# Technology as system innovation: a key informant interview study of the application of the diffusion of innovation model to telecare

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## *Abstract*

*Purpose*

To identify and explore factors that influence adoption, implementation and continued use of telecare technologies.

## *Method*

As part of the Assistive Technologies for Healthy Living in Elders: Needs Assessment by Ethnography (ATHENE) project, 16 semi-structured interviews were conducted with key participants from organisations involved in developing and providing telecare technologies and services. Data were analysed thematically, using a conceptual model of diffusion of innovations.

## *Results*

Participants identified numerous interacting factors that facilitated or hindered adoption and use. As predicted by the model, these related variously to the technology, individual adopters, the process of social influence, the innovativeness and readiness of organisations, implementation and routinisation processes following initial adoption, and the nature and strength of linkages between these elements. Key issues included i) the complexity and uniqueness of the ‘user system’, ii) the ongoing work needed to support telecare use beyond initial adoption, and iii) the relatively weak links that typically exist between users of telecare technologies and the organisations who design and distribute them.

## *Conclusions*

Telecare is not merely a technology but a complex innovation requiring input from, and coordination between, people and organisations. To promote adoption and use, these contextual factors must be specified, understood and addressed.

***Introduction***

An ageing population, pressure on health and social care capacity, and changing social roles and expectations are driving demand for innovative solutions to support independence at home for people living with long-term conditions and disability. Assistive technologies such as telecare are increasingly proposed as one such solution [1-4].

Telecare covers a diverse range of products and services that enable remote monitoring or prompting of individuals (e.g. falls detection, room occupancy, location of wanderers, medication reminders) and/or homes (e.g. detection of smoke, heat, gas, overflowing baths and unlocked doors). It differs from telehealth (transmission of data between home and healthcare provider for remote medical care) and telemedicine (use of technologies for communication between healthcare providers).

Of the 1.7 million telecare installations in the UK, all but 300,000 are pendant alarms [5]. These are generally linked with local social services departments, who assume some level of responsibility to interpret and respond to signals. Clients may be charged for the technology and/or the service to support it.

Uptake and use of telecare devices has fallen far short of levels predicted by policymakers [6,7], perhaps because technology development has proceeded faster than exploration of the personal, organisational, cultural and ethical implications [8-11].

Previous research on telecare as a system innovation has considered the user or carer perspective (generally positive in principle about assistive technologies, though concerned about issues of autonomy and dignity) [12,13]; the home environment (a physical and symbolic space which may be more or less accommodating to telecare) [14]; the process of organisational change for embedding telecare (strategically contested, operationally complex, demanding of staff time and often in competition with other priorities) [15,16]; and the challenges of sustaining and expanding a pilot telecare service (dependent on a positive policy context and alignment of multiple stakeholders with different priorities and value-systems) [17].

One qualitative study adopted a multi-level approach based on normalisation process theory (NPT), which considered not only individual acceptance and ease of use of the technology but also the implications for social relations between individuals and within the workplace [18]. The authors identified multiple interacting barriers including uncertainties about service and business models; lack of coordination across organisational boundaries; competing stakeholder perspectives arising from their different normative assumptions about illness; lack of financial or other incentives; technical concerns; and lack of continuity with previous service provision and self-care work undertaken by patients. Whilst NPT allows rich theorisation of the social context in which a technology is introduced, it offers limited potential for theorising the technology itself since its starting position is that the technology should be ‘normalised’ and its material properties are not a focus of enquiry.

The existing literature thus already positions telecare as a system-level innovation whose success depends on the social and organisational context in which it is introduced and used. Surprisingly few studies have considered the material features and functionality of telecare technologies in the context of use. One source of data on this theme is staff in the telecare industry and the service providers who support telecare-in-use. The purpose of this study was to identify and map these perspectives.

*The ATHENE project*

The study was part of the Assistive Technologies for Healthy Living in Elders: Needs Assessment by Ethnography (ATHENE) project, which seeks to inform co-design of assistive technologies [19,20]. The project involves extensive ethnographic work in the homes of older people and also a co-design phase in which participants work directly with technology suppliers and service providers to inform the design of new or adapted technologies and services. The ATHENE steering group includes representation from industry, NHS, social care, users, third sector and academics. The sub-study reported here was undertaken to gain a detailed understanding of the system into which technologies need to fit.

