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NHS adoption of NHS developed technologies

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1. Aims/Objectives:

Adoption of new technologies within healthcare systems is neither simple nor automatic; many factors act together to either enable or inhibit the adoption of a new healthcare technology. Although a simple technology might be implemented directly into existing care processes, with little need for process change or modification of staff roles or skill requirements more complex new technologies often has a profound impact on care processes and can lead to a variety of changes including:

- the addition, removal or re-sequencing of process activities.
- relocation of activities including transfers between organisations and geographical shifts.
- modification of staff roles and skill requirements.
- alteration of the relationship with the patient.

The close coupling between technology and the healthcare processes in which it is embedded means that the compatibility of a technology to a specific healthcare organisation will be crucial to its successful adoption. There has been a suggestion that one strategy for supporting the innovation of healthcare services is to encourage clinicians to lead change. This has been declared as an explicit strategy in he NHS (Darzi 2008).

One potential way in which clinicians can lead change is through their own innovation activities. The NHS has now put in place mechanisms for exploiting technology developed within the NHS through technology transfer and knowledge management processes. NHS innovation hubs have been made responsible for technology transfer out of the NHS and the National Institute for Innovation and Improvement for diffusion of best practice.

NHS developed technologies differ from those produced by the healthcare technology industry in that the balance of influence lies predominantly with the technology users (clinicians and other healthcare workers), rather than the industrial producers. However, no research has been undertaken on whether NHS developed technologies are adopted into the NHS any differently from those technologies developed commercially outside the NHS. Analysis of interviews conducted with NHS technology transfer managers suggest that the NHS origin of a technology can have both positive and negative effects on the adoption process. Positive benefits that have been posited include:

- Positive NHS brand.
- The NHS developer and team can be active advocates for the technology, promoting the technology within the NHS and supplying technology evaluation data. This is particularly the case where the NHS developer has been able to carry out clinical trails on the technology within the NHS.
- The NHS developer and team can become a valuable resource for potential adopters offering advice and guidance n the technology often at low cost.
- The NHS developer and team can play a part in policy formation processes that support the adoption of the technology e.g. care guidelines.

Negative effects suggested are:

• Internal NHS politics and competition between NHS organisations can lead to

resistance to adoption.

- Negative NHS brand image.
- Sophisticated marketing by private sector healthcare technology suppliers, makes NHS developed technologies less attractive.
- Conservative NHS marketing policy, e.g. based predominantly on cost, can inhibit adoption. In extreme cases, this may make the NHS one of the least accessible markets for a technology, compared to private sector healthcare or overseas markets.

The main aim of this research is to assess whether the balance of influence on technology development between technology users and technology suppliers impacts on the success or failure of the adoption process. The questions to be answered are:

- 1. Do user-developed products perform differently in technology assessment processes (evidence-based and preference-based) underpinning adoption decisions?
- 2. What part do informal professional networks play in adoption decisions?
- 3. Does the origin of the technology impact on the compatibility of a technology for adoption within an NHS organisation. This objective is concerned with the extent to which a technology must fit the values and assumptions underpinning its use within a specific care process in order to be regarded as compatible.
- 4. Do user-developers have a greater opportunity to gather evidence and develop implementation guidelines that support the adoption decision process and does this allow them to achieve better trialability?
- 5. Does the source of the technology impact upon the perceived relative advantage and the perceived complexity and if so, how?

The focus of the study is shown in Figure 1.



Figure 1: Focus of study: Development routes for healthcare technology innovations

The broader aims of this research project, in relation to the Technology Management Research Group at the Open University, are to enable the further expansion of an existing network of relationships with key stakeholders in the NHS and associated organisations. This network already includes a range of individuals and organisations concerned with both the creation and adoption of innovative technology in the NHS. It is envisaged that research could be used as a trigger to put in place a more formal network that could be used to support NHS innovation and adoption activities, including the dissemination of the findings and recommendations from this project.

