SIEMENS

Go HYBRID!

The magazine for decision makers in surgery

April 2014

Pioneering beyond departmental boundaries

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Dear Reader,

The integration of interventional and surgical techniques requires a new working environment for an interdisciplinary therapy team: the Hybrid Operating Room, where angiographic imaging capabilities are integrated into an operating suite. A deep understanding of the clinical applications, the current and future technology, and their implications on workflows is needed for a sound room design. That's why we developed Go HYBRID! – a magazine devoted to giving healthcare decision makers the necessary background information related to hybrid projects. Hybrid Operating Rooms are extremely complex working environments, where a large team of surgeons, interventionalists, nurses, anesthesiologists, and technicians need to work seamlessly together. The cooperation of all these players is important to make the Hybrid OR a success story. Frequent, clear, and comprehensive communication between all parties is vital. Go HYBRID! provides expert advice and aims to give you answers to the most important issues: What are the necessary steps for planning a Hybrid OR? Which major disciplines are practiced in a Hybrid OR? And: What are the most important elements to make the investment really pay off? Thank you to all supporters and contributors of the first issue of Go HYBRID!.

I'd like to recommend the interview on pages 17 to 19 to you. Prof. Dr. Dittmar Böckler is at the forefront of German vascular surgery and endovascular surgery and was one of the pioneers of 3D image-guided (T)EVAR, a technique for endovascular aneurysm repair that became possible only following the advent of hybrid environments. He sees enormous potential for surgical facilities where high-quality 3D imaging is provided in a sterile environment – and utilized beyond departmental boundaries.

So – enjoy the first issue of Go HYBRID!, the magazine for healthcare decision makers.

Prof. Dr. med. Georg Nollert
Director Global Marketing
Operating Room

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Experts from six major disciplines that use the Hybrid OR share their experiences.

The road to Hybrid OR is shown by our planning expert Prof. Clemens Bulitta.

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Pioneering beyond departmental boundaries

"At a personal level, I believe that maximum care facilities in the future will always need a Hybrid OR" – Prof. Dr. Dittmar Böckler, Medical Director of Vascular Surgery, Heidelberg University Hospital, sees enormous potential for surgical facilities where high-quality 3D imaging is provided in a sterile environment – and utilized beyond departmental boundaries.

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Regensburg: The flagship project

Right from the start, the managers in Regensburg considered the Hybrid OR project to be an investment in the future. Financial considerations initially were a lower priority. The most important thing was the idea that using this technology would maintain the hospital's appeal for both patients and employees – and in that respect it has fully paid off.

"If you have faith in something and include the employees from the outset, most things go well."

Dr. Andreas Kestler,
CEO,
The Hospital of the Order of St. John of God,
Regensburg, Germany

Watch the interview

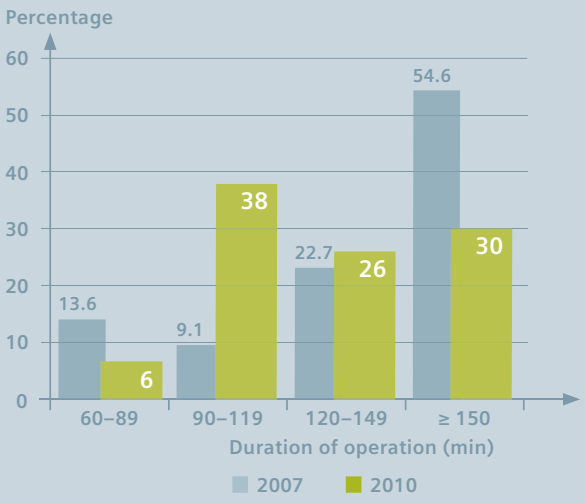
Dr. Andreas Kestler about the Hybrid Room as a marketing tool. Watch the full interview: www.siemens.com/hybrid-room-as-marketing-tool

Read the QR code with the QR code reader in your mobile!

The ability to use the Hybrid OR as a marketing tool in a competitive local setting – that was what Head Physician Prof. Markus Steinbauer and CEO Dr. Andreas Kestler had in mind when they decided in 2007 to set up the room at the Vascular Center Regensburg. *"Our decision to opt for a Hybrid OR was not primarily economic,"* remembers Kestler. He explains: *"We conceived of it from the outset as a flagship project – an investment in the future."*

And the flagship pointed the way for both patients and employees: Patient numbers are up and the Hybrid OR helps attract new employees. Steinbauer explains: *"The colleagues who apply for a position in vascular surgery will be trained in endovascular and open surgical techniques."* Kestler confirms that the room helps in maintaining the loyalty of committed specialists: *"All vascular surgeons are happy to be able to work with a machine such as this."*

At a glance:
Surgery time (minutes) for endovascular AAA therapy



Source: *The Hospital of the Order of St. John of God, Regensburg, based on data from BAA Qualitätssicherung DGG 2007-2010.*

"The new opportunities in endovascular surgery and hybrid surgery far exceed expectations and are dramatically improving the quality of our results."

Prof. Dr. Markus Steinbauer,
Medical Director/Head Physician Vascular Surgery,
The Hospital of the Order of St. John of God, Regensburg, Germany

Profitable in economic terms

The new room has brought about many changes at a practical level. For instance, the number of strainers by the table has been reduced, there are fewer general anesthetics, and there are now specialized nurses working solely in this new area, which is a special quality feature. The change in the workflow for emergency cases and the ability to perform diagnoses and treatment in the OR in real time helped bring down the time to treatment for emergency patients with critical ischemia.

