The adoption space of early-emerging technologies: evaluation, innovation, gatekeeping (Pathways to Adoption of Technologies in Healthcare – PATH)

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This report contains transcripts of interviews conducted in the course of the research and contains language which may offend some readers.

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This research assesses technology adoption processes, not particular products.

Contributions of authors

Zelda Tomlin (Research Fellow, Health Services Research) conducted two case studies, led the coding and data analysis, and led the writing of the report.

Susan Peirce (Research Associate, evaluation of medical technology) conducted three case studies, undertook coding and data analysis, maintained the database and contributed to writing the report.

Glyn Elwyn (Professor, Primary Care Research) conducted one case study, provided clinical advice and project direction and reviewed the report.

Alex Faulkner (Principal Investigator, Senior Research Fellow, sociology of healthcare and medical technology) conducted two case studies, undertook coding and data analysis, and contributed to writing the report.

All authors contributed to the concept development of the research.
Executive Summary

Background

Introduction of new technologies into healthcare systems emerged as a major National Health Service (NHS) innovation policy issue in the UK during the 2000’s. There was a dual policy discourse; on the one hand, ‘slow’ adoption by the NHS (the need to promote technology) and on the other, ‘technology creep’ (the need to control technology). Compared to pharmaceutical technologies, nonpharmaceutical (device) technologies are generally exposed to less intensive evidence production and subject to what are perceived as less stringent regulatory regimes. Despite their substantial costs and impact on healthcare budgets, there has been little in-depth understanding on central factors implicated in their adoption. The National Institute for Health Research (NIHR) Service Delivery and Organisation (SDO) programme issued a call for proposals in 2008 to study the adoption of device technologies.

Aims

The study aimed to provide insights into the underlying mechanisms of adoption of device technologies in the NHS, to contribute to defining ‘appropriate’ technology adoption, and to produce an analysis that could contribute to developing better decision-making for practice and policy. Our specific objectives were:

- to explore the adoption pathways of selected technologies and the factors and issues with formative influence on these pathways
- to explore the empirical fit of a preliminary conceptual framework (the adoption space) and to explore its utility as a sensitising concept in exploratory research
- to develop an explanatory model/framework of technology adoption
- to explore the feasibility of developing a typology of technologies
- to produce an analysis that could contribute to defining ‘appropriate adoption’

Methods

The study drew on theoretical approaches from Science & Technology Studies, especially sociology of technology, and actor-network and technology-in-practice approaches. The role of technology itself was given
due attention as a factor potentially shaping adoption. The concept of the ‘adoption space’ – an all-inclusive map of key actors, processes, influences and decisional junctures relevant in technology adoption - was introduced at the outset.

A comparative case study design was used, with four main (detailed) and four ‘rapid appraisal’ technologies. The following data collection methods were used:

- semi-structured in-depth interviews (NHS, industry, patient, academic)
- email/telephone contact with informants
- documents/websites (NHS, government, industry, other)
- media reports
- scientific literature
- observation of conferences/smaller meetings
- prescribing data.

A total of 106 informants provided 127 interviews with staff from 38 NHS trusts contributing to the study. Between 10 and 27 interviews were conducted for the main case studies, and 5-15 for the rapid appraisals. For the main cases (except the spine implant), data were collected in at least two NHS sites whereas the rapid appraisal studies were not focused on specific sites.

Interview, documentary and media data were analysed using constructivist grounded theory with: fine-grained conceptual coding using the Atlas.ti software, constant comparison, discourse sensitivity, interpretation and divergent case analysis. Content analysis was used as appropriate. The emergent elicited analytic ideas and conceptual explanations were compared within and between technologies and synthesised to develop generic conclusions. Analysis was developmentally discussed by the research team at data sessions.

**Results**

The four main case study technologies were:

- cell therapy for severe burns
- coagulometer for self-monitoring or near-patient monitoring of anticoagulation therapy
- robotic surgery for prostatectomy
- spinal fusion device in degenerative back pain.

The four rapid appraisal technologies were
• electrocardiogram (ECG) telemonitoring
• C-reactive protein (CRP) point-of-care test device
• ‘smart’ infusion pumps (dose error reduction systems - DERS)
• handheld ultrasound (imaging and Doppler blood flow).

