Designing Telemedicine Apps That Health Commissioners Will Adopt

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Abstract— **In countries with a national health service, new telemedicine and telehealth products and services are 'commissioned' according to a fairly rigorous and regulated process, that usually involves pilot studies and the assembly of 'evidence' to show that the innovation offers performance and/or cost advantages. This is problematic for several reasons and means that many innovations are piloted and performance evaluated, but relatively few pass into mainstream adoption. The current relationship between healthcare commissioners and technology developers is adversarial rather than collaborative. Evaluations and regulatory systems place the responsibility with the developer to prove that the solution works – in other words, to refute the assumption that the solution may not be appropriate. Furthermore, with telemedicine innovations the 'user' and the 'customer' is not a single individual or organisation – the healthcare professional, the patient (and perhaps carer, family or friends), as well as the organisation itself are all involved. A conventional evaluation ignores the organisationally disruptive aspect of the technology. A better question than 'does it work?' would be 'how can we use it?' This paper reviews barriers to adoption and considers the particular issues that developers of telemedicine apps need to address. We propose the Stakeholder Empowered Adoption (SEA) Model, as a process that builds stakeholder (staff and patients, managers, technologists) perspectives into the specification and early design stages and uses scenario modelling and simulations to avoid dependence on actual prototypes. The model recognises that the main economic stakeholders (the health organisation commissioning the innovation and the technology provider) need to drive the process, but end users (professionals and patients) are critical to a useful, adoptable end product. Their involvement in the evaluation and adoption process therefore needs to be well managed.**

Keywords – telemedicine, telehealth, technology adoption, co-design, self management, patient empowerment.

I. INTRODUCTION

Growth of open software platforms, lower cost mobile hardware and growing consumer acceptance of technology has made it much easier for technology developers to produce healthcare self-management tools or 'apps' (web or mobile based software applications). The plethora of new technologies across the fields of wireless technologies, pharmacogenomics, cloud computing and data mining (amongst others) offer enormous opportunities for technologists to provide personalized healthcare tools [1]. Increasingly such tools are available on consumer devices and are being adopted unilaterally by individual users. However, within mainstream health services, particularly within the European nationalized services, adoption has been frustratingly slow. A recent qualitative evaluation of the UK Whole System Demonstrator project, a very large scale telehealth and telecare pilot involving over 6000 patients, concluded that a major barrier to adoption of telehealth is that it requires re-design of health services [2]. This requirement for health re-design is disruptive: it requires significant changes to the ways professionals engage with each other and with patients or carers.

Successful adoption of telehealth almost certainly means close collaboration with users during the development, piloting and evaluation phases. A number of models have been developed to describe this process and provide a framework [3], [4]. Unlike in consumer markets, for which many apps are produced, healthcare 'customers' are a complex group. A decision to purchase involves not only the direct users (doctors, nurses or other health professionals), but also managers (healthcare commissioners) who must ensure that solutions offer a level of performance that is commensurate with cost. In telehealth, telecare, telemedicine, the patient (and often friends or family) are also key users and may even need to provide part of the solution themselves (eg. a smartphone).

In this first part of this paper, the barriers to adoption of telemedicine apps by mainstream healthcare commissioners will be reviewed, through a discussion of models for user engagement. This is followed by a discussion of the implications for technology developers and strategies to address the challenges. Finally, a proposed approach, the Stakeholder Empowered Adoption Model, is outlined.

II. BARRIERS TO ADOPTION OF TELEMEDICINE APPS

As telemedicine apps are classed as medical devices (they provide diagnostic or therapeutic outputs that could have safety implications for the patients or other users), it is important that they are carefully evaluated before

introduction. Evidence must be compiled to show that the app fulfills its intended clinical purpose and performs better in terms of clinical outcomes than the conventional solution (sometimes called the 'gold standard'). Healthcare commissioners are also required to consider economic factors. The new solution should either perform equally well at lower cost, or better at the same cost as the conventional solution. This approach is enshrined within international regulatory systems [5], which are in place to protect patients and the public from the very real risks of inadequately researched or poorly designed medical devices and drugs.

