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# Technology identity: The role of sociotechnical representations in the adoption of medical devices

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ABSTRACT

This study explored the sociotechnical influences shaping the naturally-occurring adoption and non-adoption of device technologies in the UK's National Health Service (NHS), amid increasing policy interest in this area. The study was informed by Science and Technology Studies and structuration and Actor Network Theory perspectives, drawing attention to the performative capacities of the technology alongside human agentic forces such as agendas and expectations, in the context of structural and macro conditions. Eight technologies were studied using a comparative ethnographic case study design and purposive and snowball sampling to identify relevant NHS, academic and industry participants. Data were collected between May 2009 and February 2012, included in-depth interviews, conference observations and printed and web-based documents and were analysed using constructivist grounded theory methods. The study suggests that while adoption decisions are *made* within the jurisdiction of healthcare organisations, they are *shaped* within a dynamic and fluid 'adoption space' that transcends organisational and geographic boundaries. Diverse influences from the industry, health care organisation and practice, health technology assessment and policy interact to produce 'technology identities.' Technology identities are composite and contested attributes that encompass different aspects of the technology (novelty, effectiveness, utility, risks, requirements) and that give a distinctive character to each. We argue that it is these socially constructed and contingent heuristic identities that shape the desirability, acceptability, feasibility and adoptability of each technology, a perspective that policy must acknowledge in seeking to intervene in health care technology adoption.



## Introduction

The development and use of health technologies – pharmaceutical drugs, devices and now hybrids (e.g. tissue engineering, combination products) – has been increasingly problematised in health policy in the industrialised world, including the UK's National Health Service (NHS) (DH, 2006, 2011; Wanless, 2002). This has stemmed from a frustrating recognition that the promise of 'innovation' – technology demonstrated to be cost effective and (more recently) cost-cutting – remains largely unrealised. Instead, 'technology creep' (Gabbay & Walley, 2006), where technology is adopted despite the absence of demonstrable clinical advantages, is common. Furthermore, many technologies alter diagnosis or treatment thresholds and increase service provision and use, causing concern that reported marginal gains in productivity and cost reduction are negated in routine use. This has led to policy interest in social scientific research that may help realise the goal of more 'rational' technological innovation and adoption.

Device (non-pharmaceutical) technologies have, until recently, received less attention than pharmaceuticals. The US Centers for Medicare and Medicaid Services (CMS) began, from 2006, to use its considerable leverage to require that new devices enter practice only in the context of rigorous comparative effectiveness studies (CMS, 2012). In the UK, the National Institute for Health Research (NIHR) Service Delivery and Organisation (SDO) programme (later named Health Services & Delivery Research) published a call in 2008 for research on 'organisational factors' that impacted on device technology adoption (NIHR, 2008). Here we report key conceptual findings from a study funded by this programme.

Our study, 'Pathways to adoption of technologies in healthcare' (http://www.netscc.ac.uk/hsdr/projdetails.php?ref=08-1820-253) was embedded in a sociological and Science and Technology

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Studies (STS) perspective and represented a synthesized position between, at the highest level of abstraction, technological determinism (technology's impact on society) and social essentialism (influence of social forces on technology) (Timmermans & Berg, 2003). We premised that technologies represented a mutually constitutive intertwining of the technical and artefactual with the social: social shaping *of* technology counterbalanced by social shaping *by* technology (MacKenzie and Wajcman, 1999), also encapsulated by the notion of 'co-production' (Jasanoff, 2004). Within this overarching notion, the STS concepts that are most relevant to our study concern three main ideas: first, the idea that a *network of actors* including technology itself shapes the direction of technology adoption; second, the idea that technology is represented and apprehended *through information and 'evidence' that is socially constructed* and open to divergent views; and third, the idea that technology itself has *material qualities that constrain and enable* its use, including matters such as skills, user modifications and structures of work organisation. These three ideas are notably found, first, in actor-network theory (Latour, 2005) in which technology is one active agent among others in dynamic sociotechnical networks and network members constitute organisational realities through interactions, with unpredictable outcomes. A 'technology-in-practice' approach in healthcare draws closely on this approach (Timmermans & Berg, 2003). Second, the 'social construction of technology' (Bijker, Hughes, & Pinch, 1987; Hyysalo, 2006) emphasizes the 'interpretive flexibility' of technology (Pinch & Bijker, 1987: 40–41), expressed also for example in the idea of 'technology signatures', showing how 'local, informal logics' are used in constructing meanings for specific technologies (Horlick-Jones, 2007). The recognition that uptake and implementation depend on the production and challenging of evidence in complex interactions of power is evident in some studies of health technology innovation (for example Obstfelder, Engeseth, & Wynn, 2007; Schlich, 2002). Third, the notion of 'technology affordances', a softened version of technological determinism, suggests that technologies' material properties place constraints on interpreted meanings (Hutchby, 2001), though users may be able to adapt material aspects of technologies to purposes not wholly envisaged or intended by their producers, captured in the idea of 'domestication and appropriation' (Schwartz Cowan, 1987: 261–280). This idea of technology's performativity, i.e. its active agency, can also be traced in the broader social theory of structuration (Giddens, 1984) and the concept of technology *structuring* (Barley, 1986), indicating technology's role in challenging, altering or maintaining social and organisational structures. The concept of a constructive 'usership' in technology introduction draws attention to constraining and enabling effects, which we would expect to vary depending on the particular technology and healthcare context (Faulkner, 2009).

