

Sensors and Systems for Wound Care Management

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In the frame of the SWAN-iCare European project, a monitoring system was developed to allow patients with hard-to-heal ulcers to return home and to be looked after by their physician without needing to visit the hospital very often. Some parameters are monitored continuously and others are controlled during the home care nurse's regular visit.

Some diseases lead to recurrent pathologies, such as diabetic foot ulcers for patients suffering from diabetes or venous leg ulcers for patients with blood circulation problems. These hard-to-heal wounds require long and expensive treatments. One effective treatment consists of applying a negative pressure on the wound bed, where suction will evacuate the secretion, the bacteria and debris, and will enhance the revascularization, thus speeding up the healing process. In order to make this therapy possible in the patient's home, a system is being developed by the European project SWAN-iCare [1].

The system is mainly composed of three parts (Figure 1):

- One subsystem that is applied to the wound with a device that creates the negative pressure, and several integrated sensors that measure several wound parameters.
- A second subsystem composed of a network of devices to be used daily or when the wound dressing is changed.
- A third part consists of an informatics system where the monitored parameters are stored. They can be consulted by the health care staff through an internet connection. The two first subsystems send the information through a GPRS connection.

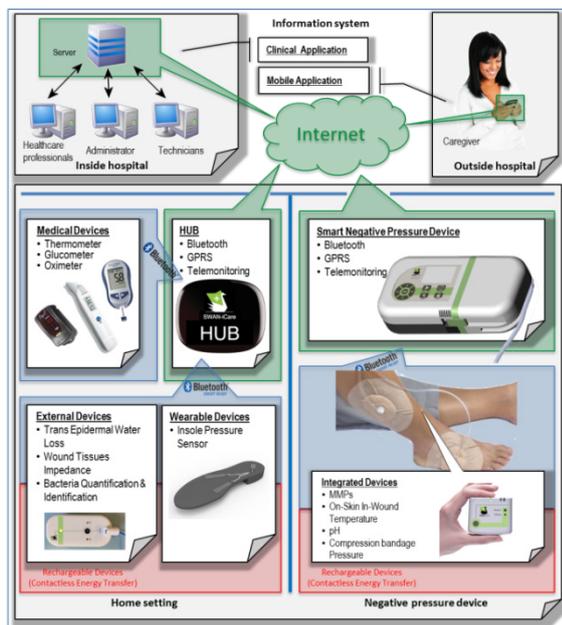


Figure 1: System for wound care management.

In this project, CSEM is developing the negative pressure device electronics and several sensors. One of the sensors measures the pressure that the patient applies on his or her foot when standing or walking. Diabetic patients often suffer from neuropathies that lead to a loss of sensation in their lower

extremities. With the insole pressure sensor, the wound care physician would be informed about the pressure the patient applies and can advise him or her how to take care for better healing of the ulcer or for preventing a new ulcer. Figure 2 depicts how the insole pressure electronics with the three sensors were integrated in the shoe of a diabetic patient.

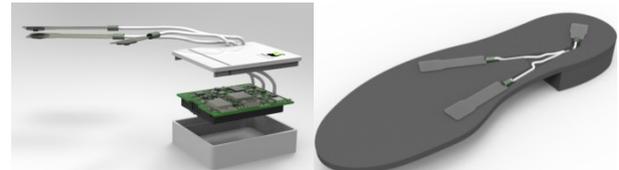


Figure 2: Insole pressure device: electronics and sensors (left), integrated in the shoe insole and heel (right).

CSEM has also developed the electronics for Trans Epidermal Water Loss (TEWL) measurement. Based on a demonstrator device designed and fabricated in partnership with the University of Pisa, CSEM developed the device adapted to the SWAN-iCare system with a Bluetooth connection to the home setting. Figure 3 shows the TEWL device delivery kit.



Figure 3: Trans epidermal water loss device.

For measurements related to the wound healing status, CSEM is developing a fiber optic biosensor for matrix metalloproteinase (MMP) monitoring. It is composed of a modified optical fiber: one part of its cladding is replaced by a colored gelatin that can be digested by the gelatinase family of the MMP [2]. When active gelatinase are in contact with the modified fiber, its transmission is modified at the absorption wavelength of the colored gelatin. MMP activity is estimated after analysis of the transmission change with time.

Thanks to wireless communication, the SWAN-iCare system offers the possibility for wound management care physicians and nurses to monitor their patients remotely. At home, the patient will have a level of control and safety equivalent to that found at the hospital, with the comfort of the home environment and the support of relatives.

This work is supported by the EU-funded FP7 ICT-317894 SWAN-iCare project.

[1] www.swan-icare.eu

[2] Patent application EP2565630