Measuring the '*success'* of telehealth interventions

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Abstract
Despite substantial investment over recent years in telehealth there appears to be little consensus regarding what a successful implementation should achieve. However, defining success is often controversial and complex due to differing views from the large number of stakeholders involved, the local environment where telehealth is deployed and the scope, or size, of any planned initiative. Nevertheless, a number of generic measures are proposed in this paper which then provides a framework for the measurement of success. The local context can then be applied to determine the exact emphasis on specific measures, but it is proposed that all of the measures should be included in the holistic measurement of success. Having considered *what* constitutes success attention is then given to *how* success should be quantified. Robust evaluation is fundamental and there is much debate as to whether the 'gold standard' Randomised Control Trial (RCT) is the most appropriate methodology for telehealth. If the intervention, technology and system, can be maintained in a stable state then the RCT may well provide the most authoritative evidence for decision makers. However, ensuring such stability, in what is still a novel combination of technology and service, is difficult and consequently other approaches may be more appropriate when stability is unlikely to be maintained.

Key words**:** telehealth, telecare, benefit, evaluation

Introduction
Before attention can be given to defining what success in telehealth might look like it is important to define what is meant by telehealth. Unfortunately there is little consistency in the terms used either within countries or internationally. Arguably the terms in Table 1 could all be used interchangeably, yet equally they can mean numerous different applications which highlights a major difficulty and explains why the sharing of knowledge between initiatives has proved difficult.

Table 1: Examples of terms

Telehealth	Telecare	Telehealthcare	Telehomecare	Smart homes
Ehealth	Gerontechnology	Telemedicine	Home monitoring	Assistive technology

At its simplest level 'tele' is the Greek for 'at a distance' so telehealth could be defined as providing health services at a distance and telecare, care services at a distance. As, from the user's perspective, there is often a large degree of cross-over between health and care, for the purposes of this paper both terms could be used interchangeably; however the term telehealth will be consistently applied throughout this paper.

Irrespective of the exact definition used, the delivery of healthcare utilising information and communication technologies is growing in popularity throughout much of the developed world and is considered to be one of the fastest growing areas of healthcare provision (Ruggiero et al, 1999). However, to date, the vast majority of deployments have either been small scale practice-led initiatives or research programmes which have struggled to become mainstream services. For example, it is thought that approximately half of the local authorities in England are actively engaged in delivering telehealth to people in their own homes (Personal Communication, Mike Clark); albeit often through pilot studies ranging from a handful of deployments to several hundred. Only a few could be described as a routine or mainstream service. Of course there are many examples of mainstream services using the more traditional telecare or social alarm, with a growing interest on key performance indicators to ensure high standards of delivery. One such set of telecare standards is those defined by the Telecare Services Association Code of Practice (TSA, 2009). For telehealth, such routine deployment and a framework of performance indicators seems some way off.

Despite telehealth deployment levels being relatively low, many believe this approach presents a substantial opportunity to provide enhanced support to a growing number of people. The 2009 European report 'Dealing with the impact of an ageing population in the EU' (Commission of the European Communities, 2009) commented that "*in order to limit the expected increase in public expenditure, policy measures which can either reduce disability, limit the need for formal care amongst elderly citizens with disabilities, favour formal care provision at home rather than in institutions or, more generally, improve the cost-effectiveness of long-term care provision, e.g. through introduction of eHealth and telecare* [or telehealth] *must be developed*."

Within England policy has supported the use of telecare and telehealth for some time. Table 2 highlights a selection of policy documents since 2004 which encourage wider uptake. This also highlights the interchangeability of definitions as one of the case studies given in the 'Building Telecare in England' document refers to long term conditions, more typically defined as telehealth at present. Alongside the policy support there has been substantial central funding. Predominately this investment has taken place through the £80M Preventative Technologies Grant (PTG) (Department of Health, 2005a) and the Whole System Demonstrator (Department of Health, 2009a) which is possibly the largest telehealth trial of its type with 6,000 participants in a Randomised Control Trial. Importantly though, despite (a) growing interest, (b) policy support (often national and local), and (c) substantial financial investment, mainstream telehealth services are the exception rather than the rule.