We have developed an ‘adoption process map’ and an ‘adoption space model’ that show that adoption and non-adoption are the outcome of intricate sociotechnical and sociopolitical interactions between individuals, professional groups, NHS organisations and the industry.

We offer a key explanatory construct that we believe will advance the understanding of factors shaping adoption decisions: technology identity. This construct encapsulates the integral material and social aspects of the technologies, unavoidable demands that they bring, local expectations and agendas, and structural frames such as the health economy, budgets and costs.

‘Technology identities’ are heuristic, transportable ideas about the technology that are centrally implicated in constructing the value propositions relating to the technology’s:

• Biography – plausibility, distinctiveness/novelty, visibility, future
• Effectiveness – clinical and cost effectiveness
• Rationale and utility – clinical rationale and market, clinical, semi-clinical and non-clinical utilities
• Risks – clinical, organisational, financial
• Requirements – financial, use-related, organisational (including disruptive potential).

‘Evidence-for-confidence,’ combining health technology assessment (HTA) type (cost)effectiveness evidence with craft and everyday forms of evidence, was instrumental in the construction of technology identities. Contingent and fluid compositions of identities helped determine the technology’s adoptability. We found, for example, that an identity as institutional image maker and income generator resulted in the acquisition of the robot by many NHS trusts despite other identities indicating high-cost and contested cost-effectiveness. The coagulometer in self-monitoring had an identity among clinicians and managers as a niche technology carrying high risks; this resulted in low diffusion despite its identity as safe/clinically-effective and widely applicable in formally produced evidence.

We found that the multi-variable interactions between different identities of the same and different technologies did not easily fall into categories, making the construction of a technology typology difficult. But we noted two adoption-relevant differences between technologies. First, technologies could be classified as either stand-alone or service-embedded, depending
on whether they slotted into existing services relatively unproblematically or necessitated systemic service changes. Second, we found that technologies differed in terms of how they could be adopted. We identified three main types of adoption:

- ad hoc, typically pay-as-you-go, clinician-driven;
- intermediate, more organised, requiring some initial commitment
- single, capital investment, high level authorisation.

The first two types of adoption made trialling within the service setting possible.

A key feature of NHS adoption processes was their informal (undocumented) and political nature, involving promotion of the technology, resistance, negotiation and persuasion, rendering them relatively opaque. Availability of funds was not always a constraining factor, with a striking degree of creativity and ingenuity exercised in obtaining funds and/or devices directly. NHS know-how relevant to adoption (information retrieval and processing, independent NHS-owned assessment, whole-system/long-term approach) was limited, and informal networking and a reliance on industry-generated information and forecasting were common. Imagined and formally planned diffusion scenarios contrasted with actual diffusion; the extent to which adoption and diffusion could or should be planned or managed varied between technologies.

The adoption space model posits that adoption and non-adoption are the outcome of three inter-related processes:

- the co-construction of technology identities
- organisational structures and processes for decision-making
- relevant organisational know-how and evidence use.

Through organisational structures and processes of assembling, examining and weighting evidence, particular identities gain legitimacy and result in adoption or non-adoption. We further suggest that the appropriateness of adoption/non-adoption has to be understood as a local phenomenon and we define appropriate technology adoption as the use of local expertise to conduct impartial scrutiny in order to establish whether adoption would best serve the interests of the local health economy and patients.

Since our study indicates that local adoptive practices generally fall short of this ideal, we propose three mechanisms that could be introduced to improve technology adoption in the NHS:

- critical reflexivity to enable more systematic and independent scrutiny of available evidence
- auditable processes to ensure deliberation and decisions are documented
• post-adooption monitoring to ensure projections relating to use and anticipated benefits are realised and where feasible, adoption decisions are reviewed.

Further, we put forward the idea of a decision aid, the ADOPT Profile tool, designed to operationalise these objectives. In addition, we make suggestions for other types of input that may improve adoption decision-making and for future research.

Conclusions

This research has spotlighted to date ill-understood sociotechnical processes that influence how new technologies enter the NHS at micro and meso levels, in the context of commercial environments. The policy-rational perspective, with an emphasis on high-level formal cost-effectiveness evidence as a basis for adoption decisions, emerges as inadequate given the highly socially mediated, multi-perspective and contingent nature of adoption evident in this study. We plan the development of an ADOPT Profile tool, drawing on the empirically grounded notion of technology identities with the potential to enable a more confident and appropriate NHS response to healthcare technology innovation.