) The characteristics of the adopter; these were most important early during implementation and persuading users who were unfamiliar with IT was a challenge.

(c) Implementation processes; user consultation during implementation, the quality of training and IT support; and creation of a 'critical mass' of benefit were crucial to their use.

(d) organisational factors; the most important were that the designers and implementers of the application understood the business process which the IT was supporting, availability of a strong project management team with high level management support, good team working within and between departments and the ability of the organisation to work as a whole.

The perceived impact of IT innovations varied according to the specific application, how they had been implemented, and relate to patient experiences, working practices and safety/governance. In all cases, interviewees reported positive and negative examples in these areas but, overall, for PACs in all three Trusts and CPOE in one Trust, the positives appear to outweigh the negatives. Very little formal measurement of these consequences was carried out by the Trusts. These consequences are important, not least because the perceived positive and negative impacts of the application influenced its continued use and wider adoption.

4.3 Quantitative findings: Impact of implementation of PACs and CPOE

The size of the effects estimated for primary outcomes, e.g. a change in the volume of test ordering of 10 to 20%, was certainly potentially important, in that such effects would have major implications if observed across the NHS during roll out of the NPfIT. However, there were challenges in distinguishing real effects from background variation and in attributing effects to CPOE or PACS.

The main effects of CPOE were to reduce the proportion of patients who had any pathology test at outpatient appointments and the number of patients who had the same test at their next outpatient appointments. These effects were observed to a greater or lesser extent for all tests that were investigated. These effects are also plausible. For some tests, CPOE also reduced the proportion of inpatients having pathology tests but this effect was not consistent between and within trusts.

Similar effects were observed when PACS was implemented with respect to repeat plain X-ray films and ultrasound scans on subsequent visits. However, there was no consistent effect on the overall proportion of patients who had a plain X-ray film, CT or ultrasound scans at outpatient appointments.

Various changes in secondary outcomes were observed but could not be attributed confidently to implementation of CPOE and PACS. There appeared to be a consistent reduction in the proportion of patients discharged at outpatient appointments after both applications were implemented.

5. Future research agenda

This study has shown that it is possible to use routinely collected patient-level data as a basis for assessing the impact of technological changes on indicators of clinical activity and operational efficiency. Our technique of joining CDS data with these specialist datasets could form the basis for operational research in the UK NHS on a nationwide scale. Our study also shows that smaller studies, designed to measure effects at a much finer level of detail, are also necessary to understand fully the impact of IT systems in health care.

The importance of studying a large number of trusts should not be underestimated; this will improve statistical precision but, more importantly, will allow variation between implementing and non-implementing trusts to be estimated much better. It is important that future studies of the impact of IT modernisation include qualitative analyses of the implementation process, in order to understand what the quantitative data are indicating. Multiple case studies, such as this one, provide useful analyses, both within and across case studies. Longitudinal studies are important in studying implementation processes and, when implementing complex innovations in large organisations, studies need to be conducted over at least 5 years.

Development of appropriate outcome measures is one example of how qualitative and quantitative methods should be combined. One way to choose outcomes is to study indices which are available, easily derived from routine sources or which are expected to change for reasons of face validity. A second approach is to choose outcomes on the basis of feedback from users experienced with IT applications, to reflect aspects of service delivery which users consider important to their ways of working and which they believe are influenced by IT modernisation.

One major evidence gap is the absence of high quality evaluations of the economic implications of implementing organisation-wide IT applications. There is an urgent need for better evaluations of the economic and financial consequences of IT

modernisation to help plan implementation but it is not clear that conventional methods are applicable to such large scale and complex interventions. In planning future economic evaluations, we recommend that, researchers should: (a) be clear about the exact question that needs to be addressed; (b) define precisely the nature of the intervention; (c) study and value health as well as resource consequences of IT implementation; (d) study the transition from the existing method of providing health to the new method based on the innovation being studied; (e) study the intervention for long enough to describe longer term effects.

This study has taken place at the very beginning of the process of implementing a national IT system at local level. However IT policy develops in the future, it will be important to continue to study the processes of implementation and the impact they have on organisations, teams, and patient care.

6. Implications for a national IT system

An important lesson from our study is the difficulty in achieving an appropriate balance of responsibility between government and local health care systems. Devolving control of IT to local managers results in a lack of standards, and disparate functionality. However, with central control, the sheer size of the task makes communication and realistic goal setting difficult. The NPfIT has not made the progress that was expected and senior NHS staff warned of the continuing challenges ahead. The process of implementation needs to change rapidly for NHS staff to feel optimistic and to embrace IT changes with enthusiasm.

A third strategy is now in place, setting central standards but with local implementation. The role of Connecting for Health is shifting from implementation towards providing a national infrastructure and standards-setting body. Implementation will be devolved more locally. Even with these changes, the issues raised in our study still need to be addressed. Connecting for Health still needs to involve local end users in discussions about the form the national infrastructure and national standards; these should not be imposed. Further, devolving responsibility for implementation locally raises questions about the degree of local customisation permitted. We found that local customisation is an important factor in successful adoption. However, too much customisation might weaken national standards and

the ability to pass data between providers. Finally, a national infrastructure needs to help trusts to prioritise IT modernisation against competing financial pressures, e.g. by its inclusion in performance management frameworks. New plans need to be communicated throughout the NHS with clear timetables to end the uncertainty.

7. Implications for local implementation of IT innovations

Both studies, of NPfIT implementation at local level and end users' views of specific IT applications, have implications at the local level in the NHS. The importance of the attributes of the innovation, characteristics of the adopter, implementation processes, and organisational factors need to be addressed.

The CPOE application in one Trust, and the PACS in another, were considered by managers and end-users to have been successful implementations, preceding by several years the roll-out of similar applications under NPfIT. It is possible that CPOE and PACS, when fully integrated with the other IT systems which comprise NPfIT (national electronic health records, PAS, electronic booking, etc), will contribute to more dramatic quantitative changes.

In the longer term, the issue of where responsibility for local implementation lies, at national or local level, remains. In the meantime, evidence to support the procurement and implementation of IT systems by health care providers falls far short of that required to inform changes in clinical practice by these same providers.

8. Conclusions

This study is one of the few carried out on the early stages of implementation of the national IT programme for the NHS in England. It provides useful insights into the challenges of attempting this very ambitious programme, from the perspective of the local level. It also provides data on the processes and impact of implementing specific IT applications on a scale not achieved before. The study has significant implications for the future direction of NHS IT policy. We have also raised important methodological issues for future studies of large scale IT implementation in health care.

Disclaimer

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Addendum

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The management of the Service Delivery and Organisation (SDO) programme has now transferred to the National Institute for Health Research Evaluations, Trials and Studies Coordinating Centre (NETSCC) based at the University of Southampton. Prior to April 2009, NETSCC had no involvement in the commissioning or production of this document and therefore we may not be able to comment on the background or technical detail of this document. Should you have any queries please contact sdo@southampton.ac.uk