Table 2: Examples of Policy Support

Year	Source	Example
2004	The NHS Improvement Plan (Department of Health, 2004)	'People with long-term conditions are particularly likely to benefit from telecare'
2005	Building Telecare in England (Department of Health, 2005b)	£80M investment through the Preventative Technologies Grant to help an additional 160,000 older people to live at home and reduce avoidable admissions to residential/nursing care and hospital.
2007	Putting People First (HM Government, 2007)	'Telecare to be viewed as integral not marginal'
2007	National Stroke strategy (Department of Health,2007)	'Increasingly, telecare and telehealth solutions can help people to live in their own homes for longer'
2008	Health informatics review (Department of Health, 2008a)	IT infrastructure *Healthspace* detailed to deliver mainstream telecare and self care
2008	Transforming Social Care Circular (LAC, 2008)	'Person centred planning … with individuals having choice and control over how best to meet their needs, including through routine access to telecare'
2009	National Dementia Strategy (Department of Health,2009)	'The needs of people with dementia and their carers should be included in the development of housing options, assistive technology and telecare.'

Different views of success

The sharing of knowledge between local pilot initiatives, along with national and international programmes, is vitally important for reasons such as: (a) to ensure the safety of users; (b) maximise the return on investment for the user, provider and funder; and (c) highlight further enhancements for organisational delivery and equipment performance. However, such benchmarking and sharing of knowledge is difficult as each initiative, even those that appear to be covering similar cohorts and interventions, often have substantially different interpretations of what *success* actually is. Even at the single, individual pilot level, anyone involved in the delivery of a telehealth programme will have experienced different views of what constitutes success. That is, a user or patient's primary measure of success may be to feel their health has improved, whereas improved efficiency of health and care delivery could be a substantially lesser measure of success for them. For programme funders this balance is likely to be different.

Any telehealth programme with a vision to embed telehealth into mainstream service delivery is therefore likely to consider some, or all, of the different views of success presented in Table 3.

Table 3: Different views and suggested primary measure of success (not exhaustive)

Entity	Involves	Measures of success
User	-	Improved health, well being, empowerment, access to more information, Quality of Life and satisfaction.
Carer	-	Improvements in health for the person they care for and greater well being for them.
Service facilitator/ commissioner	▪ Strategic Health Authority ▪ Primary care trust	Enhanced clinical and/or cost effectiveness.
Service provider	▪ Acute trust ▪ Primary care trust ▪ Social services ▪ Third sector	Maximise health benefits for end user and maximise individual (organisation or department) income stream.
Management team	▪ Project team	Initiative implemented on time, in budget and project objectives met.
Industry	▪ Companies	Validation that equipment worked appropriately, identification of product enhancements and generation of business opportunities.
Economy	▪ Regional Development Agencies ▪ National R&D funding	Greater efficiency of statutory funding and establishment of greater economic wealth.
Academia	▪ Universities ▪ Higher Education	High impact research findings and address workforce competencies.
Policy makers	▪ National (across services) ▪ Local (across services)	Implementation of previously set policies and the formularisation of new ones.

Further complexity is evident, not least in respect to the context of the environment within which any deployment is to be judged. That is, the initiative may be constrained by limited (a) resource (finance and personnel), (b) time, (c) previous deployment experience, and so forth. Therefore, *success* for an initiative with considerable sums of money compared to one with limited financial resource is going to be different. However, while success may be different in terms of scope, it is proposed that the constituent parts of success should be similar for all telehealth initiatives. For example, a generic objective across all telehealth initiatives may be to increase the number of people supported at home; for initiatives with differing resource it may be appropriate for one to support 100 people, and for another 1,000; with both being viewed as successful in their given context.