The operation time in the Hybrid Operating Room is shorter compared to a normal OR (see graphic above) and the complication rate has been reduced compared to the rate before utilizing the Hybrid Room. Nonetheless, Kestler is certain that the Center is profiting in economic terms too: *"We have plenty of evidence that our day-to-day business has improved, because patient numbers, the quality of our results, and interdisciplinary cooperation have all picked up thanks to the establishment of the Hybrid OR and the resulting new workflows."*

Hospital portrait

- The Hospital of the Order of St. John of God is the largest Catholic hospital in Germany and teaching hospital of the University of Regensburg.
- It is certified according to the global quality standard DIN EN ISO, in conjunction with the ethical Christian quality certification "proCum Cert," which takes into account criteria such as social responsibility in the assessment of quality control.

Eksjö: A new way of thinking

You thought hybrid operating rooms were restricted to big city hospitals and internationally renowned healthcare centers? Think again! The county hospital in Eksjö, a small town in Sweden, benefits immensely from the advanced technology and medical opportunities a Hybrid OR offers.

"Firefighters need a modern fire truck with the latest technology to do a good job. And surgeons are like firefighters."

Hans Ravn,
General and vascular surgeon,
Head of the county hospital in Eksjö,
Sweden

Firefighters need a modern fire truck with the latest technology to do a good job. And surgeons are like firefighters. That's how Hans Ravn, Head of the county hospital in Eksjö, explained to local politicians why they should finance his new Hybrid OR. They understood – and handed him the truck keys right away. Now Eksjö has one of the largest and most modern Hybrid OR in Northern Europe. Ravn is sure of the significance of this acquisition: *"We are the forerunners of what you might call a new way of thinking."*

So why was it so important for you to build a Hybrid Operating Room?

HANS RAVN: There were a lot of reasons. One was that we want to keep our young doctors in the house and attract other young doctors to come to our hospital. The Hybrid Operating Room improves the situation for our county as well: We are able to keep very complex cases in-house and rather invite special surgeons to conduct operations in our OR. So the patients can stay in their home county.

20,000
citizens screened –
450
aneurysms found

What convinced the politicians to finance your operating room – the return on investment or the quality of patient care?

HANS RAVN: It was both, the care of the patients but also that we can make it more effective. Now we can treat more patients at the same time and with minimal invasive procedures. We can perform more operations on the same patient at the same time. So patients don't have to come in for one operation, then wait for two weeks and return for a new operation. We can do the whole procedure in one go.

You chose a Maquet operating table instead of an angio table. Why?

HANS RAVN: It was because the angio table was fixed only for vascular procedures. But when we conduct, for example, cholecystectomies, laparoscopic cholecystectomies, ERCPs, or trauma operations we need a normal operating table. The neurologist and the gynecologist have to be able to tilt the table so they can better approach their patients. So we need two different tables on the same top.

"We can now keep young doctors in the house, attract specialists, perform complex cases ourselves."

Höglandet Hospital Eksjö

Lasarettsvägen
575 81 Eksjö, Sweden

www.lj.se

So the room can be better utilized when you have a Hybrid Operating Room with a normal OR table?

HANS RAVN: Yes, we are able to use the Hybrid OR much more frequently when we are able to do standard procedures combined with some sort of radiation or all sorts of endoscopy operations. We need to be prepared for a range of possibilities.

And what are your plans for the future use of your Hybrid OR?

HANS RAVN: We plan to make the room available 24/7. We have to get a coordinator and educate a small number of persons for this highly specialized equipment. Then we will be prepared for all sorts of vascular problems around the clock. We will also use the Hybrid OR as a trauma room. We can take trauma patients directly to the Hybrid OR, perform diagnosis and treatment in one go, and get them to the intensive care unit afterwards.

Ravn and his colleagues already use the Hybrid OR to a great extent: They perform standard vascular stenting, PGA, infrarenal and fenestrated EVAR, branched grafting in the iliac area, different coiling procedures, and a combined operation of cholecystectomy and ERCP.

Besides that, Hans Ravn has initiated a large-scale aortic aneurysm screening. And it's worth it: *"With two or three saved lives, the whole screening program pays off,"* comments Ravn. So far, 20,000 citizens between 65 and 75 years old have been screened, and 450 aneurysms were found. When these measure 5.5 centimeters, they are operated on – more than 50% of them as EVAR in the Hybrid OR. A truly new way of thinking – and of patient care.

Hospital portrait

- The county hospital of Eksjö serves 115,000 citizens.
- Besides standard and emergency care, the hospital offers vascular surgery, upper GI surgery, urology, and gynecology.
- Specialized surgical procedures performed in the Hybrid OR include ERCPs, cholecystectomies and coilings of renal arteries, myomas, postpartum bleedings, upper GI bleedings, and aneurysms.

Hospital portrait

- The Nuremberg Hospital is one of the largest municipal hospitals in Europe, offering first-class diagnostic and therapeutic medicine.
- The cardiovascular center Herz-Gefäß-Zentrum, called HGZ, comprises three main clinics: for cardiology, for heart surgery, and for vascular surgery.

Nuremberg: The early bird

In recent years, Nuremberg Hospital made change to its range of services. One of the special disciplines is vascular surgery that serves a supraregional area. From the start, the decision makers attached great importance to an interdisciplinary orientation.

"We have an interest in always offering the latest technology and medical services at a time when these offerings have matured to the point that you can establish them as standard treatment," says Dr. Alfred Estelmann, Chairman of one of the largest municipal hospitals in Europe.

When Nuremberg welcomed a new chief physician Professor Dr. Eric Verhoeven, they changed their portfolio. *"We needed the facilities to make the workplace attractive,"* remembers Estelmann regarding his decision to put the Hybrid OR into operation. Today, he is sure: *"These two things together have led to the fact that we now have a sharp increase in the area of endovascular aortic surgery."* In his opinion, the HGZ has become more attractive for referred patients as the Hybrid OR has been embedded.