Unlike apps developed for consumer uses, where the market forces are used to judge good and bad quality, telemedicine apps are subject to regulation. Moreover, consumers of health related products are conventionally guided by their health provider and tend to require validation of their purchasing decisions where medical products are concerned. This is even more important if they are receiving treatment as part of a programme and may be concerned about how a unilateral health management decision would affect their condition.

Implementation of robust and highly procedural evaluations has led to the growth of a significant organizational structure of commissioners within health services, mirrored by regulatory experts and product champions within large medical technology companies. The technology provider has to bear the cost of piloting and evaluation (although much government support has been provided).

For telemedicine apps there are a number of problems with the conventional approach. Firstly, for such innovations, the patient (or their carer) must become the main user, but they are not paying for the solution (although they may be supplying a telephone or broadband connection). Secondly, there may be a number of health professionals supporting the telemedicine service and its introduction will most certainly change the nature of their jobs. Again, they are not directly making the payment decision and do not have the financial or management information to make this decision. Thirdly, the timescales for piloting and evaluation may in fact be longer than the technology lifetime. In telemedicine, the hardware and software platforms are changing rapidly and may go out of date before commissioners are ready to make a judgment.

There is a general recognition by policy makers that adoption of technology in healthcare is cumbersome, as well as a perception that it is slower than in other industries. Within the UK, a study by the King's Fund in 2008 [6] identified 11 factors, positive and negative, that influence adoption decision making. Those relevant to this discussion are:

- The ability of vendors of technology to build and investment case and attract funding;
- The level of engagement between technology suppliers and the National Health Service;
- Consumer awareness of technology and understanding of the benefits it can bring.

Paradoxically, although validation and approval of new technologies is controlled 'top down' through the regulatory systems (such as the Food and Drugs Administration (FDA) in USA and the European Medical Devices Directive implemented through Member States), purchasing decisions are fragmented and strongly influenced by local hospitals, commissioning groups and clinical opinion leaders. Even within the nationalized health services in Europe, the national body only provides 'guidance' on which technology should be used and which care pathway adopted.

At the centre of the technology adoption approach, therefore, is an adversarial relationship between technology developer and healthcare commissioner. The responsibility lies firmly with the developer to prove that the solution works and provides both clinical and economic benefits. In fact, the regulatory system is based on an approach that the evaluation must refute the assumption that the solution is not appropriate. In the case of telemedicine, the technology is generally well proven in other fields, such as consumer markets, so the evaluation is not even asking the right question. The question 'does it work?' is irrelevant. A better question is 'how can we use it?' and also 'how do we need to modify our services to use it?'

The conventional evaluation-to-adoption process for telemedicine apps is wasteful, costly and ultimately does not bring clinical benefits to patients.

III. MODELS FOR STAKEHOLDER ENGAGEMENT IN DEVELOPMENT AND ADOPTION

The major difference between developing an app for a consumer market and for a healthcare market is that a consumer makes a decision to purchase as an individual. A healthcare commissioner must make a decision to purchase based on evidence from a number of stakeholders. The primary factors are cost and performance (efficiency and efficacy), geared to patient clinical outcomes. However, each stakeholder will weigh the factors differently, according to their values and beliefs.

For a patient, their own convenience is, of course, critical. They may opt for a remote consultation, if the technology is available, because it saves them time and money to travel to a clinic. If they are able to make their own physiological measurements (blood pressure, or heart rate), they may be able to learn to correct their medication or their exercise programme directly. For the health provider, however, they must consider if the quality of the measurement is equal to that undertaken by a skilled nurse, or if some nuance may be missed through a telephone consultation because the consultant and the patient are not

together. The patient's time and cost saving do not appear on their balance sheet, so they will naturally not rate their convenience so highly. The opinion of the health professional is more complex. Negative attitudes to telemedicine may be associated with job insecurity. The clear implication that service re-design needs to be associated with adoption means at the very least that some role changes will be made. Studies have also shown concern about creating a group of 'worried well' in which patients are excessively preoccupied with the symptoms and signs of a chronic condition [7].

