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More Evidence of the Challenges of Determining ROI on Health Information Technology (HIT): A European Telecare Case Study in Four Countries

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Abstract

Return On Investment (ROI) from novel uses of Health Information Technologies (HIT) is proving a methodological challenge. This was illustrated by an example Telecare service, linking remote patient monitoring to clinical advice and support. The service was introduced in distinct sites around Europe (London, Estonia and 2 in portugal) supporting commoner chronic conditions (diabetes, hypertension, asthma, advanced heart and lung conditions). Evaluations from patient, clinician and manager perspectives reviewed various sources (monitoring records, patient and staff progress forms, clinician activity diaries). Withdrawal rates were high. Persistent patients tended to be older and sicker. some patients were too sick to use the service, while many felt too well to warrant it. The service was never routine at any site. Adjustments were better at locations with local IT support. Work patterns did not change appreciably, though some administrative staff became more involved. Nevertheless, staff and patients were positive about the future for telecare. It still appears that investment in infrastructures of technology, trained staff and patients may be necessary before full benefits are identified and realised.

Keywords:

Telecare, telehealth, chronic disease, long term conditions

Introduction

For years the international debate has raged—is it possible to see a return on the investments on sophisticated clinical information systems? The question is an important one. The cost of these systems is enormous, easily ranging into the millions of dollars, and information technology is coming into its own at a time when the healthcare system around the world are in general financially burdened and concerned with sustainability.

As has been reported by many, the conundrum of measuring the HIT function is that:

- efficiency (“doing things right”) is easier to measure than effectiveness (“doing the right things”)
- since effectiveness ("doing the right things") and innovation ("doing new things") can not be readily quantified in terms of traditional outputs, improvements are not usually reflected in economic efficiency statistics
- new systems are often intended to change difficult to measure actions
- strategic systems elude measurement
- infrastructure investments cannot be cost justified on a ROI basis

As with any infrastructure, HIT infrastructure does not provide direct business performance. Rather it enables other systems that do yield business benefits. HIT infrastructure is strikingly similar to other public infrastructures such as roads, hospitals, sewers, schools, etc. They are all long term and require large investments. They enable business activity by users that would otherwise not be economically feasible. They are difficult to cost-justify in advance as well as to show benefits in hindsight. They require a delicate investment balance - too little investment leads to duplication, incompatibility, and suboptimal use; while too much discourages user investment and involvement and may result in unused capacity.

As Friesse points outs, some research has shown that hospitals can indeed experience powerful returns on investments, but those returns might not take the direct financial form that CEOs demand [1]. There is some anecdotal evidence of direct financial return from some electronic medical records systems in some hospitals. But what has been found more consistently over time is that most returns on investment are frustratingly intangible—though they may feed into the bottom line indirectly. This "soft ROI" includes increased workflow efficiencies, decreased medical mishaps, automated clinical decision support and the like. These improvements are clearly of tremendous value to patients and clinicians alike -- but exactly how valuable, in terms of raw dollars? The clues are enticing, but it is virtually impossible to determine objectively.

This paper will report on another HIT example of the challenge to find the evidence. The REALITY Consortium developed a representative remote monitoring service for patients with long-term conditions. The service was imple-

mented in four contrasting sites around Europe for periods of up to a year during 2004 - 2005.

Objectives

The REALITY Consortium of academics, clinicians and a technical partner developed a representative remote monitoring service for example long-term conditions. Supporting home medical and quality-of-life (QoL) monitoring and feedback to patients, the service was implemented at four contrasting sites around Europe for periods of up to a year. Socioeconomic evaluations adopted nominal viewpoints of patients, clinicians and managers. Patients were nominally most interested in technical usability and benefits of service usage. Clinicians were concerned with patient selection, training and everyday service organisation. The manager viewpoint focused on costs and wider organisational change.

