

Joram Nauta – Dutch Centre for Health Assets; Edwina Doting – University Medical Centre Groningen; Frans Jaspers – University Medical Centre Groningen; Peter Schapp – Independent Project Manager and Researcher

Operating rooms of the future

Operating rooms (OR) are complex, yet fascinating places and are one of the most controlled and expensive built areas, being subject to a plethora of rules and standards concerning hygiene, safety and contamination risk. The OR is now facing many new challenges, and will have to meet very different standards in the coming years. Robotics, advanced surgery and a different perspective on healthcare will all have enormous consequences.

Other more philosophical questions also need to be considered. Should we, for example, still see the OR as the hospital's heart? Could we set up decentralised ORs? How can we make the OR complex more flexible, more patient-friendly and a more pleasant workplace for staff? What about the actual added value of all the OR technology? Does it enhance patient safety and does it substantially prevent infections, or could the same results be achieved by alternative means?

All these questions come at a time when many hospitals are on the verge of a renovation or renewal of their OR complexes. At the University Medical Centre Groningen (UMCG) in The Netherlands, for example, this was the reason to think about the OR's development, potential lay-out and design using a fresh perspective. What could be done differently, how could we design a better place that offers more comfort and better staff communication? In short, what does the operating room of the future look like? What is its place in the hospital of tomorrow? The aim was also to return to visualising the OR complex as a fully-fledged design assignment, not as a technical template. Even though many ORs are being built today to last for decades, the role of their design has been crowded out over the last 20 to 30 years.

The design of the workshop

The UMCG initiative took shape in a two-week workshop held in the Autumn of 2010 in collaboration with The Netherlands Organisation for Applied Scientific Research (TNO) which has a special group of experts to



help design and build programmes – the Dutch Centre for Health Assets.

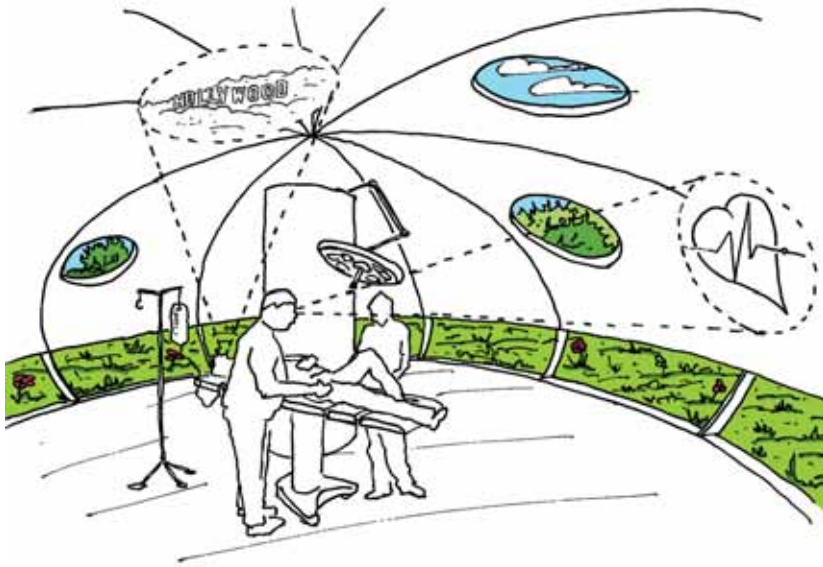
Seven interdisciplinary teams of designers, surgeons, anaesthesiologists, OR employees and other stakeholders from the OR complex studied the 'Operating Room of the Future' for two weeks, based on six assignments. Initially, the workshop focused on young (or young at heart) designers and OR professionals. This was because it is this generation that will be working on, or in, the future OR. In addition, the workshop did not want to be 'contaminated' with rusty ideas and the limiting knowledge of current standards, rules and norms. An 'open mind' as well as a willingness to question existing values with a fresh perspective was needed at the starting point of the workshop.

Six assignments were formulated that followed up on specific and topical OR themes. The decentralised OR was the topic of the first assignment, including the design of an OR in the field. The second assignment focused on the opposite – the OR as being the 'heart' of the hospital. The third assignment was based on the design of an optimally flexible OR. In the fourth assignment, participants were challenged to design a patient-friendly and clean OR. The fifth assignment focused on the route leading to the OR and finally, the sixth assignment inspired thinking through intelligent

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strategies for updating and renovating an OR complex.