"We decided to integrate hybrid technology because at that time it was apparent that we could be overtaken in the metropolitan area if we didn't tackle things quickly."

Dr. Alfred Estelmann,
Chairman, Nuremberg Hospital, Germany

Watch the interview

Dr. Alfred Estelmann about new possibilities for using the Hybrid OR: www.siemens.com/new-disciplines

Read the QR code with the QR code reader in your mobile!

The portfolio changes – the team effort remains

Dr. Thomas Grüneberg, Manager Finance and Administration, explains: *"We basically have two teams there. One team is the heart team, where cardiologists and heart surgeons work together. And the other team is the vascular team, where vascular surgeons work with the interventional radiology department."*

Estelmann is sure that the investment in Hybrid Technology pays off, as there are several disciplines sharing the room already and new possibilities for using the Hybrid OR are being developed right now. Concerning the coworking of vascular surgeons, heart surgeons, cardiologists, and interventional radiologists, he has a strong vision: *"I'm curious whether the orthopedic department will want to use this technology in the future. I'm thinking for example of the major spinal interventions that are performed in our hospital as well."*

Well prepared for the future

Last but not least: There is a side effect resulting from the Hybrid Concept as an early bird. Thomas Grüneberg explains: *"It makes us quite interesting for others. We conduct regular workshops, especially in the field of vascular surgery, where we also use the Hybrid Room and show it in action."*

It goes without saying, that – sooner or later – the HGZ will reach its capacity limits. But Estelmann has a strategy: *"Then we will have to think about further Hybrid ORs. We have created the possibility of setting up another Hybrid OR at any time – in this respect we are well prepared for the future."*

"We basically have two teams there. One team is the heart team, where cardiologists and heart surgeons work together. And the other team is the vascular team, where vascular surgeons work with the interventional radiologists."

Dr. Thomas Grüneberg,
Manager Finance and Administration
Cardiovascular Center (HGZ),
Nuremberg Hospital, Germany

Watch the interview

Interdisciplinary orientation is important to Dr. Thomas Grüneberg: www.siemens.com/interdisciplinary-orientation

Read the QR code with the QR code reader in your mobile!

AGKAMED Essen: High tech demands high utilization

A Hybrid Operating Room can pay off perfectly at small and midsize facilities, given a handful of basic conditions: good planning, multidisciplinary use, and cross-departmental cooperation.

Project planning experts from the joint purchasing association AGKAMED Essen, Germany, share their experience.

"Run a feasibility study before you make a purchasing decision."

Adam Pawelek,
Head of the Purchasing Department,
joint purchasing association AGKAMED,
Essen, Germany

"It is obvious that a Hybrid OR can be utilized much more efficiently."

Dr. Oliver Gruendel,
CEO,
joint purchasing association AGKAMED,
Essen, Germany

Small and midsize hospitals pay special attention to the efficient utilization of their large medical devices. Consider the equipment in a Hybrid OR, for example: a fully equipped, highly sterile operating suite with a high-performance, latest-generation angiography system. The more economically these technologies are used, the faster the amortization. In Germany, hospitals facing the decision on whether or not to invest in a Hybrid OR find support at the joint purchasing association AGKAMED in Essen. The association optimizes strategic purchasing for clinics and provides services to help successfully and economically run a hospital's business. Dr. Oliver Gruendel, CEO of AGKAMED, confirms that its services are meeting the latest market demands: *"In the medical field today, we are seeing an increasing fusion of the technologies used for interventions and operations. That's why AGKAMED is getting involved with Hybrid Operating Rooms, where both technologies are integrated."*

Watch the interview

Careful planning is key, especially for smaller hospitals: www.siemens.com/small-hospitals-careful-planning

Read the QR code with the QR code reader in your mobile!

AGKAMED GmbH

Ruhrallee 175
45136 Essen

www.agkamed.de

Multiple disciplines, multiple benefits

Hybrid Suites enable and demand multidisciplinary use: Specialists like anesthetists, vascular surgeons, cardiac surgeons, cardiologists, and radiologists all perform examinations and therapies together in the same room. Bundling these technical and personnel resources triggers several positive effects: It broadens the treatment range, improves the quality of care, and increases safety. And if it's good for the patient, it's good for business – as Dr. Gruendel points out: *"The economic benefit of a Hybrid OR is that I can use the same space for interventions as for minor or moderately complex operations. This multifunctionality offers a better use of the room. If an intervention does not go as planned or complications arise, I always have the safety option to perform an operation right then and there."*

Check feasibility, gain certainty

Adam Pawelek, Head of the Purchasing Department at AGKAMED, has been involved in several Hybrid OR projects. He knows how important it is to ask the right questions right from the start: *"It's difficult at first for small and midsize hospitals to judge whether the investment in a Hybrid OR will pay off – especially given the multidisciplinary involvement this requires. You need to run a feasibility study before you make a purchasing decision."* Key questions within this study will be: What disciplines? What interventions? And how many per year? Dr. Gruendel sums up: *"You first need to take a careful look at what procedures you intend to perform in a Hybrid OR. But once you've developed your detailed plan, a Hybrid OR can obviously be utilized much more efficiently than a regular OR, an interventional treatment room, or an interventional lab."*