***Methods***

*Sample*

In total, 16 semi-structured interviews were conducted with a purposeful sample of 21 participants involved in the development and provision of telecare in the UK. Most interviews were individual but some included two or three participants. Participants represented six telecare technology suppliers involved in a broad range of telecare products and 10 telecare support service providers (six local authorities, one private, two NHS and one voluntary sector). Recruitment was initiated through steering group members and contacts from knowledge brokering events (e.g. conferences). We have deliberately not given detailed information about these participants or organisations to preserve anonymity.

*Theoretical framework: the diffusion of innovations model*

We used a multi-level model for adoption of service-level innovations as described by Greenhalgh et al [21, 22]. The model is shown in Figure 1 and has nine components. First, there is the innovation itself, which the model predicts is more likely to be taken up if its attributes in the eyes of potential adopters include such things as relative advantage, low complexity, compatibility with values and ways of working, trialability, observability, potential for reinvention and ease of use.

[*Insert Figure 1 about here*]

Second, there are the potential adopters. The model considers adoption as an active and complex process. Different people are more or less technologically-minded, more or less risk-averse, and have different past experiences.

Third, social influence is key to individual adoption decisions, especially the role of opinion leaders, champions and boundary-spanners (people who bring ideas and examples from elsewhere). Such active dissemination strategies can be highly effective if played strategically. But much adoption occurs by diffusion, which though traditionally understood as an essentially passive process of copying others, may actually involve extended processes of ‘social learning’: experimentation, interaction with potential users, failures and reinvention [23].

Fourth, the model assumes that some organisations are inherently better at identifying and assimilating innovations than others. Most significant is an organisation’s absorptive capacity for new knowledge and its receptive context for change.

Fifth, even when an organisation supports service level innovation in general, its readiness for any *particular* innovation depends on prevailing pressures for change, whether its supporters outnumber opponents and have the influence to drive it forward, and the degree of innovation-system fit.

Sixth, there is the process of assimilation, the organisation level parallel to individual adoption. Service level innovations can be thought of as having a ‘hard core’ (the essential features of the innovation) and a ‘soft periphery’ (aspects of the wider organisation which need to adapt to accommodate the innovation into ‘business as usual’). Identifying and addressing these soft periphery elements can be a difficult, non-linear process.

Seventh, implementation within the organisation can be done well or badly. Devolution of decision-making to front-line teams, hands-on input from leaders and senior managers, bespoke training, targeted resources, effective channels for internal communication and accurate and timely feedback on progress can make or break an effort to introduce complex innovation, even when there is broad-based support for it.

Eighth, there is the broader, ‘outer’ context for innovation. The prevailing economic and political context and the behaviour of other organisations in the same sector can exert a powerful influence on the organisation level adoption decision.

Finally, the relationship between these different components is as critical to innovation success as any individual one. Linkage (communication, consultation, dialogue and so on) between different organisations and sectors does not lead automatically to consensus or a self-evident way forward, but it may lead to better orientation of stakeholders to one another and the development of a shared vocabulary with which to negotiate effectively.

With this model in mind, we conceptualised telecare as an innovation whose adoption, implementation and sustainability depend on a host of influences at different levels in a wider system. With the caveat that ‘telecare’ embraces a diverse range of products and services, use of this theoretical approach aided interpretation of the findings and the interactions that facilitated or hindered adoption.

*The interviews*

A semi-structured interview guide was developed with questions focused on the background of the organisation and interviewees’ roles within them; communication and collaboration within and across organisational boundaries; perceived challenges to the uptake and use of telecare; and views about future developments. Interviews with technology industry representatives included questions related to the design process. These focused on the stages involved in development and refinement of the technology and how these processes were informed. Interviews with service providers included questions related to the provision of telecare, focusing on processes involved in assessment of users’ needs and installation of telecare in users’ homes. The interview protocol was adapted over time in response to emerging themes. Interviews were recorded with consent and transcribed.

*Data analysis*

We read the transcripts repeatedly to gain familiarity, and discussed the emerging findings as an interdisciplinary team whose backgrounds spanned medicine (TG, a general practitioner), computer science (RP), psychology (JW), occupational therapy (PS) and sociology (SH). Transcripts were then analysed thematically, using the components of the diffusion of innovations model as a guide. Data continued to be collected and analysed iteratively until no new themes emerged.