The specific objectives were:

- O.G1. Develop a generalised framework for characterising and evaluating remote clinical and QoL monitoring implementations.
- O.G2. Provide information for European organisations to develop policies and guidelines.
- O.P1. Determine technology acceptance amongst diverse patient groups.
- O.P2. Determine the benefits of involving patients in collecting their own data.
- O.P3. Establish the impact of remote clinical and QoL monitoring on patients' overall well-being.
- O.M1. Provide comparative cost analyses with conventional care.
- O.M2. Identify optimal structures for future delivery.
- O.C1. Develop patient selection & training guidelines.
- O.C2. Clarify how healthcare professionals can work together to deliver services.

Methods

Figure 1 summarises the service introduced at each site. Patients were trained at clinics with home equipment to collect medical datasets specified by clinicians and Europe's generic quality-of-life (QoL) scale. Data were usually sent overnight to a central server by patients at home using telephone connections.

Clinicians could view the data and return messages of advice to patients via the server. Regular assessment of medical status and QoL factors were intended to prompt calls for face-to-face consultations or home visits by community services.

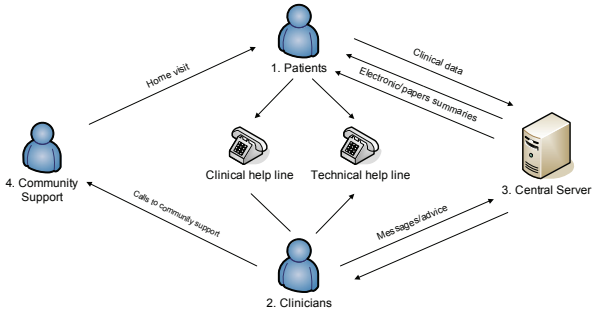

Figure 1 - Schematic summary of the REALITY service

Both patients and clinicians could communicate directly by phone and had access to technical support lines. Electronic and paper summaries of home data were provided for patients but only at Estonia.

Clinical Sites

Details on local populations and existing services were reported in [2]. Descriptions of national policies and achievements in provision for long-term conditions followed in [3].

All countries (Estonia, Portugal and England) were moving towards community care models, with varying degrees of implementation and success. Family/community doctors (GPs) were an historic feature in England. Restructuring had recently given them more powers to develop community services in combination with other health-related partners.

Results

Patients joined the project through a combination of local advertising and personal invitations. London recruited 29 asthmatics and 36 with diabetes and hypertension. 61 cases of hypertension and various heart diseases joined at Tartu. All 38 recruits at Lisbon had chronic lung conditions. Evora supported 21 asthmatics and 14 cases with advanced chronic respiratory diseases.

Most recruits had multiple medical problems. Some lived at home but most with partners/family. Conditions were often described as "reduced or inadequate".

In line with local population characteristics, several recruits at London were from ethnic minorities and many in Evora lived in rural areas. London patients appeared relatively younger and active compared to other sites. Majorities at London and Tartu were relatively well educated. The Portuguese cohorts tended to be older, sicker and rarely educated beyond primary school level.

London and Tartu had 7 doctors involved with the service. Number and roles of additional local staff at both sites were unclear. REALITY was delivered at Lisbon by a doctor-nurse team, and in Evora by a single consultant. No

staff involved from outside the main provider organisations was identified but, according to the activity diaries, Portuguese clinicians made home visits and appeared to serve in place of additional community services.

Stage of adoption

Base on interviews at site visits, two sites (London and particularly Tartu) had moved beyond constraints of novelty and early technical problems towards appreciation of consequences from new modes of service delivery. Both Portuguese sites had early technical problems, but were also thinking about wider benefits by the end of the study.

The consequences and benefits claimed were consistent across all sites (Table1). However, no example cases or documentary evidence were provided.

Table 1 - Service consequences/benefits claimed by clinicians.

For patients	Mutual	For clinicians
. Psychological support and reassurance.	. Increased communication.	. More efficient use of clinic time.
. Improved access to care.	. Increased opportunities for joint decision making.	· Availability of historic clinical data.
. Increased knowledge about and understanding of their condition.	. Increased quality of care (enhanced information to support clinical decision making).	· Created time to address other patient concerns or health promotion.
. Increased capacity for self-management.	. Increased continuity of care.	
· Increased involvement in decision-making.	. Access to continuous information enabled fine tuning of treatments or dosages between scheduled appointments.	
· Increased motivation or reinforcement of lifestyle changes.		

