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Health Is Going High Tech WIth Camera Pills, Health Sensors And Ultrasound Maps For Surgeons

ScienceDaily (Mar. 7, 2009) — Camera pills and ultrasound creating maps of the body: health has become high technology. Here are some of the recent advances in medical technology.

The smart capsule will hunt for diseased cells in the alimentary canal. (Credit: Image courtesy of SINTEF)

3-D Images For Surgeons

For more than ten years, senior medical officer Ronald Mårvik at St. Olav's Hospital in Trondheim has been collaborating with SINTEF scientist Thomas Langø. Together, they have created a new IT-base window on the inside of the body, a window that makes a patient transparent on a screen when a surgeon inserts operating instruments through small openings in the abdominal wall.

What the system actually does is transform X-ray and nuclear magnetic resonance (MR) images into three-dimensional maps by which the surgeon can navigate when he performs keyhole surgery in the abdominal cavity. The technique enable the surgeon to select a more lenient keyhole approach in operations that would otherwise demand large, open interventions. This offers benefits both to the individual patient and to society, because, in comparison with open operations, keyhole surgery puts less stress on the patient's body. As a result, the patient needs to spend less time in hospital and in reconvalescence.

Like navigation systems for shipping and aviation, this navigation technology has been developed in order to improve safety: the system provides information that enables the surgeon to avoid blood vessels and other organs when he operates via small openings in the abdominal wall.

The maps show the surgeon exactly where a cancerous tumour for example is located, relative to the tip of the instruments inside the patient's body; and no less important, the location of the tip relative to vital organs and to major blood vessels that absolutely must not be damaged by the surgical intervention.

"With a better view of vital organs and blood vessels, a surgeon can perform keyhole surgery with an extra high margin of safety, and can employ keyhole surgery much more often than before to

remove tumours in organs that would not otherwise be easily accessible to keyhole interventions; organs such as the kidneys, the adrenal glands or the pancreas," explains Thomas Lange.

A hospital in the Netherlands has now purchased the SINTEF software for the system, and doctors from Trondheim and Utrecht will collaborate in documenting the benefits of the technique.

Smart capsule

All in all, technology is becoming an ever more useful servant of the health services, in making early diagnoses, accurate operations and stressing patients as little as possible.

Health and ICT researchers at SINTEF are currently working with 17 other partners throughout Europe to develop a capsule that will be able to creep through the alimentary canal, carrying a battery of tools and sensors, as it hunts for diseased cells.

Camera pills that can be swallowed already exist. They travel naturally through the digestive system and may take several days to make the passage. Unlike these, however, the smart capsule will be controlled by the doctor or by a computer system, which will allow it to be stopped or even reversed when something is seen that needs to be examined more closely.

Senior scientist Thomas Langø plays a central role in the project, which goes by the name of "Vector". "We are working on the navigation system that will make it possible to know exactly where the capsule is in the digestive system at any given time, and control it to perform various operations", says Langø..

The pill's sensor package will include sensors based on ultrasound, spectroscopy, and possibly also biosensors, and it will also collect tissue samples. The plans are being followed with great interest by St. Olav's Hospital. Earlier diagnosis of colorectal cancers is one of the potential benefits of the capsule, which will thus help to save lives.

"The greatest challenge lies in finding room for everything we need within the capsule, without it becoming to big to be swallowed," says Langø. If everything goes according to plan, we will be able to "open wide" for the smart pill in about four years.

Health checks at home

Many of today's hospital patients are like "Martin". He has spent the past few weeks in a bed in St. Olav's Hospital – under observation. Martin is trying out medicines to reduce his blood pressure, which therefore needs to be measured regularly. This takes time, and he is fed up. He would much rather be at home, because he doesn't feel ill.

Within a few years, such week-long stays in hospital could be a thing of the past for Martin and others like him. They will be able to drink their morning coffee in familiar surroundings at home, simply wearing a little sensor on their body. Making measurements at home will also take a load off the health services. Doctors will obtain better data with which to evaluate the medication, and if a treatment is not working, it can be changed "on the fly".

"For users, the most important aspect will be that biomedical sensors can improve quality of life in an otherwise difficult situation," says Dag Ausen of SINTEF ICT. "With the growing number of elderly people and the obesity epidemic in mind, it is important to give patients the possibility of understanding their own bodies and getting help to act in ways that will benefit themselves and

thus indirectly reduce the need for the services of a doctor."

Ausen has been project manager for a Scandinavian futures project (FOBIS) on this topic,that has studied various scenarios involving the use of biomedical sensors.

"On the basis of a given situation and illness, a patient could have a measuring station at home that would make measurements on a daily basis", he says. "With wireless transmission, the patient would be able to move around quite freely, and technologies that permit measurements to be made on a continuous basis. It would also be possible. If critical values are passed, the sensors could be read remotely and medical personnel warned.

Ongoing control of bodily fluids

During the analytical process itself, sensors are capable of doing a great deal. Today, most blood sample is sent to major laboratories for analysis, a process that can take a great deal of time in many places. The scientists envisage that in the future, advanced analyses can be carried out in the doctor's surgery.

In close collaboration with Norchip AS, SINTEF scientists have made a great deal of progress in the development of analytical equipment that performs chemical and biological analyses of bodily fluids in the course of a few minutes. A doctor or nurse can place a biological sample on a credit card-sized plastic chip that acts as a microlaboratory.

The scientists have already found out how to get the little sample of fluid to flow and mix in the chip and have evaluated optical sensor technology in the analytical instrument that will read off the data from the chip. A reader of this type could be installed in every doctor's office, so that the doctor and the patient could obtain the results without delay. From a single drop of blood, even cholesterol and glucose levels could be analysed at home with the aid of such a "lab on a chip".

Growth industry

Biosensors, technology and ultrasound are thus capable of providing better diagnoses, treatments and utilisation of resources – not to mention improved working conditions. For this reason, many people believe that in the future, biosensor technology could be of even greater medical significance than antibiotics have been until today.

When persons whose health is seriously at risk can be monitored – whether continuously or at intervals – via biomedical sensors, the health services can be organised in quite a different way, and will be able to utilise their resources better. All the same, sensors will probably continue to play a supporting role in healthcare, and are unlikely to take over the role of doctors in any way.

The scientists are keeping their efforts focused on demonstrating that technology can provide improved, more efficient patient follow-up. "Technology can make this process faster, simpler and safer in the future," say Dag Ausen and Thomas Langø.

Adapted from materials provided by SINTEF, via AlphaGalileo.

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