Through an open call, designers with a background in architecture, interior design, product design and even urban development and landscape architecture were invited to participate. They could choose a certain assignment and thereby a team. Each team included medical professionals and 'hands-on' experts from the UMCG. Moreover, each team had a mentor who was responsible for progress during the workshop's two intensive weeks. In addition, a team of masters were available, consisting of Professor Michel Struys, MD, PhD (head of Anaesthesiology, UMCG), Roberto Traversari ICE (senior consultant/researcher TNO), Professor Ton Venhoeven B Sc, (architect/founder Venhoeven CS and Government Advisor on Infrastructure) and Professor Ivo Broeders, MD, PhD (University of Twente and surgeon



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at the Meander Medical Centre in Amersfoort).

The design teams followed a joint program of lectures, field visits and expert sessions. Each design team also conducted additional interviews and gained further experience based on the specific design assignment. Public lectures were held, as were conversation sessions and excursions to the new OR complexes at the Leeuwarden Medical Centre, the Groningen Martini Hospital, the VU Medical Centre and the Wilhelmina Children's Hospital (part of the Utrecht University Medical Centre). In addition, there were numerous activities held in the UMCG, including working visits to the Surgical Care Organisation, the Surgical Outpatients' Centre, the Hanze Clinic (private surgery centre), the Skillslab (skills centre for training surgeons) and the Central Sterilization Department. These activities were undertaken to ensure a broad picture of the context of the operating room was gained.

The design teams were asked to use the evidence-based design (EBD) step-by-step plan that was handed out prior to the workshop. This design methodology elicits a clear-cut formulation of the design challenges. The design teams were asked to formulate a design hypothesis and to determine outcomes that were the results of their design intervention. This may be common in the medical world, but is a relatively new phenomenon in the architectural profession. Using the design hypotheses, scientific literature is explored, designs are created and criteria are drafted to determine to what extent the design contributes to solving specific design challenges. The EBD's step-by-step plan has

had a visible influence on the development of various design problems, both in determining the objective and the design hypothesis, the use of scientific references, the development of the design itself and the ability to measure, if it were constructed, whether the design could have been a success. Making explicit where, in what way, and based on which insights the design could contribute to the assignment has not previously been executed by the majority of designers in this way.

Surprising results

To properly design such a specialised medical space is particularly difficult. Rarely will designers have been swamped in such a short time by so much new knowledge about a space that is no longer architecture's design. Their introduction to the operating room was often refreshing and led to sharp analyses and comparisons that could have only been made by 'outsiders'. On the other hand, the healthcare professionals were brought face to face with a refreshing voice from an entirely different discipline. In the beginning that might have been uncomfortable, and a common language was sought. Yet, at a certain point, it is clear that nearly every group transformed into a truly

interdisciplinary team. The results reflect the team's composition and the cooperation's solidity and show that interdisciplinary design can be valuable.

Despite the successful cooperation, those who are 'unwilling' could dismiss the workshop's results as being unrealistic, unattainable, or over-simplified. Indeed, some results may contain elements that are inconceivable in current practice and which might even be unrealistic for the future. However, the idea of the workshop was to go off the beaten track and explore new avenues; to try a different approach, to question the current practice and consciously shape the future. Looking at the assignments in this way, it is clear that they each contain elements that transcend the label 'nicely thought of' and do deserve further investigation and research.

Central versus decentralised

One aspect that emerged in many designs was the issue of central versus decentralised; even in the assignments that initially did not have this approach. There is an important task for the future there too. Suggestions included a special web of healthcare institutions and dedicated clinics with specific features; in addition to a high-tech hospital sharing the workload of the OR. It is also interesting to see how different teams connect logistics, costs and perceptions and thus go to the base of a good OR. Furthermore, the results frequently show that two weeks of study also led to the uncovering of very basic things that simply must be properly designed.

During the various lectures, tours, working visits and interviews the human element was often addressed. For patients and OR-staff, the ORs and OR complexes need to be pleasant to work and stay in and should facilitate good working conditions. Daylight is important, as are well-designed areas, a clear structure, enabling discipline and teamwork and need to include a place for staff to relax during breaks.

Finally, the designs contain several challenging examples and suggestions regarding the OR's shape and the use of materials that attempt not only to order, but also to reduce the multitude of materials, displays and other techniques that the OR has already mastered. Also, the alternative use of materials, can contribute to creating a pleasant space for the patient, the surgeon and staff; a space that is also easy to clean and answers questions regarding patient privacy.