***Results***

We present our main findings below, under the headings of the diffusion of innovations model. Participants have been anonymised to preserve confidentiality.

*1. Telecare as an innovation*

In this section, we discuss key attributes of telecare as an innovation as perceived by service providers and technology suppliers: relative advantage, compatibility, complexity, trialability, observability, potential for reinvention, risk and ease of use.

*1.1 Relative advantage (over available alternatives)*

Advantages of telecare perceived by participants included improved quality of life for users, cost and efficiency savings for health and social care providers, and ‘peace of mind’ for both the primary user and their family and wider care network. Relative advantage was considered to vary substantially depending on the device and needs of the user. Bed sensors, for example, were depicted as supporting independence with night-time toileting, a high risk activity for some older people. Some devices, however, were depicted as offering little in the way of relative advantage, either because they were technically less reliable or because they did not solve the problem for which they were designed:

‘Fall detection…can be a bit of a dark art… One of the things they have to work around is that fall detection is quite sensitive and there is no perfect way of doing it’. Technology supplier 5

Participants described numerous examples of users who had alternative solutions that provided greater advantage to them than a telecare product. For example, if the user already received regular telephone calls from a relative or visits from a home carer to prompt them to take medication, the relative advantage of a memo minder or a medication reminder system were marginal.

Many participants from social services and third sector organisations emphasised how the financial costs of telecare could negatively affect adoption, both for individuals and organisations, particularly when benefits were marginal or unclear. Two participants described how clients had asked for their telecare devices to be decommissioned when modest charges were introduced, suggesting that any advantage gained was not considered significant enough to be worth paying for.

*1.2 Compatibility (with personal values and lifestyle)*

Participants noted that the appearance and style of many devices were off-putting, represented the medical world of instruments and monitoring rather than the personal world of family and culture, had a ’frumpy’ design, and carried stigma attached to older age, illness and disability. In response to this, attempts were being made to design devices that resembled other domestic technologies, or to integrate telecare with use of existing technologies such as mobile phones.

A significant theme was that users and the people in their care networks often had to alter their daily activities and routines to fit in with telecare. For example, most provision of alarms and sensors was based within the home and dependent on a landline telephone. This was incompatible with a lifestyle that included going outdoors (in the garden, to the local shops or to spend time with relatives). The telecare device would only ‘work’ if, and to the extent that, users adapted their lifestyles to fit designers’ assumptions. Various mobile alarm devices were reported to be in development.

*1.3 Complexity*

The level of adoption appeared to be inversely proportional to the level of complexity the technology presented for users and their lay and professional carers. This is discussed further under ‘assimilation’ below.

*1.4 Trialability (opportunity to experiment before committing to adopt)*

Service providers reported setting up opportunities for users to try out and get hands-on experience of telecare devices e.g. a show flat or a demonstration area attached to a day centre for older people. In practice, however, users were often provided with a telecare device without prior opportunity for experimentation, perhaps in response to an emergency or sudden change in circumstances. Passive devices such as environmental sensors presented limited opportunities for trialability.

*1.5 Observability (visible benefits)*

The benefits of telecare for service provider organisations (e.g. ‘peace of mind’) were rarely easily observable or directly measured. Benefits might accrue in a different part of the overall system from the one which had responsibility for provision e.g. telecare provision by a social care provider might reduce length of stay for admissions to an NHS hospital.

*1.6 Potential for reinvention*

Service providers reported that individual users frequently used their telecare device in novel ways. This was sometimes described as ‘in the wrong way’. Clients would press the alarm button to report that their carer had not arrived, or to initiate social contact when lonely or anxious. This could meet the needs of the user but might conflict with those of the call centre, which might struggle to deal with the volume of calls. Service providers reported a need for strategic reorientation from responding to *emergency* needs to meeting an ongoing *social* need, and trying to incorporate these reinventions into their mainstream service, e.g. by offering a daily or weekly social telephone call.

Limited inter-operability between different technology suppliers’ products was described by service providers as a significant barrier to adapting and refining services to meet individual needs. This was considered an example of supplier-driven rather than needs-driven provision that limited possibilities for reinvention. Some service providers were critical of technology suppliers’ apparent inability or reluctance to deliver inter-operable devices and expressed suspicion that this was a deliberate ploy to tie users into one provider.