Overall this suggests the views of success differ depending on at least the (a) individual/organisation viewpoint, (b) local environment where telehealth is deployed, (c) scope of the initiative. Nevertheless, experience and anecdotal evidence suggests the components of successful telehealth deployments can be broadly defined.

Achieving success

Defining what success really means and subsequently evaluating telehealth interventions can be a confusing, complex and often controversial activity (Klecun-Dabrowska & Cornford, 2001). Not least in part, due to the large number of stakeholders from different institutions and professions involved, along with the need to re-engineer the way organisations and services are delivered. Based on over a decade's experience of introducing and evaluating such initiatives (Brownsell & Doughty, 1997; Porteus & Brownsell, 2000; Brownsell & Hawley 2004; Brownsell et al, 2006; Brownsell et al, 2008a, Brownsell et al 2008b, CLAHRC, 2009) the following are proposed:

Prerequisites for success

Before embarking on an initiative there must be a reasonable probability that the intervention would be beneficial to service users and/or service providers in the widest sense. For telehealth initiatives engaged with the NHS in England consideration should be given to the guidance published by the NHS when undertaking major change to services (Department of Health, 2008b). Encompassing these principles and those suggested in a World Health Organisation symposium on e-Health (WHO, 2003), the following are therefore proposed as prerequisites to achieving a successful telehealth intervention:

- *User benefit*: Anticipation that many users would benefit as a consequence of the intervention.
- *User engagement*: Anticipation that many users would welcome the approach.
- *Clinician engagement*: To lead the re-design of clinical pathways and embrace the new approach.
- *Supportive environment*: Senior level sponsorship and support for an innovative initiative and the corresponding risks associated with it.
- *Holistic view*: Acknowledgement that all parties work towards an agreed shared vision.
- *Workforce competencies*: The required core skills are available, and where not, staff can be supported accordingly.
- *Financial stability*: Sufficient resource to see the initiative through to completion (including contingency options) and a clear view of a sustainable business model after any initial pump-priming has ended.
- *Previous experience or expertise*: General understanding of the issues likely to materialise and therefore ability to avoid some, or all, of the known pitfalls.
- *Equipment*: That it meets requirements, such as being fit-for-purpose, reliable, effective and user friendly.
- *Dedicated project management*: To drive the process of change through agreeing and reviewing progress against the vision, objectives and deliverables. This should also involve administrative issues such as equipment/service procurement and so forth.
- *Time*: To introduce the intervention, allow any changes/benefits to materialise, quantify the impact of the intervention, report findings, review recommendations and publicise the results.
- *Evaluation expertise*: Such that reliable evidence can be generated to demonstrate the impact of the intervention – whether successful or not.

Components of success

Fundamentally any new innovation should compare clinical and cost effectiveness against current service delivery. Within the measurement of health outcomes Quality Adjusted Life Years (QALYS) or Disability Adjusted Life Years (DALY) are widely used to aid comparison. Yet although these are vastly important to some stakeholders, especially those in health, other stakeholders identified in Table 3 have differing considerations for what they deem as appropriate measures of success. Consequently defining 'success' is complex and often controversial. However, Table 4, adapted from Wotton and Hebert 2001, proposes a macro view of success taking into account the different viewpoints identified in Table 3. Depending on the local environment different emphasis may be placed on measures considered more important than others but to cover the viewpoints of Table 3, all of the measures in Table 4 should be considered in a successful

telehealth deployment. When developing local targets it may also be helpful to follow the commonly used SMART approach, such that targets are Specific, Measureable, Achievable, Realistic and Timed.

