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A smart T-shirt to help the chronically ill

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A T-shirt fitted with sensors promises to greatly improve quality of life for the chronically ill, as well as ease doctors' workload and reduce healthcare costs. EU-funded researchers have developed the innovative system to measure heart rate, breathing and physical activity, which is backed up by in-home monitoring devices and intelligent data processing technology. It may even help in training regimes for elite sports like rugby.



[1]

As Europe's population ages, chronic diseases are becoming increasingly widespread. Characterised by gradually deteriorating health and recurring incidents often requiring immediate medical attention, chronic illnesses have a severe impact on patients' autonomy and life quality and are putting increasing strain on over-stretched healthcare systems.

'Chronic obstructive pulmonary disease' (COPD), for example, is expected to be the third leading cause of death worldwide by 2030, while 'Chronic kidney disease' (CKD) affects one quarter of people over the age of 65. Patients suffering from those and many other incurable chronic illnesses require long-term care to ease their symptoms and slow the deterioration of their health.

'Currently, treating such diseases requires patients to visit their doctor or specialist frequently for check-ups to monitor their progress. This is inconvenient for patients and doctors, it's costly for healthcare providers, and the treatment may not always be optimal because of insufficient or

inaccurate data,' explains Roberto Rosso, R&D Manager at telehealth provider TESAN in Italy.

Innovative healthcare technologies based on sensor networks, ambient intelligence and remote monitoring address many of those problems and are eliciting interest from healthcare providers worldwide.

A new system, developed in the Chronious* project with the support of EUR 7.25 million in research funding from the European Commission, provides a comprehensive remote monitoring solution for the chronically ill. Developed by a consortium of 14 partners in eight European countries coordinated by Mr Rosso, the smart wearable system is designed specifically for COPD and CKD patients, although it could easily be adapted for patients suffering from a variety of other long-term disorders.

The system uses wearable heart, respiratory and activity monitoring sensors fitted to a light-weight T-shirt, alongside external devices such as a digital weight scale, glucometer, blood pressure monitor, spirometer and air quality sensor in the patient's home or room to measure vital, physical and environmental signs. These are connected to a mobile device such as a smartphone or PDA which in turn transmits the patient's data to their care provider where it is analysed with intelligent data processing software.

The open, modular and flexible approach means different types of sensors can be used depending on the individual patient's condition, making the system particularly adaptable to cases of comorbidity in which patients are living with two or more kinds of disorder such as CKD and diabetes. For CKD patients in particular, the Chronious team developed an innovative food intake program with a simple-to-use user interface so their diets can be closely monitored.

More accurate data, more accurate treatments

'For doctors one of the big advantages of this approach is that the data is highly accurate. Patients are being monitored every day as they live their normal lives so a better picture of their symptoms and progress can be used to determine treatments,' Mr Rosso says. 'For example, eating correctly is crucial for reducing CKD symptoms, but current practice relies on patients filling in questionnaires about what they eat when they go for a check-up and the information they provide may not be entirely accurate.'

More data, intelligently processed and analysed, means treatments can be fine-tuned to patients' individual requirements. And, because patients are monitored remotely, the need for regular check-ups is reduced, saving both doctors' and patients' time, while carers are alerted immediately if patients' vital signs change or indicate a problem, potentially saving lives.

'In the case of chronic diseases in particular, any change or incident that is not treated in time can exasperate symptoms and accelerate the patient's deterioration. Catching changes quickly can have a major impact on their long-term health and progress,' the project coordinator explains. 'On the other hand, using this remote monitoring technology means that if the patients' health remains stable then there is no need for them to visit their doctor for check-ups.'

The Chronious team tested the system in two trials involving 50 and 60 COPD and CKD patients in Spain and Italy, and have just been awarded EU funding for a follow-up project called Chromed in which the researchers plan to carry out more extensive trials with at least 300 patients in Spain, Estonia, Slovenia, Sweden and the United Kingdom.

'The trials in Chronious were very successful and the user feedback was useful in refining the system

and user interfaces. Chromed will extend this work and we will focus the system specifically on monitoring patients with comorbidity. The trials will provide objective data on the benefits of the system,' Mr Rosso says.

Mr Rosso points to separate trials of telehealth solutions carried out by TESAN that showed how remote monitoring can reduce hospital visits by up to 30% with potentially big savings for healthcare systems.

In parallel to their continuing research, the Chronious consortium partners are also working on developing the technology commercially for both the healthcare industry and other sectors.

Mr. Rosso notes, for example, that an Italian rugby team has expressed interest in using the wearable sensor platform to monitor and measure players' performance during training sessions.

'In the sports world money isn't as much of an issue so some of this technology could find applications there first. The vests we used in the Chronious trials are expensive and we are looking for cheaper alternatives for the healthcare market,' Mr Rosso explains. 'Nonetheless, the market and demand for this kind of eHealth technology is big and we have had interest from healthcare providers around the world, including the United States and China.'

Mr. Rosso says Tesan is considering developing a commercial service for monitoring chronically ill patients based on the Chronious project results, while project partners such as Velti and Uniscan may look to commercialise some of the underlying technological components of the system.

* 'An open, ubiquitous and adaptive chronic disease management platform for COPD and renal insufficiency'.

Useful links:

- [Project website for 'An open, ubiquitous and adaptive chronic disease management platform for COPD and renal insufficiency'](#) [2]
- [Chronious project factsheet on CORDIS](#) [3]

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[2] <http://www.chronious.eu/>

[3] http://cordis.europa.eu/projects/rcn/85452_en.html