Determine technology acceptance amongst diverse patient groups (O.P1)

Numbers starting with the service were lower than the recruited numbers at all sites. Numbers persisting also fell, most notably at London and Tartu. Compared to the other sites, proportions of persistent patients in Portugal collecting clinical data were relatively high and tended to complete QoL returns more regularly.

General usage results suggested that sicker patients, and those who were relatively fit but had clinically abnormal measurements for key variables, embraced the service. Delays in receiving equipment, and some early technical problems, discouraged some patients. A minority found the whole approach too complicated. Proportionately more patients from urban areas persisted, and Portuguese cases

with learning/memory problems appeared more likely to continue than those with sensory problems at London and Tartu.

Two usage features seem particularly important. Some patients were too sick to use the service while others felt too well to warrant it. Certainly, significant numbers at London and Tartu reported "lack of time".

Determine the benefits of involving patients in collecting data (O.P2)

No patients at Portugal passed beyond mid-term clinical visits without retraining in at least one category of technical service usage, and often in multiple areas. The same was true for at least half of the persistent cases at London and Tartu.

Assistance with accessing clinical messages and using the basic home unit were primary retraining needs. Help with third party devices was also prominent at Portugal because of connection problems between oximeters and the home unit.

Long gaps with no daily records were common at London, middling at Tartu, and relatively rare at Portugal. Key clinical variables were returned most frequently by persistent patients, but collection rates on lifestyle and medication compliance indicators appeared low across all sites and diagnoses.

Accuracy concerns were raised by the retraining needs identified above. When sites were asked at meetings about home data reliability, London stated that particular values or patterns may prompt independent tests and discussions at a patient's next visit. Notably at this site, medication was never changed on the basis of remote monitoring alone.

Clinicians found QoL data useful at two sites but "not readily available" or difficult to interpret at the others (London, Evora). Some patients found the questions difficult to answer, and several found them too general.

Relevance of the QoL data - as additional information to support calls on community services, or home visits by clinicians in Portugal - remains unclear. There were also no data on the nature of messages sent back to patients to illustrate how data may have influenced electronic advice.

Establish the impact of remote clinical and QoL monitoring on the patients' overall well-being (O.P3)

Independent analyses of persistent and low service users were expected by diagnostic groups at individual sites. Poor data availability - attributed to problems with electronic forms rather than clinical sites - restricted the tests to small groups.

There were no statistically significant changes according to the formal QoL instruments. There were, however, some clinical improvements at London (despite low sample sizes) and at the Portuguese sites. Changes were statistically significant but not necessarily clinically meaningful (e.g. a 1% increase in oxygen saturation at Lisbon).

Example case data examined in detail illustrated that some patients did make marked improvements while others appeared to worsen. With no data on clinical messages sent to the relevant patients or details from clinical visits, the contribution of the service as a whole is unclear.

Patient comments did suggest that basic measurement feedback educates and motivates some individuals, possibly with only minimal input from clinicians. But some patients were alarmed by seeing their abnormal measurements on a regular basis.

Point measurements at arbitrary times before, during and after an evaluation period may be misleading. There is measurement error, natural variation and, possibly above all for patients with long-term conditions, appreciable changes from day to day. These complicating factors are in addition to patients' basic skills to use the equipment.

Persistent patients (and/or carers), after at least the required four months' experience with the service, found the technology relatively easy to use. Large majorities reported improved relations with clinical staff and a greater sense of support. The psychological benefits are worth particular note, as they rarely appear in health related QoL scales.

Provide comparative cost analyses with conventional care (O.M1)

REALITY was an addition to existing services. Costs were automatically higher than conventional care and, apart from patients' sense of support and future potential for clinicians, there were few additional benefits identified over the study period.

Equipment, training and data viewing accounted for most of the additional cost/cost-related activities. Other uses of time appeared to be part of existing practice.

Numeric estimates and descriptions below might be put in context by patient numbers and progress categories involved (Table 2). Costs per patient increase if withdrawals are ignored; and retraining was a common activity at all sites.