The sociotechnical nature of technology adoption and diffusion is also empirically described in the health services research literature. A recent systematic review of device technology adoption and assimilation (Robert, Greenhalgh, MacFarlane, & Peacock, 2010) pointed to: the importance of relationships, politics and informal (as well as formal) processes; the privileged status of clinicians as decision-makers; the relationship between internal (organisational) structures and processes and the external environment; largely unpredictable interactions between multiple social influences. More generally, Rogers' well-known theory of innovation notes social features of diffusion: attributes of the innovation, the individual and organisations, the role of communication networks, receiving social 'systems' and 'structures' and the processual nature of adoption (Rogers, 2003). Although Rogers' work has been criticised for its linear perspective, these ideas have been extensively used in the literature (Greenhalgh, Robert, Macfarlane, Bate, & Kyriakidou, 2004).

Despite these insights, 'lack of a sophisticated understanding of what actually happens' in technology adoption persists, necessitating 'longitudinal, qualitative studies' leading to explanatory models (Robert et al., 2010, p. 249). Our study was designed to fill this gap and aimed to identify salient sociotechnical influences on whether and how technologies entered use in the UK's NHS. As noted above, we approached the topic from a deliberately integrative theoretical perspective, combining STS, and specifically ANT, with structuration theory, and we were additionally informed by empirical studies and our own earlier work (Elwyn et al., 2008; Faulkner, 2009; Faulkner & Kent, 2001; Ulucanlar, 2011).

## Methods

The study set out to explore diverse influences on the adoption and evidential pathways of selected device technologies, and to develop an explanatory model or framework. We adopted a partly prospective ethnographic comparative case study design using qualitative methods. The main unit of analysis was the technology. Four main technologies and four less detailed 'rapid appraisal' technologies were studied. This was, for the most part, a study of spontaneous (naturally occurring) adoption or non-adoption. We define adoption as *the processes involved in making the decision to use the technology*; the decision can be located at different levels (individual, organisational, regional, national) and may be informal or formal and transient or permanent. We contrast this with implementation (defined here as processes involved in operationalising a 'deliberately initiated' and 'institutionally sanctioned' (May, 2013) decision to adopt a technology at a specific setting) and routinisation (defined here as social, organisational and clinical processes that result, over time, in the technology becoming more widely and consistently used within a health economy, with or without protocols stabilising its use). The distinction between spontaneous adoption and implementation proved less useful, however, with technologies that required service-wide (re) organisation.

### *Technology selection*

The main technologies were of importance to the NHS. The objective was to ensure maximum diversity along relevant a priori dimensions (Table 1). The selection of rapid appraisal technologies was designed to extend diversity and also reflected emerging analytic ideas: poorly defined identity and significant training requirement (handheld ultrasound); adoption by trialling (telemedical ECG kit); high organisational requirements (smart infusion pumps); non-adoption (C-reactive protein test kit – CRP). Rapid appraisal methods have originated in population needs assessment (Murray, 1999) and can involve a variety of approaches; we use the term to indicate: fewer data (including fewer interviews); a more narrow range of participants; a shorter data collection period. However, as with the main technologies, the interviews were in-depth and documentary data were included in the analysis. Table 2 provides brief technology descriptions.

### *Setting and sampling of informants*

Purposive and snowball sampling were used to locate key informants (clinicians, managers, academics, industry representatives) who were involved in consideration of adoption, were users/non-users or company staff or had technology-relevant knowledge. We tried to include a spectrum of views and were able to recruit participants who were both enthusiastic and sceptical in their attitudes to the technologies. The number of interviewees for each technology depended on whether they were main or rapid