Table 4: System level measures of success (alphabetical order)

Components	Metric	
	Quality	Cost
Better quality - successful outcomes for user and provider	✓	
Clinically led and accepted	✓	
Cost effective		✓
Environmental benefits		✓
Improved access to healthcare – care closer to home	✓	
Inform decision makers	✓	✓
Integration of services	✓	✓
Job creation, inward investment		✓
Reduction in health inequalities	✓	
Routine operation	✓	✓
Sustainable	✓	✓
Technology development	✓	✓
User and carer satisfaction	✓	

(a) *Better quality - successful outcomes for user and provider*
Historically most telehealth initiatives which involve a degree of evaluation focus upon this component of success. It involves issues such as the personalisation of services, preventative aspects and reductions in the number of user exacerbations experienced, or modification of behaviour to improve health outcomes i.e. healthy living and diet. The focus however is that a clinically more effective outcome materialises than compared to the traditional approach. Regular review of how the service is offered and how it could be enhanced should be considered to ensure the best quality service possible within the context of a changing local delivery environment.

(b) *Clinically led and accepted*
Telehealth is a clinical tool; for it to be effective clinicians need to accept the data it provides and use it appropriately. Perhaps the best way to ensure the telehealth intervention meets medical practitioner's needs and to gather appropriate clinician support, is for the clinicians themselves to lead the initiative. Within the NHS any intervention should be underpinned by the four principles of change (Department of Health, 2008c): co-production, subsidiarity, clinical leadership, and system alignment.

(c) *Cost effective*
This is vitally important to decision makers and therefore should be given appropriate weight as a measure of success. There are four key areas: (1) real costs - many trials appear to estimate cost savings based on hypothetical cases as opposed to the actual initiative providing data on which to base calculations. This can reduce the impact of the results to decision makers; (2) realising any suggested cost saving – many propose cost savings as a consequence of reduction in hospital bed days. However, many of these costs are fixed in nature, so the cost savings are often more hypothetical than reality; (3) cost shunting – a holistic view of costs should be taken, that is an intervention may reduce the financial spend in one part of the system at the detriment of another. Information on the full and true costs is therefore important; and (4) for whom is it cost effective – that could be the user, hospital, community provider and so on. At a macro or system level there could be savings, but often those paying for the service are not those who receive the majority of any financial benefit. Overall, this measure should add financial clarity so that the costs and benefits can be shared appropriately across stakeholders.

(d) *Environmental benefits*
The carbon footprint of the NHS is 18.6M tonnes of carbon emissions per year, of which 18% is travel (Department of Health, 2009c). By staff visiting users/patients only when clinically required, as a consequence of telehealth data assisting in prioritisation, greater efficiencies can be gained in terms of when travel is required, reducing the carbon footprint. Improved health outcomes for users could also reduce the frequency of visits to GP surgeries and hospitals; while should a hospital admission be required the length of stay could be reduced with the consequential reduction in visitor travel to hospitals.

(e) *Improved access to healthcare – care closer to home*
Through telehealth, care should be provided closer to home through both regular monitoring of physiological parameters at home but also the facilitation of more health care interactions at home, be these remotely (through the telephone or video consultations) or physically. While this could facilitate greater access to health care, attention should also be given to enabling greater access to self care information, perhaps through the telehealth application so as to increase the knowledge base of users and empower them to take more ownership of their condition. Targets around this measure could range from the provision of more access (perhaps through 24/7 telephone service – and ensuring people know/use this), through to changing

user behaviour so people can self manage more effectively and interact with health care practitioners as appropriate.

(f) *Inform decision makers*
Ideally the implementation and results of a telehealth initiative, however supportive or not they may be, should change local and/or national policy. However, even if supported by reliable evidence changing policy is often outside of the control of project partners and as such this measure should seek to inform decision makers with the anticipation that this will inform future decision making.

(g) *Integration of services*
As costs and benefits often fall across several organisations integrated services, including where appropriate pooled budgets, should be evident. Integration therefore should occur at the 'front-line' – so staff have access to appropriate information irrespective of the organisation who obtained the information (assuming appropriate information governance) and also at strategic and organisational planning levels. One of the more challenging interpretations of this measure will be the sharing of financial benefit and risk manifesting itself in Service Level Agreements and/or pooled budgets between organisations.