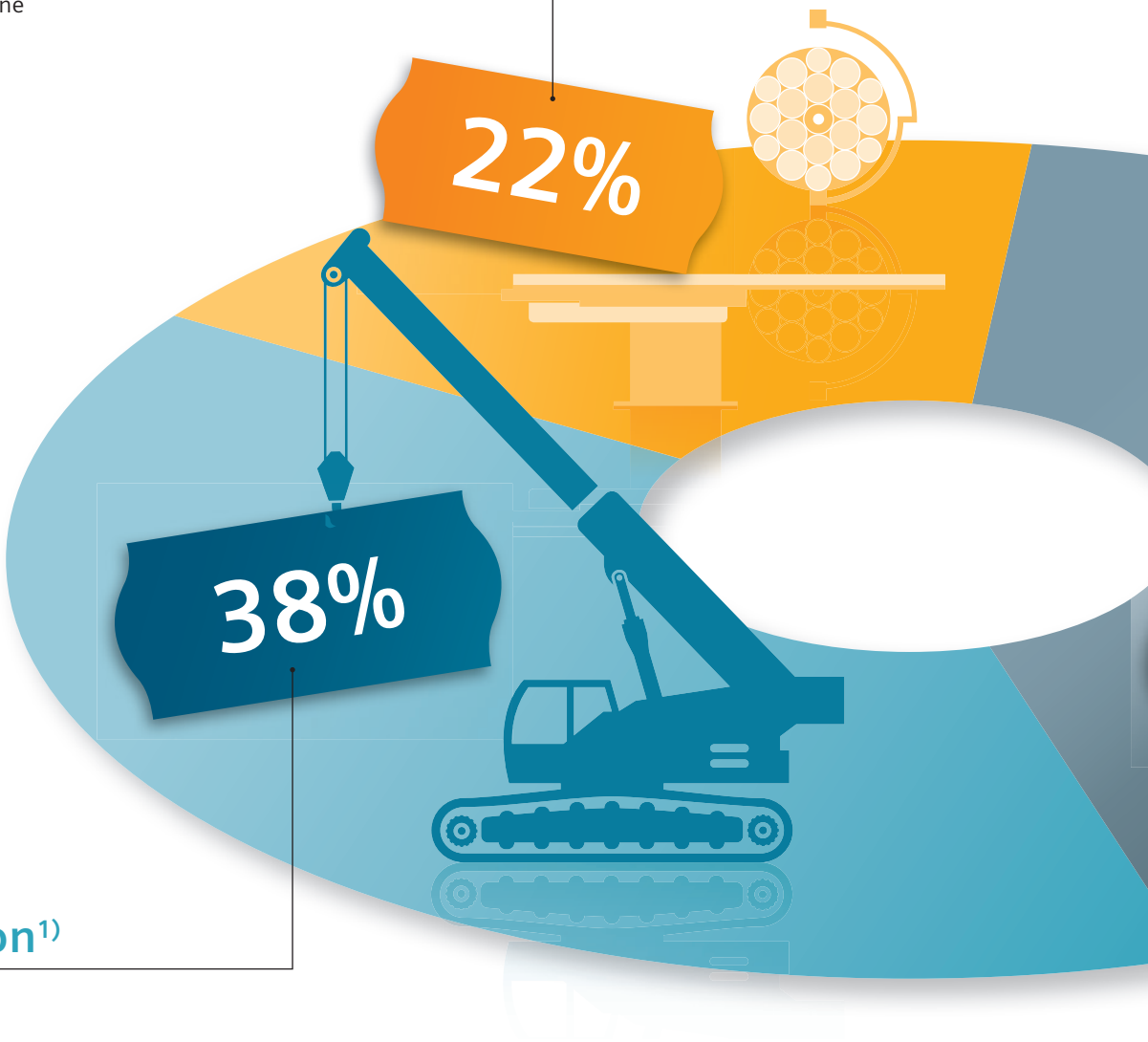
Company profile

- AGKAMED is a group purchasing organization in Essen, Germany, acting as a competent interface between hospitals and the industry.
- The group, founded in 1993, supports more than 160 clinics in process optimization, in the execution of capital investment projects, and in strategic purchasing.
- AGKAMED's major objective is the economic streamlining of purchasing management, resulting in a sustainable reduction of costs for its fellow members.

How much does a Hybrid OR really cost?

General equipment[1)]

- Heart and lung machine
- Integrated booms
- Radiolucent tables[3)]
- Further equipment



Construction[1)]

- Ceiling reinforcement
- Lead shielding
- HVAC
- Plumbing
- Cabinets/room storage
- Cost for space
- Demolition and miscellaneous construction

1) Advisory_Board_Financial_Aspects_of_building_a_hybrid_OR-Advisory_Board_Company-copyright.pdf
2) Siemens AG 3) Maquet Holding B.V. & Co. KG

The key difference between a hybrid and a conventional surgical environment, especially from a financial perspective, is the angiography system. Our cost breakdown shows that a Hybrid OR, sometimes labeled a luxury toy, isn't unobtainable: Investing in a high-quality imaging system makes the space multifunctional.

Imaging equipment[2)]

› Angiography

Starting points

Setting up a Hybrid OR is still a huge investment. To help you avoid any unnecessary risk, Siemens has a team of contact people to deal with all questions relating to strategy, planning, financing, and technology. We present the three main starting points below.

Imaging equipment implementation service

Imaging is the largest cost factor when it comes to installing a Hybrid OR, at around 40% of the total. This is where comprehensive consulting and support from an experienced partner are essential.

Management consulting

Strategy consulting, economic efficiency analyses, recommendations – the decision to invest or not to invest in a Hybrid Operating Room must be well thought through. Siemens will support you in this process.

Financial services

Long-term calculations, individual leasing or financing models, and the discussion of possible debt models are all part of the financial services offered by Siemens.

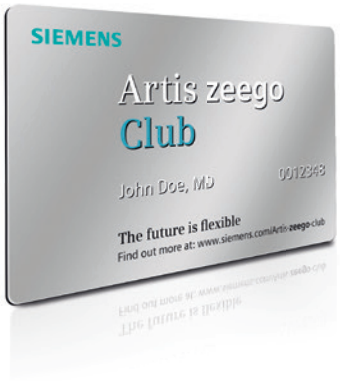
Contact

Do not hesitate to ask us for, should you need further information or assistance on your Hybrid project.

