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# Considerations of interface efficiency in scaling up telehealthcare systems

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**Abstract**

One of the most important promises of telehealthcare is that of increasing care provider productivity in managing patients, which is essential for dealing with the changing demographics. Amongst other factors, this is currently put to the test by several European projects trialling large scale implementations of telehealthcare systems. Any minor interface problem which affects productivity at small scale may prevent a care provider from managing more patients at large scale. This makes interface efficiency, a component of its usability, an essential criterion to consider in the evaluation of telehealthcare. This paper describes a post-deployment usability evaluation study of a telehealthcare system conducted in Lothian, Scotland, the findings of which revealed important efficiency issues. Using these findings, and experience from two older studies, it concludes on interface design decisions which could be taken to avoid efficiency issues for telehealthcare solutions.



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## 1. Introduction

The world's population is ageing, due to factors such as increasing longevity, decreasing fertility and the ageing of 'baby boomers' [1]. In Scotland, it was estimated that the number of people aged over 75 will increase by 85% between 2014 and 2039, from 0.43 million to 0.8 million [2]. Long-term conditions being prevalent in the older age, this will lead to growing numbers of adults suffering from, sometimes multiple, long-term conditions [3].

The increasing demand for care of people suffering from long-term conditions is also compounded by the shortage of human resources in healthcare, reported by the European Commission ever since 2001 [4]. Due to demographic changes, it is expected that there will be fewer workers per dependant in general, and therefore even unpaid carers, whose life is already burdened by the care for family or friends, will be in shorter supply [3].

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Telehealthcare was proposed as a solution for coping with the demographic changes. Together with important care and cost benefits, it offers the promise of a more efficient interaction between patient and care provider, by substituting face-to-face consultations with remote monitoring and the provision of care at a distance[5,6]. Telehealthcare can improve the productivity of care providers in managing each patient, and thus make it possible for fewer additional members of staff to deal with the increasing numbers of patients.

To thoroughly assess these and other claims, several European countries are currently planning and developing large-scale telehealthcare pilots. Examples are the Renewing Health European project[7], ITTS (Implementing Transnational Telemedicine Solutions[8], and DALLAS (Delivering Assisted Living Lifestyles at Scale[9]) in the UK which includes the 'Living it Up' programme in Scotland.

In scaling up a telehealthcare system, care providers will repeat common operations for more patients. At the level of the interface, even minor delays in their work may then escalate and affect their possibility to manage more patients. This makes efficiency, a component of usability, an important factor to consider ever since a telehealthcare system is trialled in small scale pilots. Efficiency is defined by the ISO 9241-11 standard as "*resources expended in relation to the accuracy and completeness with which users achieve goals*"[10].

Three post-deployment usability studies of telemonitoring systems were conducted by the author in 2010 and 2013 in Lothian, Scotland. The findings of the first two (from 2010) were described in[11]. This paper, based on the author's PhD thesis[12], focuses on the last study (from 2013) and its results on efficiency, to draw conclusions on interface design decisions which could help avoid efficiency issues in telehealthcare systems. A discussion about whether the conclusions are supported by similar findings in past studies is included.

## 2. Description of the 2013 usability evaluation study

### *2.1. The system*

Using lessons learned from one of the Telescot trials[13], the telemonitoring system which constituted the object of the 2013 usability study was the product of a collaboration between NHS Lothian and NHS 24 the purpose of which was to develop a mainstream telehealth service for the home based telemonitoring of patients suffering from COPD (Chronic Obstructive Pulmonary Disease) and CHF (Congestive Heart Failure) in Lothian. The service development was gradual, and its continuous evaluation, including that of the technology, was seen as key.

By using an application running on a tablet installed in their home and wireless measurement devices, patients could take physiological measurements (e.g. of oxygen saturation and pulse for COPD) and answer a daily health survey. The measurements were sent by Bluetooth to the tablet and then, together with the patients' survey answers, via the Internet to a remote secure server. Alerts were computed based on pre-existing algorithms which attributed scores to symptoms, or if physiological measures were outwith previously agreed parameters. All of the resulting data was made available to monitors on a **telemonitoring website**. Every day, one non-clinical NHS 24 call operator (CO) would monitor patients on the website between 9 am and 1 pm. She would complete an **alerts Excel spreadsheet** with each patient's alerts and take an appropriate action as directed by it. These actions could be: call the patient to find out more about her health and, if necessary, to ask her to retake her measurements for a reassessment; send an email to the patient's care provider team (by using an **email client**), attaching the alerts spreadsheet, if the patient's state was not improving or getting worse, or if she had not succeeded in contacting the patient ('Contact Care Provider' outcome); or conclude that the patient did not require an intervention ('No Action' outcome). The CO would record the action on the website by changing the status of the alerts appropriately. She would also record at the end of her shift statistical data (the number of patients monitored that day, the outcome of her monitoring, frequency and duration of calls, etc.) by using a separate table, also an Excel spreadsheet (the **statistics Excel spreadsheet**). If alerted by the CO email (through the same email client system), the patient's care provider would log onto the telemonitoring website to reassess the patient's condition, and contact the patient to discuss her health, offer her advice and change her treatment if necessary. In addition, the care provider would sometimes need to use the patient's paper or electronic record (a separate system) to record data about the patient, prescribe medication or obtain patient test results. To communicate her actions as regards the patient to the COs or to her colleagues, the care provider would also change the status of the patient's alerts on the website. A representation of the monitoring process is provided in Fig. 1