(h) *Job creation, inward investment*
At a macro level, areas which are leaders in the application of telehealth could secure inward investment to the detriment of others. For instance, one geographical area could perform the remote telehealth monitoring for people in another; if data from telehealth monitoring and corresponding interactions between service users and providers suggest an operation was required, it could be envisaged that users would choose to have the operation at a hospital connected or recommended by the telehealth monitoring centre rather than their normal choice. It could also be suggested that manufacturers could work alongside some of the larger service deployments to identify enhancements to their products. Thus leading to job creation, inward investment and potentially greater exports as enhanced products are sold internationally.

(i) *Reduction in health inequalities*
There is a risk that telehealth could increase health inequalities, for instance, uptake of the devices could be considered higher in some social classes than others. However, overcoming this and supporting people appropriately could result in a reduction in health inequalities as health care decisions can be supported by reliable and long term data as opposed to supporting those who are most evident or active in seeking assistance.

(j) *Routine operation*
Any new initiative should seek to continue after its initial pilot stage, but of more relevance is that routine operation should be manifested by telehealth being integrated into care pathways. For example, that there is appropriate clinical and information governance and that for defined cohorts and environments, telehealth is the normal care offered. It may be that the 'tele' aspect of telehealth is removed as perhaps the pinnacle of this measure is that telehealth delivery is just the way it is done.

(k) *Sustainable*
There have been occasions where telehealth has been introduced but working practices have not altered. That is, telehealth has provided more data for patients and clinicians, but the same regular pattern of home visits at pre-defined times continued irrespective of the telehealth data. Consequently, the telehealth intervention may have improved healthcare outcomes but costs increased and such an approach is not utilising the intervention efficiently and therefore is unlikely to be financially sustainable in the long-term. An important measure of success is that both financially and operationally telehealth can continue to be delivered after any initial pump-prime funding. A high number of diverse users such as, preventative users, very high intensity users, early hospital discharge, self funders/private purchase or an extended geographical area may be considered to provide economies of scale and a sustainable operation. This measure can vary in scope from continuing with the same number of deployments after any pilot phase to targets around growth and perhaps even income generation.

(l) *Technology development*
Although telehealth is considerably more than just a technology, hardware and software are the tools on which any telehealth service is offered. Introducing or increasing the number of deployments will lead to a better understanding of the strengths and weaknesses of the technology and such information should be fed back to manufacturers so they can enhance their products. Ultimately this should lead to a cycle of deployment, identifying technology gaps, development of technology to better address user needs, and then deployment again of the enhanced products.

(m) *User and carer satisfaction*

This revolves around users, and their carers as appropriate, being satisfied with the telehealth intervention. For instance, targets could be set around the percentage of users who are highly satisfied that the intervention is better than the previous system. Other aspects of relevance within this measure are around maintaining carers Quality of Life and their ability to continue employment.

Prioritising components
No prioritisation of the components in Table 4 is given because depending on each individual person or institution involved, certain measures will be more important to them than others. Across the whole initiative however, and in order to achieve success at the macro level, each of the measures is likely to be a primary objective for an individual stakeholder involved. However, all stakeholders will want to ensure the clinical safety of users and be able to make future business decisions. Therefore, clinical and cost effectiveness should be given particular attention.

Quantifying success
Even when the system level measures of success have been agreed, two further challenges present themselves: firstly to deliver the initiative and secondly to quantify the success. Our focus now falls to the evaluation, as in order to measure success efforts must focus not just on what to measure but how to measure it.

Many telehealth trials have not been able to demonstrate success because they have given little or no attention to evaluation. There are also examples where evaluation has been 'bolted on' towards the end of the initiative which equally does not provide the robust evidence service commissioners require on which to make informed decisions. Instead, it is suggested that understanding *what* to measure and *how* to measure it are both fundamental aspects that should function in unison prior to actually commencing the intervention 'live'.