Our experts will provide you with special knowledge and effective support.

gohybrid@siemens.com

Artis zeego – invented for operating rooms



There's never been anything like the Artis zeego. The unique multiple-axis design of Artis zeego enables unparalleled positioning flexibility and makes it the optimal imaging system for Hybrid Operating Rooms.

Artis zeego meets the highest hygienic standards in the OR – allowing laminar air flow and maintaining sterility requirements even in imaging position. The imaging system can be integrated with several OR-tables that allows the utilization of the room not only for endovascular procedures, but also for surgical disciplines where complex patient positioning with a segmented tabletop is required – such as in spine and neurosurgery. Thanks to its unique variable isocenter, the OR table and the C-arm can be adjusted to a comfortable working height. Flexible parking positions provide surgeons with ample work space around the table when imaging is not required or when conversions are necessary in emergency situations. 3D imaged guidance plays a more and more important role in minimally invasive surgery.

Artis zeego allows intraprocedural 3D imaging in high quality from right, left, and head side. This makes the Artis zeego a perfect fit for all multidisciplinary Hybrid Operating Rooms.

Discover Artis zeego

Artis zeego brings unmatched flexibility to the Hybrid Room: www.siemens.com/zeego-flexibility

Read the QR code with the QR code reader in your mobile!

Join the Artis zeego Club

Be the first to know why Artis zeego redefines flexibility with one-of-a-kind robotics to allow users extraordinary versatility. Unparalleled applications such as *syngo* DynaCT 360 add to the unique advantages customers receive along with exclusive privileges offered by membership in the Artis zeego Club.

Dedicated Artis zeego team
Receive privileged advice and assistance.

Knowledge base
Access dedicated technical and clinical knowledge.

Complimentary software updates*
Stay on the cutting edge.

Artis zeego user forum
Network with other users, share insights and learn from each other.

Journal Club
Stay on top of your changing world with news from Siemens.

** Service hours and application training not included*

The Hybrid trend is not a suppliers' trend

What do you see as the potential of Hybrid ORs?

MARKUS MEDART: The potential and opportunities deriving from Hybrid ORs reach far beyond heart surgery, which is where the trend started. The term hybrid, as I understand it, implies all intraoperative diagnostics enabled by imaging technology. In addition to Hybrid ORs becoming accessible to more and more clinical disciplines like traumatology and neurosurgery, there are also possible approaches with CT and MRT systems.

Why does a Hybrid OR need a full-fledged OR table?

MARKUS MEDART: It doesn't just require an OR table; it needs a specific OR table system consisting of OR column, exchangeable tabletop system, and the corresponding transporters. Thanks to the exchangeable tops, the OR table can be utilized efficiently and in specific ways depending on the application. You can, for example, use the carbon fiber tabletop for 360° fluoroscopy and switch immediately for the subsequent intervention to a segmented tabletop for optimal patient positioning. This allows great flexibility and short turnaround times.

How much integration is needed between imaging and OR equipment?

MARKUS MEDART: I believe that integrating OR equipment with imaging devices and having them work together intelligently provides tremendous benefits and support for the user, because there is no need to coordinate the systems over and over again – this is performed by the software and the mechanics. Risk avoidance through collision prevention also makes this integration essential for an optimal operation.

"The hybrid trend is not a suppliers' trend: It was the users who approached equipment manufacturers with their requirements."

Markus Medart,
President of the Surgical Workplaces Department, is responsible for everything related to operating room equipment at Maquet in Germany.

Why is the combination of Artis zeego with a table from Maquet such a recommendable solution?

MARKUS MEDART: A Hybrid Room's potential can only be fully exploited when there has been good consulting throughout the planning stage. So it's not just the table or the Artis zeego but also the collaboration with specialists when equipping the room that is essential for the customer. With their leading role in this hybrid trend, Maquet and Siemens in my opinion offer perfect support as well as an optimal solution. What also helps is that products like the Magnus OR table and Artis zeego have already long proven themselves on the market as high-quality systems.

Showroom Maquet

Surgical Workplaces
Rastatt, Germany

www.maquet.com

Minimally invasive myths

There are many prejudices against Hybrid ORs, and most of them have long since become outdated. These are the three most persistent.

1 Are Hybrid Operating Rooms empty most of the time?

This favorite "hybrid myth" can be countered by two facts: First, demographic change means there are more and more patients for whom conventional treatment for cardiovascular diseases can no longer be considered on account of their age and comorbodities. According to the UN, people over 60 years of age will account for over a third of the world's population by 2050. The growing number of screening options and programs also ensures constant growth in the volume of treatments. Moreover, Hybrid Operating Rooms fitted with a conventional operating table can also be used at a multidisciplinary level for conventional open or minimally invasive operations, such as in orthopedics or neurosurgery. The experience from Nuremberg, Heidelberg, and Bad Krozingen also shows how little credence we should give to the accusation of insufficient capacity utilization when we look at the question more closely: The Hybrid Rooms installed there quite recently are already not adequate to meet demand, and a second one is needed at all these locations.

2 Are Hybrid Operating Rooms too expensive?

Setting up a Hybrid Operating Room does not come cheap. Figures published by consulting companies show that hospitals have to invest some $3–4 million to convert an existing operating room into a hybrid unit that can be used for multiple disciplines. The imaging system accounts for a major part of the cost. Compared to a new operating room with a new state-of-the-art mobile C-arm system, which is not suitable for many types of complex treatment, the additional investment costs for a fixed imaging system will be 20 to 40% of the whole investment. So – more costly? Yes! Too costly? That's a matter of opinion.

