The health care

A robot often makes one think of a machine with very human characteristics – a bit like C3PO from Star Wars or the no less charming WALL-E. But outside the film world, robots are hardly as colourful and charming. They can do amazing things – but it is not always easy to see

By Nadia Louise Kristensen

At a hospital in Kolding – a small town in Denmark – there is on one of the many long corridors, a black box containing something reminiscent of the bullet chamber of a revolver. On each side of the box is a pipe not much thicker than a garden hose. The parts constitute the Tempus 600 robot, a small revolution in the world of blood test collection. The revolving chamber is not designed to contain bullets, but blood sample tubes, which are shot down the pipe with a hissing sound at 7 metres per second, or 25 kilometres per hour. In just 43 seconds the tubes arrive in a metal tray at the haematology lab. Tempus 600 is still being tested to see if the blood samples are damaged by the high speed transit, but so far it appears that they are damaged more by being transported on a hospital trolley than by Tempus 600. When the robot is fully integrated, it will not be a person who retrieves the blood sample from the metal tray – everything will be automated so that the samples are automatically centrifuged and analysed, and the test results relayed to the digital screen of the relevant physician.

Robots reduce waiting time

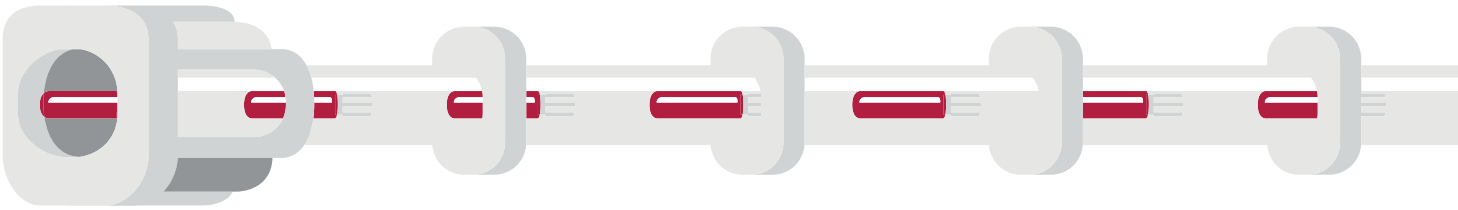
The revolutionary aspect is that the machine can reduce the time interval between a blood sample being taken and the doctor receiving the results from 3-5 hours to 30 minutes.

"Staff are expensive to run. When they transport something, it uses up time. They have coffee breaks or just chat to a colleague on the way. Robots are cheap to run and very reliable. If a person takes a blood sample and then delivers it, it can take a long time. The person must first collect a batch of 10 blood samples before delivering them. It can easily take an hour, and then at

Photo: Kolding Hospital

The revolving chamber of Tempus 600 is designed to contain blood sample tubes, not bullets.

system's WALL-E



least ten minutes to deliver the blood samples to the laboratory," says consultant Ivan Brandslund, who helped conceive the idea of the robot together with the Danish company FagTek Vacuum System A/S.

"A blood sample waiting on a table is a patient waiting in a bed. It costs money keeping a patient in a bed. The staff patient ratio is about 5:1, so you save money if you save patient waiting time. It is a question of reducing waiting time throughout the system. And there are limits to how much we can push people," says Ivan Brandslund.

FagTek Vacuum System A/S, which has developed the system, is noting great interest both in Denmark and from abroad.

"The interest is quite overwhelming. We have not yet started sales activity, but we have already been contacted by several major companies such as Abbott in Sweden, Norway and Switzerland, and Siemens in Denmark and the US. They are all interested to know if the Tempus 600 is really that easy to ope-rate. The other pneumatic transport systems on the market are complicated to operate. With Tempus 600 you just take the blood sample tube and put it in the hole, then you can go off and forget all about it," says Daniel Blak, director of FagTek Vacuum System A/S.

Designed for efficiency

At neighbouring Vejle Hospital, where Ivan Brandslund works as a consultant and laboratory manager, one can see how the hospital of the future can be formed both in terms of technology and the way in which the various wards are equipped. Previously, laboratories were scattered around the various hospital wards. Over time, these laboratories began using many of the same technologies to handle their work – technologies which are still very expensive. By bringing together all the laboratories in the same building, staff can share the use of equipment, which both reduces equipment costs and minimises the time spent going from one place to another.

It became the start of a new building, which several Danish experts in streamlining working procedures have declared to be so efficient that they cannot see anything that needs to improved.

"Part of what makes the building unique is that, right from the start, we put strong emphasis on flexibility, so that the interior layout can be adjusted. User requirements change over time, and so it is essential that the building can do likewise," says Niels Bøge of Søren Jensen Consulting Engineers, which helped plan the laboratory building.

