

## Chapter 56

# Towards Evaluating the Quality of Experience of Remote Patient Monitoring Services: A Study Considering Usability Aspects

**Lea Skorin-Kapov**

*University of Zagreb, Croatia*

**Ognjen Dobrijevic**

*University of Zagreb, Croatia*

**Domagoj Piplica**

*University of Zagreb, Croatia*

### ABSTRACT

*The applicability of advanced mobile technologies in the m-Health domain has led to a number of studies and (limited) commercial products supporting delivery of health services to remote users. A key issue regarding successful delivery and acceptance of such services is meeting their Quality of Service (QoS) and Quality of Experience (QoE) requirements, focusing on technical aspects and end user perceived quality, respectively. In this paper, the authors address the topic of evaluating QoE for non-emergency remote patient monitoring services. They identify relevant QoE influence factors and metrics, and present the results of a QoE evaluation study, whereby they focus on usability aspects. The study involves 26 users testing a prototype version of the Ericsson Mobile Health service, which is based on a smartphone application and measurement of vital signs via medical sensors. The results show a strong correlation between QoE and: perceived effectiveness of the mobile interface (regarding both adequacy of smartphone screen size and smartphone application navigational support), perceived ease of conducting a blood pressure measurement task, and user motivation for service usage.*

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## INTRODUCTION

With rapid advances in mobile network technologies, involving advanced and low-cost end user terminals, and broader network coverage with higher data rates, mobile communications are providing an effective means of delivering healthcare services (Mechael, 2009; Mosa, Yoo, & Sheets, 2012; Vital Wave Consulting, 2009; WHO, 2011). The term *m-Health* was coined by Istepanian, Jovanov, & Zhang (2004) as the use of mobile computing, medical sensors, and information technologies for healthcare. More recently, Istepanian & Zhang (2012) identified the challenges and future implementation issues of m-Health services in the context of emerging 4G mobile communications systems. A market report released in late 2010 anticipates that approximately 500 million smartphone users worldwide will be using m-Health services by 2015 (research2guidance, 2010).

In a recent WHO report (WHO, 2011) providing a categorisation of m-Health services, remote patient monitoring (RPM), identified as one of the categories, is specified as being based on the use of “technology to manage, monitor, and treat a patient’s illness from a distance (e.g., diabetes and cardiac patients)”. RPM services capitalize on the functionalities supported by mobile devices, including voice and multimedia communication capabilities, mobile network access, and Bluetooth technology which enables connections to various sensors. Remote sensors or devices are linked to mobile phones, which are further used to facilitate data transmission to a health service provider. Given that mobile phones are becoming a part of patient’s daily lives, they can be seen as an essential element incorporated into collaborative home care systems (Lyles et al., 2011). It is expected that mobile technologies will help to increase access to care, in particular in emerging markets, by providing less-expensive (compared to current healthcare costs), prevention-based, and patient-focused systems (PwC, 2012).

When analyzing the performance of a given m-Health service, in addition to considering technical parameters, there is a need to consider the acceptance, perceived service quality, and overall user experience from the end user point of view (e.g., healthcare professional, patient). A study conducted by Broens et al. (2007a), which was focused on identifying the key determinants influencing successful implementation of telemedicine services, reported user *acceptance* as being the most common determinant (reported in 37% of studied telemedicine implementations). Studied works showed that the involvement of patients and professionals in the service requirements analysis and the design process is crucial in order to fit such services into users’ daily work practices. Among the general requirements of pervasive healthcare, Varshney (2007) listed “the usability, reliability and functions of a patient’s device, portable or wearable”. In line with these findings, a report issued by the UN Foundation-Vodafone Foundation Partnership (Vital Wave Consulting, 2009) lists the key building blocks of structuring successful m-Health initiatives, among which they identify service design that keeps the end user in mind, focusing on usability (ease of use).

In general, the subjective end user perception of the overall acceptability of an application or service has been referred to in literature as Quality of Experience (QoE) (ITU-T, 2008). More recently, a user’s QoE has been defined as resulting from “the fulfilment of his or her expectations with respect to the utility and / or enjoyment of the application or service in light of the user’s personality and current state” (Le Callet et al., 2013). While often highly dependent on technical Quality of Service (QoS) linked to performance parameters, QoE extends the notion of QoS by additionally considering the impact of user- and context-related factors on a user’s subjective quality assessment. Hence, the field of QoE deals with studying and quantifying the impact of a wide range of factors on *user perceived* QoE. QoE may also be related to the user experience (UX) field, whereby even though the origins are different (UX stems

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