3 Are Hybrid Operating Rooms only required in large university centers?

The standard approach for new medical procedures and devices is to start with research institutes and universities, before comprehensively incorporating them into everyday practice and hospital use. The objection that hybrid treatment methods are not yet well established is weakened by simply checking the procedures normally performed in a Hybrid OR against the guidelines of various medical societies: Thus, for instance, there are now clear recommendations in more and more countries, issued by entities such as the American Association of Thoracic Surgery, that the use of mobile C-arm imaging systems is not adequate for vascular heart disease surgical programs, for example transcatheter aortic valve replacements (TAVI) .

"At a personal level, I believe that maximum care facilities in the future will always need a Hybrid OR."

Prof. Dr. Dittmar **Böckler,**
Medical Director Vascular Surgery,
Heidelberg University Hospital, Germany

Pioneering beyond departmental boundaries

Driven by cardiac and vascular surgery requirements, hospitals across Europe are at a crossroads: invest in a Hybrid OR – or not? And can Hybrid Rooms really pay off? Prof. Dr. Dittmar Böckler knows the answers. He is at the forefront of German vascular surgery and endovascular surgery and was one of the pioneers of 3D image-guided (T)EVAR, a technique for endovascular aneurysm repair that became possible only following the advent of hybrid environments.

Prof. Dr. Dittmar Böckler sees enormous potential for surgical facilities where high-quality 3D imaging is provided in a sterile environment – and utilized beyond departmental boundaries.

Could you give us an insight into vascular surgery here at the Heidelberg University Hospital?

D. BÖCKLER: Heidelberg is the cradle of vascular surgery in Germany. This is where the first EVAR and (T)EVAR procedures in Germany were performed in 1994. That makes it a special place. There is an element of pleasure in taking the subject forward. To succeed, you need a philosophy, a strategy, a vision and the opportunity to establish international contacts. Together with our team and our research partners, we are aiming for a place among the top three in vascular surgery in Germany.

What part will technology play in the process?

D. BÖCKLER: Technology plays an extremely important role. When it comes to invasive therapy, everything is highly technologized, from imaging to materials engineering. And, of course, all of this revolutionizes medicine. For us, however, the Hybrid OR was a quantum leap. Endovascular procedures are meanwhile used for 70–80 percent of all vascular diseases. I therefore had to have a Hybrid OR. We can now use new endovascular methods that would have been impossible without top-level imaging – for instance, procedures involving the endovascular treatment of carotid artery or fenestrated and branched stent grafting in aortic aneurysms.

What has the establishment of the Hybrid OR changed in this regard?

D. BÖCKLER: Putting it simply, imaging has broadened the range of treatments that we can offer and simultaneously increased patient safety. We can now provide more innovative medicine for more patients – for instance those who would previously have been turned down because they were too ill to undergo open surgery. Expressed in figures, our performance is up at least 10 percent. But there is much more to it than that: the way we manage complications has improved, because we can respond more directly in the operating room. Procedures have become faster because we can operate everything ourselves using a joystick to move the Artis zeego. We need lower dose of radiation and less contrast agent – which is quite important, because about one patient in three suffers from renal insufficiency. The Hybrid OR has therefore catapulted us forward in many areas. At a personal level, I believe that maximum care facilities in the future will always need a Hybrid OR.

What are the most important tips you can offer for planning a Hybrid OR?

D. BÖCKLER: Space, space, space (like more than 80 m²)! And – set up a small lecture room with video transmission from the Hybrid OR to enable students and guest physicians to observe the procedures without radiation exposure. The effect on learning is huge. The design should also take the aspects of nurse care and anesthesia into consideration from the outset. In general terms, we should be looking to the future right now. Think about what could be standard in ten years and invest a little more. Ultimately, a room of this type should be in use for many years.

How does the Hybrid OR score for radiological protection?

D. BÖCKLER: Working together with Eric Verhoeven of Nuremberg, we have initiated a radiation dose study. We wanted to record how patients and employees are exposed to radiation in a Hybrid OR. We expect results and will publish the figures soon. I can let one secret out already: we need less radiation in the Hybrid OR for complex procedures. The time of exposure is shorter and, most importantly, we have better radiation protection measures in place.

What is the current role of 3D imaging in the OR?

D. BÖCKLER: Surgeons can work with much greater accuracy when they can see where they are working in 3D rather than 2D. Now we really have reached the point where fusion imaging takes three-dimensionality to the screen. But 3D imaging is also

important during the preoperative stage, when the highest-quality 3D imaging is crucial for taking measurements and planning. It is important that the 3D images taken before the procedure are available to guide the deployment of the endovascular device. When 3D imaging is available to check precise positioning during the actual procedure, you could not wish for a better imaging system in an operating room.

For which disciplines could Hybrid ORs be of interest in the future?

D. BÖCKLER: We – vascular surgeons – have very quickly acclimatized to the system and our use of the Hybrid Room is running at more than 90 percent. We also share the facility with cardiac surgeons. Urology and visceral surgery are now also starting to realize the potential it offers, and three Hybrid Rooms are currently being constructed in the in the new surgical department planed for 2017 of the University Hospital Heidelberg. I consider that the Hybrid OR can be used wherever there is a need to minimize the scalpel traces you leave behind. In neurosurgery, for instance. Pediatric surgery would be another possibility. Likewise traumatology and cancer surgery.

What will the (endo-)vascular surgeons of the future be able to achieve?