*1.7 Risk (uncertainty and potential downside of adoption)*

Although telecare devices were generally perceived to be reliable, participants identified some reliability issues and risks, for example devices using GPS technology depended on a satellite signal. More significant perhaps was the question of who was liable and responsible should a device or service not function effectively.

‘Particularly medication, everyone wants to protect themselves. We’re not as bad as the States but, you never know, we might get down that route where everyone sues all the time for any mistake going on’. Technology supplier 3

Another risk mentioned frequently by participants was loss of independence. Use of a telecare device exposed the user to surveillance and control by social services.

‘They’ve [older people] got this fear of social services, the name… Absolute fear, they don’t want anyone interfering or taking their home off them or ‘sticking them in a home’ as they say’. Service provider 7

*1.8 Ease of use*

A technology is more likely to be adopted if it is perceived to be easy to use [21, 24]. This varies considerably depending on the needs and capacity of the user. In our participants’ experience, falls monitors were particularly difficult to use, and service providers found in practice that many were used incorrectly due to practical problems such as remembering to wear the device and managing battery life. Technology suppliers commented that older adults tended to resist technologies they were not familiar with, such as touch screens. Technical support for telecare might increase ease of use and is discussed under ‘Assimilation’ below.

*2. The potential adopters of telecare (what people care about, what they can do)*

As described under ‘Compatibility’ above, telecare may be resisted because of its negative symbolic meaning. Rather than viewing telecare as bringing an end to loneliness and isolation, some potential users assigned precisely the opposite meaning, linking the telecare device to social isolation and rejection by the healthcare system:

‘Older people are resistant to having technology to replace people, aren’t they? And I think I would be as well. You think, I used to have someone come round my house…and then suddenly I don’t see anyone’. Service provider 5

A commonly cited barrier to telecare adoption was cognitive impairment, which made the individual less able to learn new skills or imagine how their life and routines might be different if the technology were used. The key challenge was introducing the technology early enough in the course of declining cognitive function. Mental health conditions, which occurred commonly in older people with complex health needs, might affect both their willingness to adopt the telecare technology and their capacity to use it appropriately:

‘And basically we put the thing in and then she [client with psychotic illness] rang the police and said that she had a bomb in her flat. And they sent up a special bomb squad’. Service provider 3

Many participants described a ‘digital divide’ between the current generation of older people (perceived as resistant to information and communication technologies) and younger generations (perceived as comfortable with and willing to adopt such technologies). Some felt that future generations would be keener on telecare and more discriminating in their choice of products. Others gave examples of people previously comfortable in using technologies who stopped using them when they lost physical or cognitive abilities.

Our interview data suggested that the adoption decision for individual telecare users was not an all-or-nothing, one-off event. Rather, it was a process that evolved over several months or years. The initial adoption decision was often contingent on the person’s social network of family, friends, neighbours and informal and formal carers, each of whom might be asking themselves questions such as, “Is this going to make work for me or cost me money?”. How these questions played out for the pivotal people in the network might or might not support adoption and use of telecare.

Within organisations, telecare could hold different meanings for different staff members and professional groups, and sat more or less comfortably within their professional jurisdiction. This affected how services were implemented:

‘When you just had OTs [occupational therapists] doing it, it becomes a social work non-issue and they ignore it. And one of the biggest benefits of telecare is how it works with the care needs’. Service provider 6

*3. Diffusion (adoption by copying) and dissemination (active efforts to influence adoption)*

Within service provider organisations, participants gave examples of how enthusiasm for telecare had spread as a result of peer influence by individual staff members in horizontal networks across teams or departments. Active dissemination programmes had been attempted in service provider organisations, with varying success. Limited success was sometimes attributed to organisational change and loss of key staff. Two local authorities had trained champions to help embed telecare within the organisations. Both experienced an initial but short-lived positive impact as designated ‘champions’ moved on to new roles.

Lack of a consumer market for telecare was seen as both evidence of and a causal factor in limited adoption. Until recently, technology suppliers had mostly marketed telecare to service provider organisations, but were now starting to market directly to individual users and to organisations linked to them such as housing associations.

