Telemedicine for patients with chronic liver diseases

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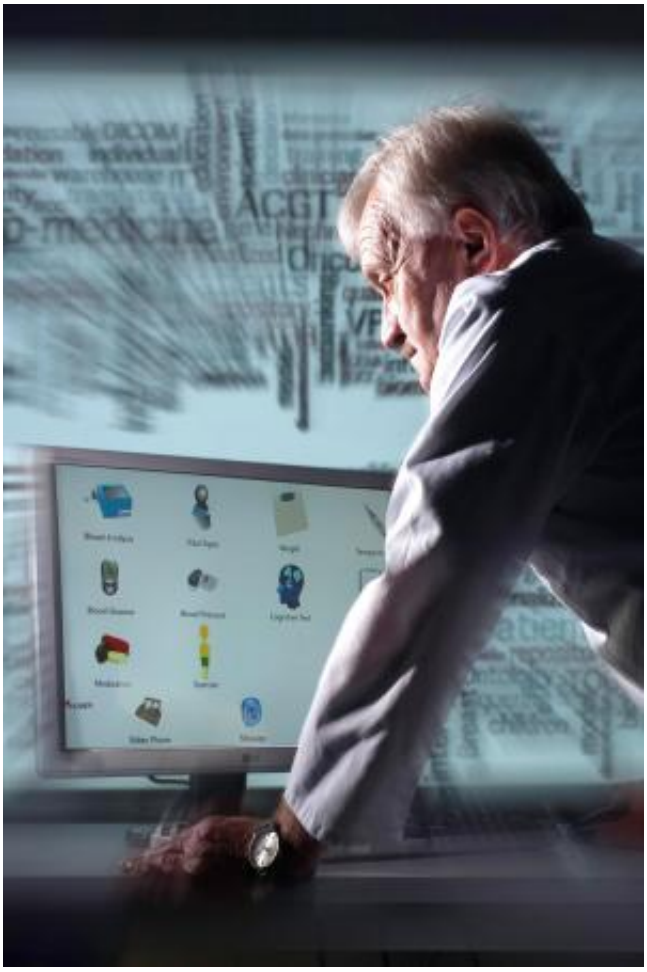

Telemedicine involves doctors and patients communicating with each other via an IT platform. Researchers are working on technology to extend the benefits of telemedicine to liver patients in the near future. Credit: Fraunhofer IBMT

Although telemedicine could improve the quality of life of patients with chronic liver diseases, viable home care systems are still lacking. Scientists working on the EU-project "d-LIVER" mean to remedy this situation. Initial results have now been released.

The liver is one of the most important organs in the human body. Its job is to ensure that we utilize our food properly – this is its synthesis function – and that toxic substances are removed from our organism – this is its detoxification function. Lack of exercise and too much alcohol, stress, and unhealthy food all damage the liver. The resulting diseased cells can lead to inflammations, cancerous ulcers, fat deposits, cirrhoses, and life-threatening liver failure. According to the German Liver Foundation, over five million people in Germany have liver diseases. Often these diseases take a chronic course. Patients suffer from a variety of conditions, including memory disorders (encephalopathy), peritoneal fluid excess (ascites), and itchy deposits in the skin.

Medical systems that assist liver function can tide patients over until they can receive a liver transplant, or accelerate regeneration of the liver after surgery, or even render a transplant unnecessary. They can carry out both the synthesis function and the detoxification function of the liver. To date, however, there are no medically approved cell-based systems. What are also lacking are telemedicine platforms that allow patients with chronic liver diseases to be monitored and treated outside of hospital. "Telemedicine is something that would greatly improve the quality of medical care and patients' quality of life," says Stephan Kiefer, a computer scientist at the Fraunhofer Institute for Biomedical Engineering IBMT in St. Ingbert, near Saarbrücken in southwest Germany.

In the EU-project "d-LIVER", the IBMT is working with European partners to develop an IT- and cell-based system that will help people suffering from chronic liver failure to receive medical support in their

homes (www.d-liver.eu). Its engineers are responsible for programming the IT platform and developing the sensor technology that will measure the condition of the liver cells in the cell-based system. Of the research being carried out at the IBMT, the patient management system is currently at the most advanced stage. For the first time, the scientists are combining classic components of telemedicine – such as remote monitoring for doctors – with a system that assists with decision-making. This system is called the Care Flow Engine, and Kiefer explains what exactly is behind it: "We've created IT systems that can take treatment plans drawn up by doctors and turn them into such user-friendly automated processes that chronic liver disease patients can receive quality long-term treatment at home."

To this end, the scientists have developed an IT application called Personal Health Manager, which patients can access conveniently on tablet computers in the form of an app. It amalgamates all the data from devices that measure blood pressure, heart rate, weight, temperature, and liver values along with the treatment plans from the Care Flow Engine. "Its main purpose is to ensure optimum treatment for the typical complications that tend to accompany liver diseases," says Kiefer. This can be achieved by means of tests, questioning, exercises, or instructions. For example, patients are regularly asked to weigh themselves, measure their liver values, and accomplish a cognitive test. This provides indications as to how much patients are suffering from conditions such as encephalopathy and ascites. The system automatically evaluates the results, suggests adjustments to medication doses, and recommends courses of action that are then discussed between the doctor and the patient. "Although the technology is currently set up for liver diseases, it's suitable in principle for the telemedical treatment of any chronic illness. Adapting the existing system to make this a reality is our medium-term goal," says Kiefer. An initial prototype of the IT platform was successfully tested by doctors last year. Preparations are currently underway for a study involving 20 liver patients in the United

Kingdom.

Sensors measure vitality of cells

The sensor technology for monitoring the liver cells was developed at the IBMT by physicist Dr. Thomas Velten: "Our sensors continuously measure the vitality of the cells in a bioreactor – and they do so by analyzing the cells directly. This is an important new tool to complement conventional biochemical analyses." Thanks to built-in sensors, operators do not have to open the bioreactor for every measurement, eliminating the danger of the cells becoming contaminated in this way. Impedance spectroscopy plays an important role in the methodology. Impedance is the technical term for resistance to alternating electric current. When cells deteriorate, their impedance spectrum changes. So far, scientists have been able to prove this effect in smaller laboratory reactors. At the end of this year, the researchers want to confirm those results using bigger bioreactors that are equivalent to a human liver in terms of their volume. "Online measurement of cell vitality is an important part of our IT-based system to support liver treatment," concludes Velten.

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