

# Towards tailored rehabilitation programs after lower extremity fractures

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## **Valorisation**

### **Relevance**

Healthcare is extremely expensive and innovative solutions are necessary to decrease costs, while ensuring the high quality of care. A considerable part of the costs is related to hospital admission, for example for the necessary equipment and personnel. One of the solutions to decrease healthcare costs is to limit the length of hospital stay. This could be achieved by providing care at home, for example with informal care, home care and/or the use of innovative technologies. SensiStep is an innovative technology that has the potential to play an important role in the upcoming shift from hospital care to home care.

Currently, patients are unable to rehabilitate at home as supervision by experts is essential, but unavailable or extremely expensive in the home setting. In this way, the demanded high quality of care is not guaranteed. By using SensiStep at home, patients are able to train gait individually, without the physical presence of expensive healthcare professionals. Instead, healthcare professionals are able to remotely supervise training exercises and evaluate rehabilitation progress via the online Web Portal. Communication between the patient and healthcare professional could take place via the Web Portal, mobile phone or outpatient appointments. This shift from hospital care to home care is foreseen in the nearby future and SensiStep is able to play a crucial role in the field of rehabilitation at home. Currently, the development innovative rehabilitation programs with Sensistep at home is already explored (see further under 'planning and realisation'). The preliminary results are promising and this could lead to lower economic costs, while ensuring the high quality of care.

### **Target audiences**

The main objective of this thesis was to develop an innovative rehabilitation tool to improve existing rehabilitation programs after lower extremity fractures. This resulted in the biofeedback system SensiStep that could be used by various patients following all types of lower extremity fractures. These patients are located either in the hospital, the rehabilitation clinic or at home. The results described in this thesis were gathered in the hospital and the rehabilitation clinic. The beneficial effects of monitoring and providing real-time biofeedback have been shown. The results of this thesis are not limited to lower extremity fractures, but could also be used for the rehabilitation in other diseases, such as

stroke, diabetes or an amputation of the lower extremity. One important aspect in the design of the system was that it should be user-friendly and affordable for all types of patients.

SensiStep was developed in close collaboration between universities and SME's. The SME's ensured the commercial availability of the biofeedback system to society. Institutes, patients and other interested people are able to buy SensiStep for institutional or private use against relatively low costs (i.e. compared to other commercially available biofeedback systems).

In order to increase the usage of innovative technologies such as SensiStep, it is important to create public awareness of the availability and possibilities of these technologies. Scientific publications, congresses and expert workshops are important dissemination activities to create awareness at the level of experts, such as healthcare professionals. Other outreach activities are important to create awareness in society and potential users of SensiStep, such as patient groups. In this light, several outreach activities were already done to inform various interested people.

### **Dissemination and outreach**

Important results were communicated to healthcare professionals in scientific publications and congresses (see Addendum: list of publications and international abstract and poster sessions). In addition, several workshops and expert courses were organised to train various expert groups with SensiStep. The most important aspects were to create awareness and familiarity with SensiStep, but also to show the possibilities of innovative techniques in medicine to experts. The expert courses were organised at three different platforms: 1) Nederlandse Vereniging voor Fysiotherapie in de Geriatrie (NVFG), 2) Nederlands Paramedisch Instituut (NPI) and 3) Sportmedisch Wetenschappelijk Jaarcongres (SMWJC). The target audience varied between experts, healthcare professionals and (para)medical students. Dissemination to these people is important as they are considered to be the main users of the product. Therefore, also a SensiStep symposium for experts and other interested people was organised at the University Medical Center Utrecht. Various presentations and workshops were organised to increase knowledge and familiarity with SensiStep.

Outreach and communication to society and other interested people was established through various channels, including popular magazines, newsletters and radio. A broad

audience was reached via interviews in Smarthealth (online available at [www.smarthealth.nl](http://www.smarthealth.nl)) and BNR newsradio (online available at [www.bnr.nl](http://www.bnr.nl)). Special newsletters at innovation platform VitaValley (online available at [www.vitavalley.nl](http://www.vitavalley.nl)) and geriatric rehabilitation center Zorggroep Groningen (online available at [www.zorggroepgroningen.nl](http://www.zorggroepgroningen.nl)) created public awareness of SensiStep.

### **Innovation**

The development of biofeedback systems has a long history, as described in the introduction of this thesis. Many improvements have been made over the past years that resulted in the development of SensiStep. Recently, many companies, including multinationals, became interested in the measurement of gait patterns in the ambulatory situation. This resulted in the development of several devices, such as smart socks, smart soles and smart shoes. The largest difference compared to SensiStep is that these products focus on sport activities, such as running, instead of measuring patients in the clinical setting. The error margins in smart devices for running are allowed to be much larger compared devices used for clinical purposes. Therefore, SensiStep used innovative sensor technologies and is currently the state-of-the-art biofeedback system in ambulatory gait analysis techniques. Further innovation is necessary to improve aesthetics and comfort, for example to increase usage at home.

### **Planning and realisation**

Recently, Sweden was one of the first members of the European Union implementing the shift from hospital care to home care in order to reduce the high medical costs. This Swedish situation provided the optimal environment to test SensiStep in the home setting. The experimental set up was to use SensiStep under direct supervision of the physical therapist at the patients' home. The first results showed that patients improved gait if SensiStep was used during training sessions. However, these are preliminary results in an ongoing project and results need to be further evaluated in the future. This is a first step in the right direction and improvements are still possible as patients could train without direct supervision of the physical therapists. The plan is to investigate these possibilities in future research.

One of the requirements to provide care at home with SensiStep is that these rehabilitation programs will be reimbursed by insurance companies. Therefore, meetings with insurance

companies are envisaged in the nearby future to explain the potential of SensiStep. The first reactions from insurance companies are promising. The beneficial aspects of SensiStep need to be further discussed and focussed both on the healthcare perspectives as costs effectiveness. For costs effectiveness reasons, it is important to consider the use of SensiStep not only after lower extremity fractures, but also in other diseases such as stroke and diabetes.

## **Conclusion**

In conclusion, this thesis resulted in a new and publicly available biofeedback system: SensiStep. Dissemination and outreach activities have created public awareness of the possibilities of this biofeedback system. One important step to increase the usage of SensiStep is to arrange reimbursement for costs by insurance companies. The potential of SensiStep in rehabilitation is evident, especially with the foreseen shift from hospital care to home care in mind. The society could benefit from this system in the nearby future, not only after lower extremity fractures, but in various diseases.