2. Background:

The NHS is experiencing a massive amount of technological change. In all areas of healthcare, pharmaceutical, diagnostic, therapeutic and informatics technologies are being developed that have potential to improve the efficiency and the effectiveness of the NHS. Indeed, actual improvement of NHS services is dependent on the extent to which new technologies can be adopted successfully. It is the case, however, that adoption of this new technology will inevitably lead to the need for organisational change, re-design of NHS processes and the re-definition of staff roles but unfortunately technologies are not neutral black boxes that work irrespective of the social context into which they are introduced. There has to be a fit between the social context and the technology. The people in an organisation must not only accept the technology but also be willing to change their own patterns of working.

This research is concerned with whether technologies developed within the NHS have inherently different adoption characteristics compared with technologies developed outside the NHS. It is asking whether the fact a technology was developed by NHS staff, in an NHS context, makes it more or less likely to be adopted successfully in

7975 Savory Protocol Stage 1 & 2 Substantial Amendment 1 Version 1 6/4/10 other parts of the NHS.

After an initial survey of NHS developed technologies, six internally-developed technologies will be identified for further research and compared with six comparable technologies developed outside the NHS. A total of 12 case sites will be investigated, six using the internally-developed technologies and six using externally-developed. Detailed case studies will be prepared that look at adoption policy and processes. These will then be used to develop an understanding of how a technology's origin impacts on its adoption.

3. Need:

The benefits of this research to the NHS are:

- Provide insights into the enablers and barriers to successful adoption of technologies by the NHS.
- Provide a clearer understanding of the relative adoption performance between NHS-developed and supplier developed technologies.
- Inform NHS policy on technology adoption;
- Inform the design of technology assessment so that it ensures the development context is taken into account. Especially where the NHS context has been the primary target for the technology and was explicitly addressed during development.

4. Methods:

This research will adopt an interpretive case study approach (Eisenhardt 1989; Klein and Myers 1999; Jones 2001; Yin 2003; Walsham 2006). Following a preliminary survey, six cases will be selected involving the adoption of NHS-developed technologies. All the cases will be selected on the basis that they incorporate a significant element of exploitable intellectual property. Other characteristics will also be taken into account including: nature of the product, e.g., therapeutic/diagnostic medical devices, service improvement; extent to which adoption impacts on service design; extent of adoption; and level of success.

Following consultation with the stakeholders on a case by case basis, each of the six cases will then be paired with another benchmark case, where adoption of a competing commercially developed product has taken place. If no competing product exists, the adoption of an equivalent commercially developed product will be selected instead. This benchmarking will allow the importance of different characteristics of NHS-developed and commercially-developed technology that effects adoption to be noted so that causality can be attributed by process analysis and the development of theory.

5. Protocol

EC REFERENCE NUMBER: 09/H0305/56

This protocol relates to Stage 1 and Stage 2 of the study.

Protocol Stage 1

The data collection and analysis for Stage 1 of the study will involve the following stages.

- 1. <u>Identification of a number of NHS-developed technologies and their</u> <u>respective development.</u> This identification will rely on the co-operation of NHS innovation hubs and other technology transfer organisations that are responsible for facilitating the commercialisation of NHS-developed technologies.
- 2. <u>Recruitment of participants.</u> A member(s) of each development team will be approached, provided with information about the research project (PIS/CF) by email or hard copy, and requested to participate in the project. Hard copies of the consent form will be used for recording formal consent to participate in the study by members of development teams.
- 3. <u>Interview development team member(s).</u> Representatives from the development teams will be asked if they are willing to be interviewed and an indication of the content of the interview will be provided in advance of the interview. The interview schedule "NHS-based technology developers" will be used to conduct the interviews. Each interview is expected to last approximately 45 minutes and will be conducted by telephone. Each interview will be recorded providing the participant agrees to this at the start of the interview. If permission to record is not granted notes of the interview will be made.
- 4. <u>Identification and contact with adopters.</u> The interview data will be used to draw up a list of adopters. A sample of adopters on the list will be approached and provided with information about the research project. Adoption team members will be approached, provided with information about the research project (PIS/CF) by email or hard copy, and requested to participate in the project. Hard copies of the consent form will be used for recording formal consent to participate in the study by members of adopter teams.
- 5. <u>Interview innovation adopters.</u> A second round of interviews using the schedule for "NHS-developed technology adopters" will be conducted. (See step 3 above.)
- 6. <u>Coding of interview data.</u> Interview audio recordings/notes will be coded using conventional qualitative data coding techniques (Miles and Huberman 1994; Strauss and Corbin 1998).