Site expenditure on equipment and facilities and supported by the REALITY server ranged from 49,000 to 64,000 euros (Table 2). Compared to other sites, total Portuguese costs were substantially higher and costs per recruit were double. The differences were attributed to provision of oximeters with special links to the Docobo unit [4], and additional software handling firewalls at both Portuguese hospitals.

Costs include: the main Docobo units and server facilities; oximeters at Lisbon and Evora; peak flow meters at London and Evora.

Table 2 - Equipment and technical service costs (Euros) for the clinical sites

	London	Tartu	Lisbon	Evora
Total (€)	49,000	49,000	63,224	53,041
Official number of recruits	65	61	38	35
Mean cost per recruit(€)	754	803	1,664	1,515

Records via Evaluation Forms at mid-term and final clinical visits may have contained double counts. Nevertheless, visits to other clinics/hospitals were extremely high at London; and emergency hospital admissions at Lisbon were around 26-36 over the study period compared to around 2 at each of the other sites. Since these analyses, Lisbon has provided records of emergency hospital use by all their patients, to be included in ongoing work to improve evaluation methods (see S4 in particular).

There were few calls for face-to-face consultations and, notably, no recorded home visits by additional community services. In addition, regular visits to the London clinic by patients seeking feedback on data were not entered on Evaluation Forms. (Note: only Estonia patients received automated summaries, and experience at London suggests that messages to patients were not used to give such feedback).

Site activity logs (and server use by clinicians).

Logs of a "representative period" from all sites except London illustrated the 1-2 hours required to commission and initially train a patient. Tartu clinicians did not visit patients. But home visits in Portugal lasted some time and, particularly at Evora, involved considerable travel. Phone calls to patients appeared commonplace. They were short at Tartu (5mins) but almost as long as clinical visits at Lisbon (15mins compared to 20).

Clinicians appeared to access patient data in block sessions of over an hour. Records did not identify viewing practices for individual patients, but Portuguese clinicians seemed more likely to send messages back to patients (substantially more messages sent more frequently).

Summarising notes/documentation was a major activity at all sites, It was a regular three hour process at Evora though performed only once at Tartu over the logged period. In common with most of the recorded activities, time spent summarising notes specifically for the new service was unclear.

Discussion

Patient numbers fell significantly at most sites. Those who persisted felt a greater sense of support, although group data showed no improvement in health status. Clinicians had positive views about the future, but different approaches for different disease severities were not formalised and the general service was not embedded into local practice at any site.

Stronger conclusions are limited by lack of data. Obtaining costing details and independent clinical indicators for the service in operation was particularly difficult. Details on local service organisation and individual patient/carer circumstances - putting other information sources into context - were missing. Moreover, accuracy of data returned by patients was never demonstrated while specific actions by doctors to improve health or QoL status were not necessarily related to the new service and, in any case, not recorded.

Researchers believe that the technology and local service organisation required longer periods to resolve problems and adjust before formal evaluations and detailed data collection were justified. This seems true in particular for Evora where all responsibilities rested on one consultant. Perhaps clinicians at Lisbon provided the best overall summary:

"Remote monitoring can be a very important tool for patients with chronic respiratory diseases, particularly if they live alone and far from the medical services. This study showed the first steps - but there is a long way to run"

Conclusion

Patients with long term conditions tend to be older and sicker. Reporting a greater sense of support, they wished the service to continue. However, available information did not show group improvements in health status, reflect true costs, or explain the relatively high withdrawal rates at two of the four sites. Notably, some patients were too sick to use the service while others felt too well to warrant it.

Clinicians were also generally positive. In practice, though, the service was not integrated into other local operations at any site, and views appeared to reflect future possibilities rather than direct experience. Clinicians themselves concluded that "this study showed the first steps - but there is a long way to run".

There is still debate over what constitutes "evidence" and how best to obtain it in a field where technology is constantly changing and studies are relatively short. The methods raise their own difficulties. Economists, make assumptions about individual or continuous treatments

with long-term effects while poor characterisation of populations limits public health assessments. It also appears rare for organisational change to be examined with rigor.

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