Our participants generally did not perceive these active marketing efforts to have been very successful thus far. They cited the different strategies required for different users (e.g. public sector organisations versus individual older people), the slow pace of change in some organisations, the large number of small technology suppliers in the market with few widely recognised brands, and how to promote telecare as a desirable product when many associated it with negative ideas of older age and disability. Many target audiences were perceived as lacking even basic awareness of what technologies were available and what potential benefits they could bring.

*4. Organisational innovativeness*

Telecare needs to be assimilated at an organisational level by organisations such as local authorities and NHS Trusts, some of whom are more inherently capable of capturing and mainstreaming technological innovations than others. Importantly, participants identified financial pressures and competing priorities as major barriers to the introduction of new services. It was also apparent from that some provider organisations had elements of a receptive context for change such as strong leadership, good managerial relations, good internal communication mechanisms and a climate that encouraged experimentation and risk-taking.

*5. Organisational readiness for telecare*

In some ways, service organisations appeared ‘ready’ for telecare but in other ways were less so. Pressure for change was widely reported by our interviewees, and was attributed to a combination of an ageing population, increasing numbers of people living with long term conditions, pressure on health and social care resources and the need to reduce costs. However, there was also a growing perception among service providers that telecare may not reduce costs. One service provider in our sample provided an example of a service user provided with an extensive formal care package and range of telecare devices whose costs were equivalent to those of residential care.

The reality was that a finite budget was available for telecare in most local authorities. One service provider in our sample chose to offer a basic package of pendant alarms and environmental sensors, but not more innovative and specialised devices that required a much finer degree of tailoring to individual circumstances and were perceived as more expensive. This interviewee suggested that one way to assess and evaluate telecare is to consider whether its use would lead to a reduction in the cost of existing care packages. If clear cost savings were identified then assimilation of telecare would be promoted but, in practice, these savings were difficult to assess and quantify.

A recurring theme in our interviews was the current small size of many service providers in terms of numbers of clients. One participant said telecare needs to be adopted on at least a moderate scale to be cost-effective:

‘The theory is you need ten thousand connections before you can break even. So if you’re a borough scheme then you’re not likely to have ten thousand connections… So I would imagine that’s the biggest restrictor…unless community alarm services join together’. Service provider 1

All service provider participants described both supporters and opponents of telecare within their organisations. Interestingly, there was a tendency for senior managers and policy makers to be supportive, perhaps based on an idealised view of who is helped by the technology and how, while frontline workers tended to temper their enthusiasm with experience of the realities of service users struggling to incorporate the devices into their lives. This could sometimes result in tension, with frontline staff not being fully committed to a new initiative instigated by their managers.

*6. The assimilation process of building a ‘soft periphery’ around the telecare device*

The assimilation of telecare requires extensive changes to systems, structures and ways of working. This is because complex innovations such as telecare have a ‘hard core’ (the unchangeable features of the innovation itself) and a ‘soft periphery’ (systems and services essential to full implementation). A telecare alarm, for example, may consist of a pendant plus a wall box, as well as the technical connections to a call centre. But much more needs to be in place for the alarm to ‘work’. For example, trained and motivated staff and an arrangement (formal or informal) with the user’s relatives, neighbours or other members of their social network as to who will be called and under what circumstances, how they will access the home and what actions will be taken. The more adaptable the ‘soft periphery’ and the more attention is paid to this aspect of the innovation, the more likely the innovation is to be adopted [21].

Technology supplier participants reported that current devices could be set up to connect with family members, wider networks such as 24-hour call centres or a combination. They emphasised the importance of including a range of service providers, including local authorities, third sector providers and stand-alone telecare. One key finding in our data was that this ‘soft periphery’ was far from standard. Rather, it needed a high degree of personalisation to meet the needs and preferences of the individual technology user and their extended family:

‘And then because not everyone wants to be linked to a response centre or get social services involved in, you know, mother not being able to take her medication or whatever. They see that as intrusive, to have social care popping in or phoning. They don’t need that link’. Technology supplier 3

An important dimension of the ‘soft periphery’ was training for both service staff and users in the use of a telecare device and ongoing technical support. This might be provided at many levels, with technology suppliers typically supporting service providers (e.g. with training programmes or DVDs) and service providers supporting individual users (e.g. by a visit to review whether the technology was effective and meeting needs). Whilst extensive customisation of the device and the support package to the individual and their circumstances was seen as essential, our participants agreed that because of the heavy time commitment to do this task thoroughly, full assessment and ongoing tailoring did not always occur in practice:

‘When you are fitting technology to a person, I think the key thing is assessment. Knowing the person, knowing their behaviour profile, knowing what they do, knowing who is working with them to support them. Involving them and interacting with them. It really is multi-agency. To be honest, people are doing assessments over the phone without even visiting clients in the home. And really for the technology to be successful you need to have home-based visits’. Service provider 1

One reason for cutting corners on the assessment and support process was the modest budget allocated for this aspect of the telecare service:

‘I think a lot of people mistakenly think it’s just the technology, it’s about putting a bit of kit in… The big problem in terms of processes, who does reviews? How do reviews happen? Are they part of care management? Are they part of commissioned service?’. Service provider 6

The picture is complicated by the fact that some stakeholders, e.g. local authorities, might be both part of the innovation, providing a vital service element to support the use of telecare, and a user, assimilating the innovation to meet specific objectives. Furthermore, these complexities played out differently for different organisations and groupings, so the territory often had to be trodden anew every time the provider sought to break into a new locality.

*7. The implementation and routinisation process*

Implementation and routinisation beyond initial adoption were identified as key challenges by participants. Sustaining the service was an ongoing process that required changes in individual and team attitudes and ways of working. Dedicated resources for telecare implementation in service provider organisations varied. Participants emphasised that delivering a telecare service was an ongoing cost, not a one-off, and there were different ways to divide costs between stakeholders and users. Maintaining resources was a constant challenge, especially when a ‘set-up’ budget had been allocated but not a recurrent budget line.

Local authority service providers stressed the need to embed telecare widely across social services departments and described attempts that were being made to do this. If this ‘embedding’ did not occur, the danger was that telecare services were isolated from the wider provision of services and routinisation only partially achieved. Two methods to embed telecare were described:

‘They [local authorities] approached it in various ways. Whether they’ve had a specific telecare team and they do everything, or whether they're trying to mainstream it in the fuller sense of the word of actually trying to get the training out into the grassroots of assessors and field workers so that they can have core skills to do the assessments themselves. We've attempted to go down the latter route of doing core skills across. And that’s been successful in some places but not as much in others because of the amount of support that we’ve had available to follow up on the training and the process and has been very difficult to manage’. Service provider 6

As predicted by previous studies on diffusion of innovation [21,22], service provider participants described the need for hands-on management and oversight by leaders and managers who understood telecare and were up-to-date with developments, particularly because of evolution in technologies. Some organisations had such awareness in-house but this was not always the case.

Embedding telecare across an organisation required people to think and behave in different ways, so staff training and workforce development was a key human resources issue and cost. Staff in service organisations felt that when training was provided by technology suppliers it tended to be too technology-focussed and failed to address things that clinicians needed to know e.g. how the telecare device might fit with a package of care to safeguard a vulnerable adult.

Internal communication about telecare within organisations (e.g. among housing and social services departments within a local authority) and collaboration between organisations (e.g. between the NHS and social services) was sometimes sub-optimal. Awareness and understanding of telecare appeared to vary widely among individuals in local authorities and NHS Trusts, resulting in inappropriate or limited numbers of referrals being made.

The over-riding concern for inter-organisational collaboration related to funding. Telecare services implemented by one organisation might reduce costs for another, e.g. a pendant alarm provided by a local authority reduced the demand for accident and emergency services in an acute NHS trust. This was an example of Berg’s more general axiom that introducing an ICT innovation in one part of the healthcare system tends to produce benefit in a different part of the system and may actually make work for the individual using it [25]. When organisations were placed in a position of competition rather than collaboration, implementing telecare proved particularly difficult.

‘Well it’s the old conflict between health and social care. Whose responsibility is it? …traditionally health have said well if someone’s not taking the pill, that’s your problem. And social care have said well we are left with the problem and we have to pick up the bits when someone doesn’t take their medication. And you know, that involves medication prompting, you know, putting in visits and you know, maybe respite care or admission into residential care. So all the costs are loaded onto social when it’s really a health issue because the person has got cognitive problems. And there’s always been this argument over budgets and so forth and who pays for what. It’s one big barrier’. Technology supplier 3