In summary, findings from a pilot of a new telemedicine solution will be interpreted differently by each stakeholder. This is because each has a different set of values and beliefs, which act as a lens through which objective data is viewed. The conventional technology adoption system is designed around the values of the healthcare organization, but this is not explicitly recognized. A values-based approach to evaluation and adoption needs to recognize each stakeholder's values explicitly and take account of the principle of 'dissensus' in which disagreement is openly recorded [8].

It is clear that a suitable process to aid adoption of telemedicine needs to take account of all the stakeholder perspectives and to involve users as early as possible in the design process. Some authors have looked at product development and human computer interaction (HCI) disciplines, for instance through the Technology Acceptance Model that looks at two factors for user acceptance, perceived ease of use and perceived usefulness [9]. An analysis of the attitudes and perspectives of different health professionals was used to develop a checklist of organizational issues and challenges for implementation of telehealth projects [3]. A sociological approach has been used to develop the Normalization Process Theory, which looks at the impact of a new technology on patient-professional relationships, inter-professional relationships, skills and training needs, and organizational goals [10]. Whilst such models describe useful frameworks in which to consider all the issues, they do not provide practical processes that developers can use effectively.

The concept of co-design or co-innovation is one in which users are actively involved with developers from the planning and specification of a new product, through to completion [11]. Technology developers produce mock ups, storyboards, prototypes and other visual aids to enable users to understand what the new product might be and provide feedback at each stage. In theory the users help to design the product, by being actively engaged from the start and various tools have been developed to enable this to work effectively [12].

In practice, it is difficult, as well as expensive, to make co-design work well. Users often struggle to understand the potential of new technology until they see a finished product. Furthermore, their availability is limited and it can be very hard to recruit an active user panel. In the case of telemedicine, the users may not even see themselves as users – they may not (yet) have the condition for which the solution is being developed. A study of a co-innovation approach to tele-rehabilitation for COPD patients [13] identified several obstacles , including difficulties for the healthcare professionals viewing their patients as co-innovators and inexperience in being creative about organizational design. Again, co-design can end up by being another cost to the developer, without necessarily producing sufficient benefits.

IV. The Stakeholder empowered Adoption (SEA) Model

The Stakeholder Empowered Adoption Model (SEA Model) has been developed to provide a framework that recognizes values of all the stakeholders and to propose a structured approach to incorporating them within the product design process [4]. Central to the process are two considerations. Firstly, each stakeholder type has a different set of values and perspectives through which they view evidence and make decisions. The key stages of design, evaluation and adoption-decision need to take account of these values. Secondly, the transactional relationship between the healthcare commissioner and the technology provider must drive development. Both of these parties must take responsibility for the other stakeholders, who do not play an economic role in the transaction, but are key users.

The four key stakeholder groups are the healthcare organization, the technology developer, the professional clinical staff and the patient (including family, friends, carers). In spite of very different perspectives and inter-relationship, there is a common goal that all these groups share. If there is no common goal, the technology provider should not invest time in developing a solution. However, for telemedicine, we can generally summarise the shared goal as seeking to provide high quality clinical outcomes, but with greater convenience and efficiency. The inter-relationships between the four are shown in Figure 1. The transactional relationship that must drive the process is the horizontal arrowed line, with the other relationships being less formal and shown by dotted vertical arrows.

For the different groups of stakeholders, their criteria for a successful outcome from a telemedicine pilot will be different. For the 'economic stakeholders' (the healthcare organization and the technology developer) these are to do with financial and service effectiveness. For the 'user stakeholders' they may be more complex and sometimes related to entirely different factors than health itself (see Table I).

To incorporate all these perspectives is, as many have already noted, a non-trivial task. The technology developer often feels that they are on the outside, trying to break in.