There are many useful specialist resources on study design and evaluation (Office of Health and the Information Highway, 2000; Grunn, 2006; Craig et al, 2008) but recently there has been considerable debate as to whether the Randomised Control Trial (RCT) is the ideal research methodology in telehealth. Robust trials are not routine in this area and Whitten *et al* in their paper of research methodologies in telehealth suggest the recruitment of participants through randomised means is only present in 11% of patient studies and the majority of studies involve sample sizes of less than 100 (Whitten et al, 2007). Yet the level of evidence required by decision makers is often at the individual RCT level or higher.

Perhaps to address concerns regarding a perceived lack of evidence which could constrain telehealth developments, the English Department of Health launched the Whole System Demonstrator programme using an RCT design with 6,000 participants in 2008. However, it has been highlighted that "*the dominance of the randomised controlled trial (RCT) as the 'gold standard' of medical research is clearly apparent..* [but evaluating telehealth] *requires more pragmatic and flexible approaches to the production of evidence than those permitted within the rigid structures of controlled study designs…. trying to impose sufficient constraint on the system for the purpose of measurement conflicts with the dynamic nature of the health service environment, where some flexibility is necessary*." (Finch et al, 2003) A similar stance is taken by the Kings Fund (Rosen et al, 2007) who comment in their report 'Improving Chronic Disease Management' "*a classic RCT may be most suitable for evaluating a 'mature' intervention that is well developed and embedded in its local health care system. An RCT may be a less suitable or feasible option when the intervention under consideration is regularly changing and improving, or is imprecisely defined from the start*."

This is the crux of the matter as the intervention needs to be 'stable' throughout the whole evaluation period, however there are many variables which are difficult to control, such as the:

(a) technology
(b) install procedures for users; especially as installers and trainers become more skilled and efficient over time
(c) monitoring strategy; including the consistency and frequency of data input by users and alert threshold setting by medical practitioners – which determines when further investigation is required
(d) response; how alerts are responded to
(e) stability of staff; in terms of staff turn-over and the expertise of staff to have reached a plateau so that interactions are provided in a consistent manor throughout the evaluation period
(f) organisational interactions; such that expertise is stable across organisations and information is shared, and acted upon, according to defined and accepted protocols
(g) political environment; for example external events such as reports of hospital ward closures or announcements that changes are imminent to community services.

If such variables can be controlled then the 'gold standard' RCT may well be the most appropriate methodology to provide evidence which is acted upon. However, if that can not be said, then it may be more appropriate to either: (a) conduct a pilot stage of evaluation before commencing a formal RCT design, i.e. to give time for the variables to become stable, or (b) embrace a different methodology, perhaps quasi experimental methods or a 'Realistic Evaluation' which appreciates the interplay between intervention, context and outcomes (Pawson & Tilley, 1997).

Balancing the requirements of generating results which the medical community and other decision makers will act upon, while introducing such a complex intervention as telehealth with its multiple stake holders and different views of success, is often an unenviable task. Put another way, should the evaluation seek to generate results which the medical community and decision makers would accept, but may constrain service delivery, or should a less rigid research methodology be employed which should still produce effective results, but runs the risk that decision makers will not act upon the resulting evidence. The international guidelines for consistent assessment of the impact of telehealth being developed by the European Commission will be helpful but are not anticipated until 2011 (European Commission, 2009). Nevertheless, whatever the approach taken it is imperative to incorporate evaluation, however imperfectly applied, into the ongoing process of spreading innovation and making it sustainable (Chapman et al, 2004).

Conclusions

The NHS Confederation has said that "*the NHS has a strong record in research, discovery and invention, but has a patchy record in adopting and diffusing the new services, technologies and ideas that result*." (NHS Confederation, 2009) Telehealth is perhaps a good example of this; there has been much innovation and development but, despite noticeable activity, it has rarely been adopted as a mainstream service. It is proposed that this is partly due to a lack of consensus on what success actually means and how it should be measured. This paper seeks to add some clarity in the hope that further discussion and debate will lead to a universally agreed strategy for measuring success and that telehealth initiatives can be compared effectively against traditional approaches.

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