Of course, there are still many issues for

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development and further interpretation and there are still things that have not specifically been addressed by this workshop. For example, how do we keep care accessible, both physically and for a wide audience? And how do we deal with the aging population? Are dedicated clinics enough for this, or should more be done? In addition, there is the challenge of including the workshop's outcomes in practical application. We all need to take on the good ideas presented by the workshop and implement them practically in real-life projects where possible.

The most valuable lessons lie not only in the physical results of the masterclass itself, but in the minds of all those that participated. Instead of a small technical team that usually prepares the design and construction of the new OR complex, the UMCG has chosen to prepare its organisation to participate in the design of their future working environment. This makes it more likely that real innovations and alternative options will be accepted with a greater degree of confidence than those proposed via a top-down vision from the board of directors. That is the real success of this masterclass, together with a publication that describes state of the art OR design theories and



constraints and widespread recognition for the pioneering work done.

Another lesson that has emerged is the idea that strategic decisions with regards to OR design must be taken early in the design phase. Making clear choices based not only on ambition but also on realism will help to create a clear and unambiguous program. The time when all operating theatres could be designed and equipped similarly to ensure full flexibility lie behind us; more differentiated ORs in different locations, in and outside the hospital, are likely to occur in the future. This will not only give more flexibility but also solve questions with regard to the lifecycle of the OR complex and its need for upgrading. The historical 'over-specification' of OR-complexes is based on avoidance of choices and conflicts and a reliance on technological advances. However, more technology and bigger spaces will

generally not help to reduce post-operative wound infections or miscommunication. Improved staff working conditions and training is likely to have a greater effect. What started out as a design challenge with a large technical component has, over a period of time, turned into a challenge to create the ideal working spaces for OR-staff and patients, to ensure patient safety and improving staff performance.

The results are published in an e-book which also contains a variety of essays concerning specific aspects of the OR, such as indoor air quality, patient safety in the OR and a complete historical overview of OR design history. It also contains original views on working conditions from an anthropological viewpoint – the need for human factors engineering. Information regarding the e-book can be found at www.oktoekomst.nl

Joram Nauta MSc

Joram Nauta MSc is a researcher/project manager at the Dutch Centre for Health Assets.

With a background as a civil and industrial engineer, he is interested in the match between building, patient and healthcare organisation. Besides contributing to the defining 'AU! Bouwen aan de architectuur van de zorg' (2007), he worked as an author and editor on the bilingual publication 'All Designers Use Evidence' (2008). He actively supports the innovation platform Architecture in Health (2005-2010). He worked for the Netherlands Board for Healthcare Institutions from 2003-2008 and since 2009 for TNO, which includes the Dutch Centre for Health Assets.



Frans C.A. Jaspers MA

Frans C.A. Jaspers MA studied Medicine and Hospital Sciences at Utrecht University. He worked as an internist and medical manager at the Slingeland Hospital in Doetinchem. He is a member of the executive board of the University Medical Centre Groningen (UMCG). He was the initiator of the conference The Architecture of Hospitals (2005) and the driving force behind several publications and related activities, focusing on putting healthcare and architecture on the agenda. He is also chairman of the steering committee Architecture in Health, a member of the jury of the Hedy d'Ancona Prize for outstanding healthcare architecture and chairman of the Thomassen à Thuessink Foundation.



M.H. Edwina Doting, MD PhD

M.H. Edwina Doting, MD PhD trained as a doctor at the University of Groningen (RuG) and the University Medical Centre Groningen (UMCG). In 1995 she won the Annual Award of the European Association for Cancer Education. Before her medical exams she conducted scientific research in Boston (USA). Following her degree she worked in the surgical department in Shrewsbury (UK) and in the UMCG as a trainee surgeon. In 2007 she obtained a medical sciences doctorate at the University of Groningen with a dissertation 'Sentinel lymph node biopsy in breast cancer and melanoma.' Since 1999 she has worked as an advisor to the executive board of the UMCG. Her areas of attention include the perioperative chain and the acute care.



Peter Michiel Schaap MA

Peter Michiel Schaap MA studied Art and Art Policy (KKB) and History of Art and Architecture at the University of Groningen. He works as an independent project manager, researcher and publicist/copywriter in the areas of architecture, urban architecture, urban culture and landscape. In 2005 he was project leader of the international conference 'The Architecture of Hospitals'. Afterwards he wrote about the relationship between healthcare and architecture. As an author and editor he was involved in publications such as 'AU! Bouwen aan de Architectuur van de Zorg' (2007) and 'All Designers Use Evidence' (2008).