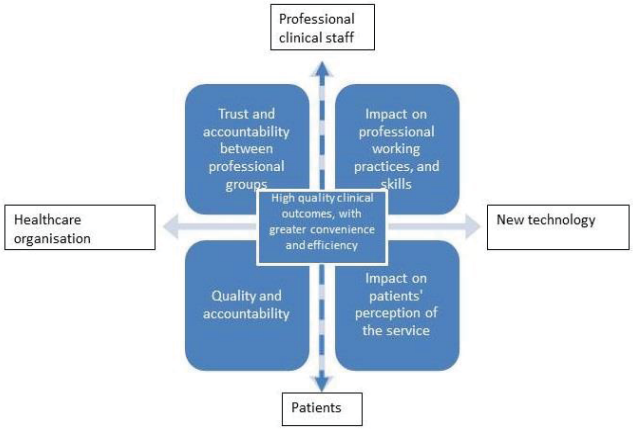

Fig. 1. The key stakeholder groups, their inter-relationships and perspectives for evaluating telemedicine innovations

TABLE I. THE CRITERIA FOR SUCCESSFUL OUTCOMES OF A TELEMEDICINE PILOT, REFLECTING DIFFERENT VALUES AND PERSPECTIVES

Stakeholder group	Values and outcomes
Technology provider	• Workable and efficient system • Scalable to a large market
Healthcare organization	• Cost effective • Clinically effective
Professional clinical staff	• Patient safety • Improved clinical outcomes • Minimal impact on work practices
Patients (including carers)	• Ease of use • Rapid support if needed • Minimal impact on daily lifestyle

The healthcare organization may eventually place a large and lucrative contract, but not until they have been able to demonstrate that their product will meet everyone's needs. All this has to be done with very limited access to the busy healthcare professionals, who have their own operational targets that do not leave much time for what is to them 'blue skies' thinking. The patients and their carers may be more motivated to help to influence a new product, but they are not a coherent group and often find it difficult to be objective and generalize from their own personal, perhaps emotionally sensitive, experience.

For the different groups of stakeholders, their criteria for a successful outcome from a telemedicine pilot will be different. For the 'economic stakeholders' (the healthcare organization and the technology developer) these are to do with financial and service effectiveness. For the 'user stakeholders' they may be more complex and related to entirely different factors than health itself. The SEA Model proposes a way for the economic stakeholders to work together from the outset and define an approach that enables the user stakeholders to engage at a level and time that is appropriate.

The key principles for using the SEA Model in a product development process are as follows. The values of each user group need to be recognized and understood, in order to identify the common goal that justifies development to proceed. Each user group has limited time and is likely to find it hard to visualize what the technology has to offer. The technology developer needs to manage this process by planning very carefully how users are consulted and engaged, and by judicious use of prototypes and visualization tools. The economic relationship between the technology developer and the healthcare provider drives the process, but will be more successful if it is collaborative then adversarial.

V. IMPLEMENTING THE STAKEHOLDER EMPOWERED ADOPTION MODEL

Implementation requires a different relationship between the transactional partners (economic stakeholders), with shared understanding from the start and a commitment to use an effective co-design methodology that takes account of the limited time availability of the user stakeholders.

Ideas for new telemedicine apps come from many sources, but probably most frequently from a collaboration between a clinician or health professional and a technology developer. Often development may be grant funded, as may the piloting and evaluation phases. Only after this, do the commissioners get involved, at which point they are seeking to procure finished solutions, ideally complete with the associated healthcare delivery pathway.

For telemedicine solutions to be adopted, the healthcare delivery pathway and the technology need to be designed together, and patient/carer input needs to be fully researched to aid development of both. This requires a completely different way of doing product development and user evaluation. Essentially, given the high costs of development, it means finding a way to engage in healthcare delivery design using prototypes.

One of the concepts emerging in the telemedicine debate is that of patient empowerment. The traditional clinician-patient relationship is changing, to one where the patient expects to have more information and knowledge of their condition, the options for treatment, risks and benefits and then to have a share in the decision of which is the best option. This is a radical change that requires re-education of both the patient and the health professional. It also requires a change to how health services are delivered.