As the above example illustrates, the provision of a telecare device did not substitute for effective working relations and communication between different sectors. Indeed, it made the disconnect between organisations more apparent and more significant. Effective integrated work between health and social care was often perceived as lacking. One participant described a situation where a local authority telecare monitoring centre agreed to monitor data from the local NHS Trust telehealth installations:

‘So these patients were doing the readings at a certain time of day, they were flashing up on the screen to non-clinicians who were seeing reds and ambers, ringing clinicians who were then having to go out and check the patients, but a lot of them [were] false alarms really’. Service provider 8

Some more successful examples of external collaboration were described between local authorities that were attempting to implement similar telecare services. In one region, formal networking and information sharing meetings were set up between local authorities who had been selected as part of a fast track programme to implement telecare. In another example, a local authority, which had a comparatively large number of telecare connections, was contracted by two neighbouring authorities to provide their call centre functions.

*8. The broader (‘outer’ or extra-organisational) context*

Prevailing economic pressures on the provision of health and social care were described by many participants as a driver for adoption of new technologies. However, the *perception* of many participants that telecare would save money in a cash-strapped system failed to acknowledge the reality that telecare has not been shown to cost less overall than more traditional models of care [26].

One specific policy initiative in the UK is the ‘3 million lives campaign’, an agreement between government and industry to support the public sector in creating an enabling infrastructure for assistive technologies (http://www.3millionlives.co.uk). Whilst participants believed this ‘concordat’ might increase public awareness of telecare in a very general sense, they were unclear which technologies were included in the vision, how the campaign fitted with current service provision and business models and how to move from initial adoption decisions to implementation and routinisation of telecare at scale.

Inter-organisational norm-setting and networks were spontaneously raised by some participants and seen as a positive influence. For example, providing a telecare service was perceived to be the norm for social care providers because a sufficient proportion of such organisations have now adopted telecare. Some service providers described networks in which they shared experiences with similar organisations. This effect appeared to be much less evident in NHS organisations where inter-organisational norms of best practice did not really include the provision of telecare or telehealth technologies.

*9. Linkage between different parts of the system*

Participants who were technology suppliers were extremely keen to learn about and understand the user perspective. They tried to involve users, generally meaning people with assistive technology needs, at all stages in the design and development process, from initial concept through to final product. Methods of involving users included design workshops, installing prototype devices in individuals’ homes, and user forums i.e. inviting a group of users together to generate feedback on existing telecare products.

Challenges to conducting user-centred design noted by participants included gaining access to difficult to reach users e.g. very frail older people, those with cognitive impairment or very low incomes; the amount of time required; sometimes only getting feedback that was already expected; and developing shared meanings and ways of working across the public and private sectors. Participants suggested that the ‘used-centred design’ approach tended to focus on ensuring technical usability and proof of concept of a specific device rather than on considering the technology-in-use in the context of the person’s wider needs or its impact on their life more generally:

‘It would be great to have an understanding of when somebody has equipment at home. Some feedback about how comfortable they felt with it, how it changed how they interacted with the world, or their life. We tend to focus on the measured outcomes...but it is sometimes to get a handle on how they felt personally about that’. Technology supplier 6

In the above quote, the ‘measured outcomes’ referred to included how often the technology was used and whether it performed according to its technical specifications. As well as access to this quantitative data, the participant wanted access to qualitative data about telecare in use.

Linkages between telecare developers and users occurred during the implementation phase, i.e. after a product was launched. Again this is something predicted by the diffusion of innovations model as likely to increase routinisation and sustainability. There tended to be a strong focus on usability issues, but a wide range of other links were mentioned including the development of protocols and information-sharing. With individual users, successful capture of user-led innovation was evident:

‘The friendship service we developed as a consequence of feedback from customers, you know, saying I’d quite like somebody to phone me once a week type of thing’. Service provider 5

***Discussion***

*Summary of main findings*

This study, based on key informant interviews, has illustrated all the main components of the diffusion of innovations model as applied to complex health and social care innovations. In particular, participants identified the attributes of the innovation (relative advantage over existing arrangements, low complexity, compatibility, trialability, observability, risk involved in adoption, potential for reinvention and ease of use); characteristics of the intended user (especially physical and cognitive capability); the process of social influence (especially the limited awareness of these technologies among many health professionals, who therefore do not mention these to their patients); low levels of organisational innovativeness (due partly but not entirely to squeezed budgets); low levels of organisational readiness (due partly but not entirely to a sense that these innovations would not be cost-effective); weaknesses in the assimilation process (especially inadequate assessment and tailoring to the individual and the social network of friends, relatives and professional carers needed to make telecare ‘work’ effectively); weak embedding of telecare in the business-as-usual of the various organisations who might contribute to the support network; and poor links between users and developers at the design stage.

