A black box, but then in the operating room.
Meet the digital surgical assistant Dora. TU Delft is developing the system together with hospitals and businesses in the province of Zuid-Holland.
“We can learn a lot from aviation.”
Jos Wassink
Dora is the ultimate Big Brother machine in the operating room. She monitors patients from the moment they come in. She films the operation, registers the instruments used and identifies the equipment. Big Sister doesn’t miss the patients’ privacy. Formerly enough, initial trials reveal that patients are less interested in their privacy than in correct and safe treatment. Staff, on the other hand, are worried about the operating room, so to speak, that an operation is in progress.

The patient has been in the corridor for an hour’ ‘Have you seen the coagulation machine’ ‘How much longer does Mother have to wait’

Just as with imperfect equipment, many hospital staff consider operation schedules running late an inevitable natural phenomenon. This does not apply for gynaecologist Prof. Frank Willem Jansen (LUMC) and information scientist Dr Laurena Bouarfa, who recently obtained her PhD. ‘Hospital planning systems are extremely basic’, Bouarfa concludes in her doctoral thesis Recognizing surgical patterns. ‘Practical data are not used to adjust the system and thus improve the efficiency of the system from the field.’ Jansen puts it slightly differently: ‘What we’d like to is a Sat Nav in the operating room, so to speak, that automatically monitors the progress of the operation and dynamically predicts how much longer it will take. A system like that would be a blessing for the wards and patients, who could see when it’s their turn by looking at a board. It could also alert the complex planning system and put an end to annoying phone calls because everyone could see who should be where.

However, automatically determining the stage of an operation is by no means simple. Doctor-researcher Mathis Bikkelaar (LUMC) explains how they plan to do this using a camera, light sensors and a microphone. The camera detects the blue cloth covers — indicating that an operation is in progress. The light sensors register coloured bands round the handles of the instruments used for the keyhole surgery, forceps, needle holder and scissors each have their own colour code. And the microphone registers bleeps that are specific to the use of a needle holder or coagulation forceps (to coagulate the blood). Based purely on the type of operation and basic patient data (age, weight, gender) a system developed by Bouarfa can predict the end time of an operation 12-18 minutes more accurately compared to the average duration. The add the signals from the camera, light sensor and microphone and predictions will be even more accurate, Bikkelaar explains. Trials during which Dora will run simultaneously with the operating room planning are due to begin in the middle of next year. These will reveal whether Dora predicts the duration of an operation more accurately than the current system.

The remaining 1700 cases are apparently not reported. ‘Doctors tend not to report mistakes for fear of legal action’, observes Frans Hiddema, CEO of the Rotterdam Eye Hospital. He would nevertheless prefer to have all operations video recorded. ‘Contrary to the aviation sector, where no stone is left unturned to find the cause of an accident, mistakes in the operating room are still often covered up. In this fairly closed culture people have grown used to the fact that equipment sometimes doesn’t work optimally and consider the fact that operations take longer than scheduled as inevitable as autumn rains. Dora is an attempt to improve through registration and transparency.

Checklist

The findings of the then trainee surgeon Dr Emiel Verdaasdonk were the starting point for the Dora project. In 2006 he had conducted an observation study into the practice of keyhole surgery to remove the gall bladder. In 86 percent of the operations there were one or more ‘incidents’ with medical equipment and in 45 percent of the operations equipment was unavailable or not set up properly. ‘If you asked the operating room staff about this, they hadn’t noticed anything’, explains head of the Dora research project Dr Johan van den Dobbelsteen, of the Biomechanical Engineering department of the Faculty of Mechanical, Maritime and Materials Engineering (Mmk). ‘They see that to incidents with equipment.’ Emiel Verdaasdonk compiled a checklist to be used before an operation commences to check that all equipment is available and in full working order. A tried and tested method applied in aviation. ‘Two minutes work for fifty percent fewer faults’, Van den Dobbelsteen summarises the effect of the list. ‘There was nevertheless some opposition to the checklist. Some felt it was for dummies while others felt there was nothing hi-tech about ticking off a checklist with a pencil. Was there no alternative?’

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An automated checklist is indeed under development in the Reinier de Graaf hospital in Delft. Clinical physicist Dr Jaap Bak is collaborating with TU researcher Annetje Guerdon (Mmk) and the company Double Sense to develop a system that uses radio frequency chips (RFIDs) to check whether all necessary equipment is available. For the purpose of the test a hundred pieces of equipment, including anaesthetic equipment, laparoscopy towers, lasers and pumps have been fitted with an active RFID the size of a pillbox. It contains a registration button, a motion detector and a red LED light. If the piece of equipment is moved the RFID transmits a presence signal which is received by the central system. This is how Dora knows which piece of equipment is where. All being well Dora should soon also know which operation is scheduled and which equipment is required. She also knows the maintenance status of all the equipment. Dora will only display a green light on the IPad on the wall if all the equipment present is in correct working order. ‘In theory, the operator is responsible for checking that the equipment is in correct working order’, Blik says, ‘but in practice he really doesn’t go round checking all the equipment and stickers himself. Now all he has to do is check whether Dora displays a green light?’ Reporting faults has also been much simplified and standardised.

The system was implemented in part of the hospital in October. ‘There were a hundred troubling problems’, Guerdon says smiling, ‘but at least it is being used.’ Asked when the implementation would be a success, they both answer: ‘When we receive lots of fault reports.’

Partner in the Dora project are the LUMC, Reinier de Graaf Group, Bronsre Hospital, Rotterdam Eye Hospital, TU Delft, Aytos, Sense IT, Jakus, NewCompliance, LogSense, MedCheck, Accorda, RFID Studio, Carely, LogMedical and Report. The total budget is 3.8 million euros over a period of two years. Half of this is to be funded by the partners, the other half by the province of Zuid-Holland.

Science

‘How much longer does Mother have to wait?’

In the Rotterdam Eye Hospital, it is not the duration of the treatment that varies as much as the patients’ waiting time. ‘One might be treated within five minutes while another has to wait an hour and a half to even be seen’ Safety & Quality advisor Dr Dirk de Korne says, summarising the problem. As measurement is the initial source of knowledge, the Eye Hospital has implemented a patient monitoring system. Upon arrival, every surgical patient (of which there are 14 thousand a year) is given a wristband with an RFID chip, which registers his or her location in the hospital. This enables family members accompanying the patients to see where they are (still in OR or has the operation finished?). Nurses can prepare their patients in good time, and many annoying telephone calls can be avoided. ‘Over the coming period, data analysis conducted by TU Delft researcher Dr Linda Wauben should reveal how waiting time can be made more uniform and reduced.’

Besides aiming to improve efficiency and patient safety, Dora also raises questions about protection of the privacy of both patients and practitioners. As was evident during the working conference on Improving Operation Processes at Yse- Daft on 27 September. The conference called for more transparency by means of systematic data collection; better analysis of the data collected and feedback of the findings to the practitioners. Director Hiddema (the Eye Hospital) expects more transparency in the OR to coincide with the emergence of a different kind of doctor: a team player rather than a soloist. Quality advisor De Korne does not expect more openness until surgeons have come to terms with fear claims or criminal proceedings. ‘The Dutch Public Prosecution Service wants to blame someone but, for us, the question is not who was wrong but what went wrong.’ Hiddema feels medics should follow the example of the aviation sector, which, in the event of an accident, gives priority to the Dutch Safety Board rather than criminal law.