Protocol Stage 2

The purpose of Stage 2 of the project is to develop twelve case studies of technologies that are currently being adopted into the NHS. Stage 2 builds on the previous stage by carrying out a deeper and more extensive inquiry into the technology and how it is

being or has been adopted into the NHS from the perspectives of a range of adoption stakeholders.

- 1. <u>Using data from Stage 1 identify six theoretically important case sites</u>. Based on the survey in Stage 1 six NHS-developed technologies will be selected on the basis of theoretical sampling strategy (Eisenhardt 1989) in which distinctive examples of technology adoption are identified. The cases will be selected on the basis that they incorporate a significant element of exploitable intellectual property. Other characteristics will also be taken into account including: nature of the product, e.g., herapeutic/diagnostic medical devices, service improvement; extent to which adoption impacts on service design; extent of adoption; and level of success.
- <u>Identify six commercial technologies that represent "commercial analogues".</u> For each of the six selected cases, a commercial analogue of each technology will be selected. This will be a technology that serves a similar purpose or solves the same or very similar clinical problem to the NHS-developed technology. Thus the technologies researched in Stage 2 will be made up of six pairs of technology, with each pair comprising an NHS-developed and a commercially developed technology.
- 3. <u>Identify key stakeholders in technology adoption for each of the twelve</u> <u>technologies.</u> Once the twelve technologies have been identified, key stakeholders in the adoption process will be identified. These are likely to include: NHS staff involved in with the development or adoption of the technology; staff in non-NHS organisations involved in development, marketing or other innovation related activities; and staff who provided support during the adoption process.
- 4. <u>Gain consent from adoption stakeholders.</u> Using the Stage 2 Participant Information Sheet and Consent form, informed consent will be gained from all NHS staff who will participate in Stage 2.
- 5. <u>Interview adoption stakeholders.</u> Interviews with participants will be held either face-to-face or by telephone. With the agreement of the participant the interview may be recorded using a digital recorder.
 - 5.1 Collect data from published and unpublished sources relating to the technology and its adoption.
- 6. <u>Produce interview summary.</u> After each participant interview with the participant a summary will be produced of the key content of the interview. This will be based upon contemporaneous notes taken by the researcher and /or audio recording of the interview. The summary will represent the data that the researcher would wish to use in any published work and will be a themed summary of key points using *verbatim* quotations where necessary.
- 7. <u>Gain authorisation for use of interview summaries in published work</u>. Participants will be given the opportunity to review the summary of their interview and to add, amend or remove details. Once they are satisfied that the summary reflects their interview and contains data that can be placed into the

public domain the participant will be asked to authorise the summary using the Interview Summary Authorisation Form.

8. <u>Develop detailed case studies.</u> Based on interview summaries, documentation provided by adoption stakeholders and other published literature, case studies of technology adoption will be produced. Individuals will not be identified by name within the case studies though it must be accepted that due to the nature of the technologies it may not be able to prevent either the technology adoption project or organisations referred to in the case being identified.



6. Contribution of existing research:

Lord Darzi's recent NHS review has reiterated the need for ensuring that innovation within the NHS is supported and rewarded; and also that due support is given to adoption of technological innovations (Darzi 2008)p.13. Darzi's interim report however noted that technology adoption had to take place within a wider context of service redesign and improvement aimed at improving the effectiveness of care, not just efficiency (Darzi 2007)p.39. These reports do not however examine the extent to which NHS-developed technologies are either any more or less adoptable than technologies developed outside the NHS. For technologies developed within the NHS, it is possible that many of the problems in integrating the technology within existing patient services have been addressed during development, possibly easing their subsequent adoption in other areas of the NHS.