*Implications for practice, policy and further research*

Three key implications are evident from our study. First, we have shown the complexity of what might be called the ‘user system’, that is, the intended telecare user and his or her care network. With most telecare services in the UK currently provided through the public sector, the innovation depends for successful adoption on cooperation and coordination among a wide range of individuals and service provider organisations. A telecare technology needs to be adopted more or less simultaneously by an individual *and* by their health and social care professionals. Families are complex social microsystems in which each person has needs and wishes. But health and social care professionals operate under a code of practice that places the individual patient’s needs and wishes as paramount, hence the wider dynamics of the care network may fail to be appreciated. Low levels of uptake and use may in part be explained by the different priorities of these stakeholders and the different meanings and implications which telecare holds for them. Aligning interests across the multiple stakeholders remains a challenge.

Second, our findings suggest that, in common with other complex service level innovations, the real challenge lies in implementation and routinisation of the telecare service beyond this point. For service provider organisations, there is uncertainty about ownership of implementation processes, especially between health and social care providers, and concerted and ongoing efforts are required to make telecare a routine and sustained service. For users, effectively tailoring telecare solutions to meet individual needs requires sustained assessment, support and review, but whose responsibility this continued work is often remains unclear. The perception that provision of telecare will automatically result in reduced costs may be an example of the fallacious modernist vision of efficient, effective ‘plug-and-play’ technologies which is widely held in contemporary society [27].

Third, the development of telecare technologies that meet the priorities of users is likely to be greatly aided by creating links between users and other stakeholders at the earliest stages of design and development. But such co-design should aim to identify how technologies might better fit with users’ material surroundings, social networks and desired lifestyles, rather than (as is often the case currently) being technology-driven and focused on proof of concept or the single attribute of ‘usability’. All stakeholders – individual users, service providers and technology suppliers – surely need to be involved in this process.

*Strengths and limitations of this study*

This study fills an identified gap in the literature by reporting the perspectives of service provider organisations and technology suppliers on the uptake and use of assisted living technologies. The use of open-ended interview techniques allowed participants to speak freely and offer detailed examples to illustrate their concerns.

However, whilst this research design can raise many issues and provide preliminary themes, a further phase (ongoing) is necessary to demonstrate and explore these more directly by empirical observation. The findings from this UK-based study pertain to the particular organisational arrangements and social context prevailing in this country; other countries and settings may illustrate different opportunities and challenges.

These preliminary findings resonate with those of other researchers, although previous studies have not specifically sought to link all components of the model together [12-18]. As predicted by the model, it appears to be the interaction between the multiple components of the model – which in the case of telecare typically involves more than one sector and more than one system – that determines the extent and speed of adoption and the success of implementation.

***Conclusion***

This study identified multiple interacting influences on the adoption, assimilation, implementation and sustainability of telecare technologies. We have demonstrated what many clinicians, telecare managers, technology users and their relatives know from personal experience: that making assistive technologies work is a complex personal, family and organisational challenge that begins rather than ends when the initial adoption decision is made.

Whilst many of our findings have been demonstrated previously by other researchers and/or resonate strongly with established service wisdom, the bulk of investment in assistive technology research remains directed at the technology industry or other technology-focused design projects. This rests on the (incorrect) assumption that the ‘right’ technologies will eventually emerge from the design process and operate more or less as ‘plug and play’. Yet the research questions that emerge from this study sit largely outside the domain of technology design. They include: how can we optimise the process of assessment and personal ‘tailoring’ of an off-the-shelf device?; how can we overcome organisational inertia and lack of resource when introducing telecare services?; how can we make telecare services more cost-effective (and hence more attractive to commissioners and purchasers)?; and how can we optimise the long-term support for the technology user so that it is sustained as a ‘working’ technology in the long term?

The answers are unlikely to come in the shape of a simple or universal fix, but we believe it is time to make questions such as these, rather than the technology itself, the main focus of assistive technology research.

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***Declaration of interests***

None.

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