

## Chapter 9

# Patient–Telemonitoring After Revascularization Procedures in the Lower Extremities

**Roman Gumzej**

 <https://orcid.org/0000-0002-2646-217X>

*University of Maribor, Slovenia*

**Lidija Fošnarič**

*University of Maribor, Slovenia*

### ABSTRACT

*Multidisciplinary cooperation of participating healthcare professionals, use of common standards in diagnostics, and clinical pathways in the treatment of vascular patients should provide for a higher-quality clinical practice. Using telemedicine, a more efficient way of obtaining specialist treatment is achievable. However, its introduction may raise safety and security issues, which originate from its enabling information technology. In this chapter, a model of patient-telemonitoring after revascularization procedures in the lower extremities is presented. A protocol for proper authentication and authorization to access medical equipment and patient medical records has been introduced. The associated clinical study has shown that most post-operative follow-up examinations can successfully be performed by trained nurses. Hence, improvements to healthcare logistics, mainly due to shortening waiting times for specialist treatment and the reduction of follow-up examinations on the secondary healthcare level, can be achieved using telemedicine.*

### INTRODUCTION

The worldwide prevalence of lower extremity peripheral artery disease (PAD) is between 3 to 12 percent. In 2010, 202 million people around the world were living with PAD (Fowkes et al., 2013). Due to its epidemic proportions, management of PAD patients represents one of the most challenging problems of contemporary angiology. Since timely diagnostics and strict follow-up examinations play a key role

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in proper healing, the introduction of telemedicine may be a keystone to a better and more accessible health service for PAD patients.

The ageing of the population, increase of chronic diseases, increasing people's demands for new, more complex diagnostic and therapeutic methods, and lack of health providers lead the way towards the introduction of new health services based on new process models and advanced information and telecommunications solutions. E-health services are promising a better health service for the future, being more effective than existing, established healthcare models.

In current medical practice, patients usually get an appointment at the angiology clinic upon recommendation from their general physician. After waiting in queue for their first interview with the angiologist, they obtain their first diagnosis. Depending on the severity of their medical condition, they are then given some medication or assigned an approximate period for their admission at the angiology clinic. When they are admitted, they are inspected again, and their status is checked. If they need an operation, a bed must be assigned to them, and a team assembled to perform the surgical procedure. After the operation, they are re-examined to determine their further therapy. Usually, they leave the clinic after a few days with an appointment for a follow-up examination at the clinic. The timespan for this whole process varies and may be anything from a couple of weeks to a couple of months. It depends heavily on the capacity of the angiology clinic and the availability of their resident specialists. The documentation on the patient and his/her handling are currently stored in patient's as well as hospital's medical records but are transferred mainly in printed form. Hence, the documentation tends to pile up during the process.

By applying the telemedical approach, an efficient way of equally personalized, but faster multidisciplinary specialist treatment can be introduced into clinical practice. On the other hand, its introduction raises data security issues. Data in electronic form are easy to access, track and archive, and they also travel very fast – properties facilitating the abuse of data (Harrington et al., 2011). While ensuring patient safety is primarily an organizational concern, in e-health and telemedicine, one should also consider information security and make use of the mechanisms provided by the enabling (information) technology. In telemedicine, proper information security management should provide for confidentiality, integrity, and availability of electronic medical records (Harrington et al., 2011). The provision for security should be an integral part of e-health and telemedicine services since the healthcare professionals involved are morally, ethically, and legally responsible for their patients' medical records.

Previous telemedical applications in angiology and vascular surgery featured various partial solutions (e.g., one-/two-tire pre-/post-operative medical consultation via e-mail/teleconference (Schmidt et al. 2014; Polombo et al., 2009), three-tire electronic referral, assessment by a practice nurse, and teleconferencing (Hands et al., 2006). In this chapter, a complete telediagnostic solution for telemonitoring vascular patients after applying revascularization procedures in the lower extremities is presented and empirically evaluated.

## **METHOD**

### **Electronic Oscillography**

The telemonitoring platform uses electronic oscillography to measure fluctuations in blood circulation volume. They can be recorded by infrasonic condenser microphones or electronic receptors. The resulting oscillographic curves are evaluated according to the variations in oscillations on symmetrical

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