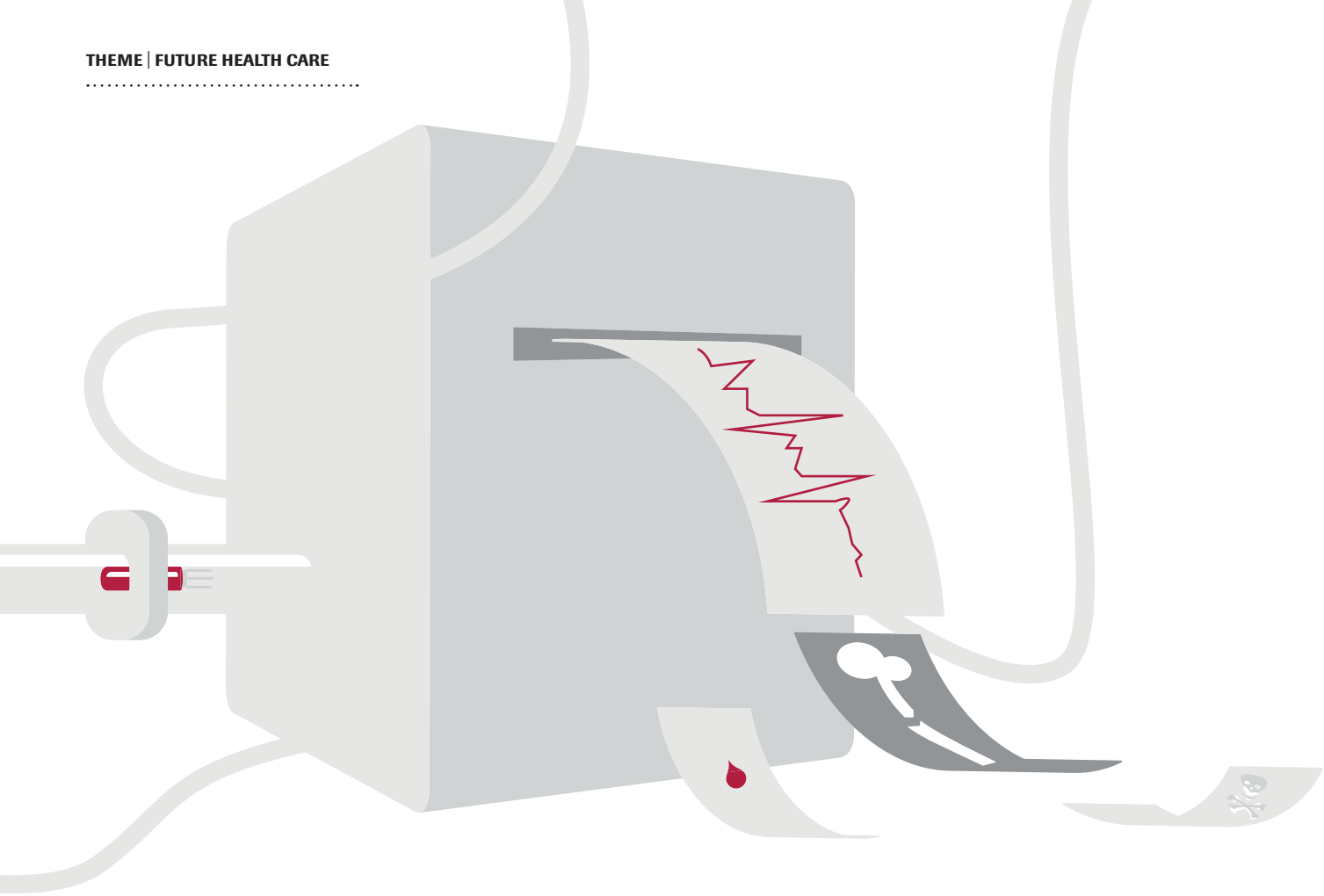
Vejle Hospital's laboratory building has served as a model for other hospitals, including Bergen in Norway, Santiago in Chile and Lund in Sweden.

The square building is five stories high, with the technical facilities housed in the centre.

"Having the technical facilities in the centre means that the distance to the places they serve is very short. This makes it easy to move installations when needs change," says Niels Bøge.

It is not only cheaper and more efficient to run the laboratory in this way. It also results in more research and collaboration.

"When heads of laboratories talk to each other, so do their specialist staff. There is competition between these specialities – but also a synergistic effect. The academic level, quality and research all went up after we moved together. To put this



in quantifiable terms, the number of articles we publish in international medical journals each year has risen from five or six to about 50," says Ivan Brandslund.

Robots are the future

A few years from now, patients admitted to Vejle Hospital will be the first in Denmark to have a blood sample taken by a robot called Roblood, developed in collaboration between the University of Southern Denmark, Vejle Hospital, the Danish Design School and others.

"There is great potential in robots. We can streamline a lot of processes and enhance quality. The robots will perform the simple activities, so that staff can use their time and resources to care for seriously ill patients. The net effect will be to provide a better service with the number of staff that are available. A comparison can be made with craftsmen: if they have a power screwdriver, they can increase their work rate and produce better work. With robots, we can improve our offering and provide services to more people if our healthcare and nursing services adopt the technology in the same way as craftsmen and ourselves," says Anders S. Sørensen, an associate professor at the University of Southern Denmark.

At present, 11-12 million blood samples are taken annually in Denmark, and each year the total increases by about seven percent. More diseases can be diagnosed by blood samples, and most treatments require that regular blood samples are taken. The pressure on staff is thus continuously increasing.

"Our goal is to develop a technology that can take the pressure off the haematology labs. The staff in outpatient clinics have more and more tasks to perform in the same period of time. They make the same movements day in, day out, which result in injuries to wrists and elbows," says Professor Sørensen, who is involved in the competence network RoboCluster, where educational institutions and private sector businesses are working together to create a new generation of robots.

The technical challenge is to create a robot with three-dimensional awareness. It must both be able to locate a vein, know where the needle is, and keep the patient from moving about or be able to change course if the position of the vein moves a little. This is what the University of Southern Denmark and Vejle Hospital have just started to test.

Professor Sørensen reckons that Roblood will be fully functional in 5-7 years.

Both at Vejle Hospital and the University of Southern Denmark, they believe that the future will bring variations of Roblood.

"Robot technology is becoming increasingly sophisticated. Over time, robots might be used for other things – for example inserting an intravenous drip. What is almost impossible is to get robots to perform functions where they need to take complex decisions. If there is a cup on a table, how should it be picked up without spilling it? It's easy if all cups are identical. The more well-defined the work the robot performs, the easier it is. Robots designed to show care, for example, are very difficult to develop because showing care involves a lot of information and many decisions," says Professor Sørensen. •