D. BÖCKLER: They will have to be multiskilled – capable of performing both conventional open and endovascular surgery. I am convinced that patients will get the best treatment from a team that can offer all options: open, endovascular including conversions as well as complication management. Within this team, however, the vascular surgeon will always play a major role. Our key phrase is "disease-based treatment by vascular specialists". Nonetheless, it is a philosophy that needs to grow. These days, we as vascular surgeons enjoy close cooperation between interventional radiology, angiology and heart surgery here in Heidelberg in particular. We discuss indications of complex arch and thoracoabdominal aortic pathologies together and even operate together. But there is still room to bring down those old traditional psychological barriers further.

And what will the technology of the future be able to achieve?

D. BÖCKLER: I can imagine software-supported vascular surgery performed by robots with a learning function in the near future. In other words, a computer that is capable of learning and automatically saves unnecessary steps next time around. We already have simulators, we have three-dimensional imaging, we have robots in the OR and of course, we have experienced surgeons … now we just need to bring all of these elements together. In the near future we may have an (endo-)vascular navigation system of the type we are familiar with in automobiles. You might say, "I would like to get to the aortic arch. I have this stent graft, I have this individual patient anatomy, etc." I can find out from the navigation device how long I will need to get to my destination and what the best route is and how to "park". If I can simulate all of that in advance, then I have the perfect operation. In the medium term, we may find ourselves working with a sort of "Google glasses," a miniature computer mounted on a spectacle frame that projects information into the field of vision. This information can be combined with the recorded image supplied live by a digital camera incorporated in my line of sight. In my perspective, that would be revolutionary!

How can these visions be reconciled with the need to remain cost-effective?

D. BÖCKLER: Education and health are the supreme assets of a society. Remaining cost-effective cannot always be top priority. Our administrative director believed in my vision and knows that a university like Heidelberg has to be a lighthouse for innovation in medicine. Now – four years after the implementation of a Hybrid OR – we will evaluate whether our Hybrid OR really does pay for itself. I suppose that it will pay off in the long term. Not every vision benefits from an opportunity such as this, however. In general, financing future-oriented research is a major challenge.

Hospital portrait

Heidelberg University Hospital is one of Germany's largest medical centers. The Department of Vascular and Endovascular Surgery has treated patients with acute and chronic arterial disease including venous disease for more than 25 years, with a focus on treating carotid artery stenoses, aortic aneurysms and peripheral arterial occlusive disease (PAOD).

It has been a trailblazer in the field of transcatheter, minimally invasive endovascular surgery since 1994.

The 6 major disciplines

Cardiac surgery

"Because of the sterile environment, potentially all open cardiac and vascular procedures can be performed in a modern Hybrid OR. To date, we did not see any wound infection after a sternotomy or minithoracotomy."

Dr. Ardawan J. Rastan,
Director of Cardiac Surgery, Herz- und Kreislaufzentrum,
Rotenburg a.d. Fulda, Germany

In Rastan's opinion, one major advantage for minimally invasive CABG procedures is the ability to easily perform angiogram of the mammary bypass grafts to control patency early and, if indicated, to perform concomitant PCI procedures in multivessel coronary artery disease. Several other hybrid concepts will be possible in the future. Since establishing the TAVI program in parallel, an increase in conventional aortic valve procedures of 35% from 2011 to 2013 was seen at his institution.

Neurosurgery

"Spine surgery is greatly improved with reduced stress and increased precision. The workflow is speeded up, the quality is increased and demonstrated preoperatively, the outcome is so far without any surprise."

Prof. Dr. Christian Raftopoulos,
Head of the Department of Neurosurgery, Saint-Luc University Hospital,
Brussels, Belgium

Christian Raftopoulos has been Head of the Department of Neurosurgery at the Saint-Luc University Hospital since 1996. He shares an Artis zeego with the cardiovascular department and treats spinal fusion cases once every other week in this Hybrid Operating Room.

Orthopedic procedures

"In orthotrauma the biggest advantage is image size and quality, especially in pelvis and spine cases. In large-joint fractures the 3D capability is very useful. The integration of navigation introduces new MIS approaches, techniques, and workflows."

Prof. Dr. Florian Gebhard,
Director and Chair, Department for Orthopedic Trauma, Vice Dean Faculty of Medicine,
Ulm, Germany

Orthotrauma cases depend on injuries that are not predictable, but Florian Gebhard and his team see an increase in diagnosed cases that can be treated in the Hybrid OR (secondary referrals): on average, currently six cases per week.

What are the benefits of hybrid technology? What effect does it have on workflow and on results of treatment? How will the opportunities to use it further evolve? Experts from six major disciplines that use the Hybrid OR share their experiences.

Thoracic surgery

"An additional use of the Hybrid Operating Room in thoracic surgery resulted from the idea to mark pulmonary nodules under fluoroscopy and then remove them with the VATS technique. This method is applied if there are nodules in the parenchyma that cannot be removed without marking."

Dr. med. Helmut Isringhaus,
Medical Director, SHG-Kliniken Völklingen, Germany

The Hybrid OR was originally established for TAVI. After implementation in cardiac surgery, we began with vascular surgery. This department primarily focuses on endovascular, hence, the presence of a Hybrid OR is indispensable. The result is that many surgical disciplines of the SHG clinic use the interesting new possibilities of the Hybrid OR. Thus, the OR is well utilized and works economically.

Vascular surgery

"In our opinion, it is not recommended to perform more complex fenestrated procedures and branched stent-grafting for TAAA without a Hybrid OR."

Prof. Dr. Eric Verhoeven,
Director of Vascular Surgery, Nuremberg Hospital, Germany

The evolution of endovascular techniques has led to the concept of the Hybrid Operating Room that offers high-quality imaging in the sterile environment of an operating theater. In the United Kingdom, guidelines have already been published that require a Hybrid OR even for normal endovascular management of the infrarenal aorta.