A recent study explored barriers to adoption of telemonitoring within the UK Whole System Demonstrator [2] noted fears from patients that they would lose the current support provided to them, rather than seeing the technological support as something additional and beneficial. Many concerns were also voiced relating to difficulties engaging with technology, privacy and data security, but the issues around the care relationship are something rather different that have not yet been addressed by the technical community. Both developers and health commissioners need to recognize that telemedicine is potentially a paradigm shift in how care is delivered.

Telemedicine enables patients to be empowered and to self manage their condition. This changes the patient-clinician relationship and requires a re-education by both parties. Hence the developers and health commissioners have a more significant task to undertake than simply a procurement and sales process. They need to work closely to build this new type of health delivery. By changing from an adversarial, transactional relationship to one that is consultative and developmental, the views of the other stakeholders (patients and health professionals) can be properly incorporated.

So what can a technology developer do to influence health commissioners and the adoption process? Engaging with users and stakeholders earlier in the process of development must be a key aim. The SEA Model proposes a structured process in which the first step is to understand the commissioning objectives (for example, reduce emergency admissions for patients with long term conditions such as diabetes or COPD due to poor management of their condition). The idea then needs to be developed and explained just in enough detail to get the interest of commissioners and health professionals, so that they can begin to engage and understand the implications for service delivery. The process should continue iteratively, using progressively more and more sophisticated prototypes, to involve other types of users with the support of the commissioners (see Figure 2).

The technology developer needs to use their connections with health professionals very carefully. Clinicians and other professionals (nurses, social workers, occupational therapists etc) may have some influence in the decision making process, but will certainly have knowledge and insights that can guide the developer in understanding how their innovation is going to impact on delivery. However, there are often negative perceptions of telemedicine, because of its impact on job roles and routines. At worst, health professionals fear being 'superseded by a computer', at best, they are right to assume some changes to their work routine. The technology developer needs to recognize these concerns and to turn them to a positive by harnessing their very detailed knowledge of processes and patient experiences.

Recent growth of interest in the patient voice within healthcare delivery is helpful to the developer, as there are now many networks and charitable initiatives to support 'expert patients', often according to particular illnesses and conditions. The contributions of these groups can be highly beneficial to any product design process, but needs to be carefully managed and handled as part of an overall picture. Patients (and their carers) see a relatively narrow view of the healthcare experience. This issue can be handled by a process of cross-checking with other users, especially health professionals. However, in order to be most useful, the involvement of patients and carers needs to be structured so that they are able to provide input in a way that is convenient to them, occurs frequently from an early stage of development through to the evaluation stage and provides them with sufficient information and visualization tools to be useful.

The use of social online media to allow different groups to contribute as a product develops is attractive. Through providing visual concepts online, developers can allow different stakeholders to contribute feedback more conveniently. Developers can also make use of online groups such as the Patients Like Me network [14], which provides rich information on particular conditions and from where patients can be recruited to studies.

The model is currently an idealized process and we are working with technology companies, commissioners and health professionals to find suitable test cases.

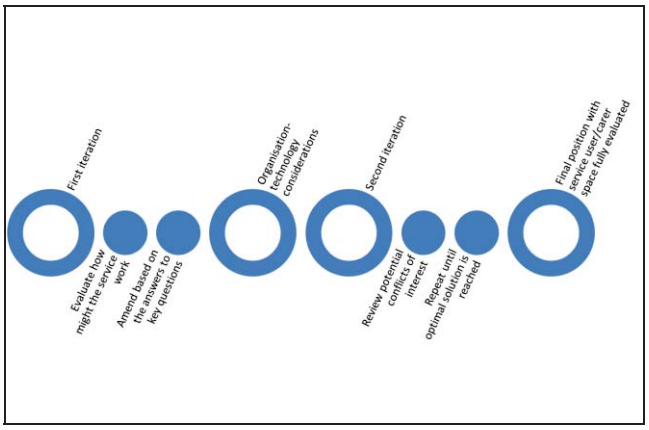

Fig.2. An idealized process for stakeholder engagement throughout the product development process.

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