Most technologies used in healthcare have had clinician involvement in their development; indeed, clinician involvement in the development of healthcare devices has been described as 'crucial'. This is because much of the 'state of the art' knowledge required for design of healthcare devices is held by clinicians (Shaw 1985) and their inventive and innovative personalities, combined with experience of working in situations where there is a high problem pressure and a lack of availability of relevant competences and resources, make them ideal candidates for these roles. In healthcare service delivery, a similar picture emerges with clinicians developing technologies in response to their own patients' needs but then paving their way from wider adoption. For example, a tele-medicine system to support the shared-care of leg ulcer patients was developed by a vascular surgeon in a midlands hospital before being licensed for use in other trusts (Savory 2007).

The roles that surgeons assume in healthcare device innovation include those of originator, developer, entrepreneur and marketer (Lettl 2005). The contribution of the clinician to technological development can be brought about in two ways. The first is where a clinician is identified as a lead-user by a commercial technology supplier and agrees to work with the supplier to develop products. This has been the traditional method of working for quite some time but more recently the second method whereby technologies developed by users and then taken up by other users or 'the market' has become increasingly common in recent years. Indeed, following the Baker Report (Baker 1999; Office of Science and Technology 2000) and the guidance published in 2002 (DoH 2002) on the exploitation of intellectual property (IP) developed within the NHS, various structures such as innovation hubs have been put in place to facilitate technology transfer from the NHS.

NHS-developed project contexts will typically be predominantly controlled by userdevelopers and address problems with which the users have a personal involvement. NHS-developed innovations may also develop with only a limited view of the future market. NHS developers will often be motivated by professional concerns rather than potential financial profit from the innovation. By contrast, commercially developed technologies will focus on problems that are more generic and development will be controlled predominantly by technology suppliers, focusing on clearly defined market requirements. The innovation trajectory taken by technology suppliers will often be defined by their existing products and the technological capabilities that underpin them.

NHS-developed projects will often be the product of a range of activities, some of which will impact on the technology's adoptability. Figure 2 shows an activity model of user-led innovation (Savory 2008).



Figure 2: Activity model of user-led innovation processes

Though wider diffusion and adoption of the technology is a distinct area of activity, the proofing and validation activities of the project can create data or evidence that potentially improves adoptability of the innovation

The development context has the potential to influence the adoption characteristics of the resulting technology. These characteristics may be affected by the extent to which developers are able to carry out development in relation to a real operational environment, resulting in technology that has a "fit" with specific contexts. Development carried out in close proximity to user-contexts may also enable guidelines for implementation and evaluation to be developed, affecting adopters' success in trialling and implementing technologies. The origin of a technology may also influence informal networks, for example the professional groups and their inter-relationships, which support the technology assessment process and the adoption decision.

Where medical devices are concerned, research (see, for example, (Rogers 2003) and (Roback, Gaddlin et al. 2007)) has shown that that the characteristics that affect adoption include:

- the relative advantage of the technology
- its compatibility with the new context for the technology
- the perceived complexity of the technology
- the trialability of the technology, including divisibility and reversibility
- the observability of the results of adoption

As noted by Roback *et al*, adoption decisions span both evidence-based and preferencebased assessment so this influence can be exerted in two ways ((Roback, Gaddlin et al. 2007), p. 171). First, it can make a difference in an objective sense. For example, a technology developed entirely within one NHS setting may genuinely be more compatible with other NHS contexts in which it will be used. Secondly, the origins of the technology may influence the subjective judgements of decision makers. The latter may, of course, operate in a positive or a negative direction. Decision-makers may prefer to rely on technologies from large, well-known suppliers rather than homegrown products from their counterparts in another trust or *vice versa*. (The 'invisible college' principle (Crane 1972) may be relevant here.)

7. Plan of Investigation:

The project is planned to be completed in two years and the project timetable is shown below.

Month	Activity
1-3	Literature review, gaining any necessary research approval (e.g.
	through COREC) and negotiating access.
4-5	Carry out and analyse survey. Write interim paper on survey results.
	Identify case sites.
6-9	Carry out case site interviews and data collection
10-12	Preliminary analysis.
13-18	Case writing
19-24	Writing:
	• Final report;
	• Journal articles;
	• Articles for professional journals
	Preparation of other materials to support face to face dissemination

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7975 Savory

Protocol Stage 1 & 2 Substantial Amendment 1 Version 1 6/4/10

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7975 Savory

Protocol Stage 1 & 2 Substantial Amendment 1 Version 1 6/4/10

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