Trauma surgery

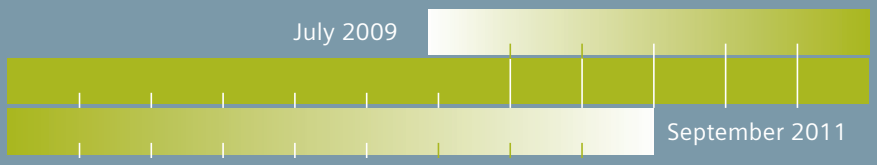
"Hybrid Operating Rooms are important in trauma. Patients who are hemodynamically unstable with a pelvic fracture and no obvious site of hemorrhage are sent to the Raptor Hybrid suite for interventional radiology and possible pelvic embolization, avoiding laparotomy."

Glen Schlaphoff,
Director of Radiology, Liverpool Hospital, Sydney, Australia

Blunt trauma is the most frequent presentation to Liverpool Hospitals' trauma unit. The team has defined trauma guidelines to manage the workflow. If there is significant bleeding, surgery and interventional techniques can be used simultaneously. This has simplified the patients' journey and improved the time to definitive care.

Go HYBRID! – facts & figures

2¼ years



... How long it should take for the two Hybrid Operating Rooms built for the Cleveland Clinic in 2009 to pay for themselves. This was the conclusion reached by Gina M. Cronin, Administrator, Heart and Vascular Institute at the Cleveland Clinic, in a presentation given in May 2010. In her view, the key success factor is the fact that, as an "early adopter", the Cleveland Clinic quickly gained a reputation as a national center of excellence.

Source: "Financial Aspects – Hybrid Operating Rooms", G. M. Cronin, 2010 http://webcast.aats.org/2010/presentations/27B.03-1.pdf

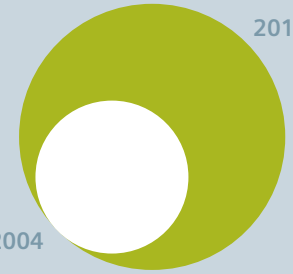
284.6%

... The estimated return on the Hybrid Operating Room at the St. Vincent Heart Center of Indiana (installed in 2009) by 2015. This was the result obtained by Chief Operating Officer Michael Schroyer in a pro-forma account that he submitted to the annual meeting of the American Association of Thoracic Surgery in Toronto in 2010. Despite the high procurement and running costs of the new room, the increase in patient throughput makes this impressive figure possible: In the first year alone, the Hybrid OR at St. Vincent resulted in some 150 additional discharges.

ESTIMATED RETURN

The associated patient revenue came to US$6.2 million, with a profit of US$1.6 million following deduction of all outgoings.

Source: "Financial aspects of building a Hybrid operating suite," in: American Association for Thoracic Surgery, 90th Annual Meeting M. Schroyer, 2010 http://webcast.aats.org/2010/presentations/27B.03-2.pdf



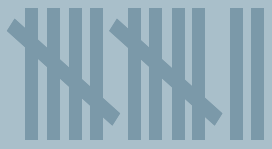
+74%

...The increase in thoracic aorta operations recorded by the Essen University Hospital between 2004 and 2012, after installing a Hybrid Operating Room. Most of the patients operated on during this period had previously been treated somewhere else, but in the meantime Essen had grown to be the emergency center for urgent care in the region.

Source: "Hybrid-Operationssaal", in: "Rapid Assessment no. 06", Ludwig Boltzmann Institut, ISSN-online: 1996-9368, 2013 http://eprints.hta.lbg.ac.at/995/1/Rapid_Assesssment_006.pdf

Results like these show clearly how your investment in a Hybrid OR can pay off.

Discover other success stories on pages 4–15.



12 DAYS

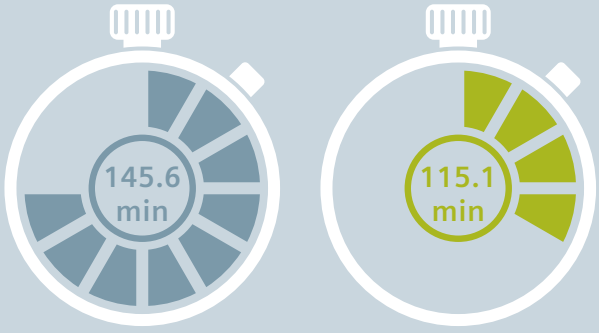
Conventional

5 DAYS

Hybrid

... The average period of admission following stent-graft implantation performed in a Hybrid OR. Conversely, aortic surgery requires an average admission period of 12 days, including five days in Intensive Care. At about € 32,000, the costs of stent-graft implantation are markedly higher than those of conventional treatment, which come to about € 19,500. However, the bottom line shows a cost advantage of about € 12,500 in favor of endovascular surgery when the total stay in hospital is considered, including treatment.

Source: *"Abdominal and thoracic aorta surgery" – Part 2, Rückert / Hepp / Luther, ISBN 978-3-642-11718-3, 2011*



OR/C-arm

Hybrid

30 min

SHORTER OPERATION TIME

...and 28% less contrast dose and 13% fewer EVAR components. Efficiency and safety both are significantly improved with the utilization of a Hybrid Room. Vinit Varu, J.I. Greenberg, and Jason T. Lee from the Division of Vascular Surgery at Stanford University Medical Center published these results in 2013. The ongoing collaboration of the Division has promoted remarkable academic and clinical productivity involving new and dramatically improved techniques for the diagnosis and treatment of vascular disease, gaining the Division international recognition as a Vascular Center of Excellence.

Source: *European Journal of Vascular and Endovascular Surgery, Volume 46, issue 6, p. 675-679 December/2013, www.vascular.stanford.edu*

... The highest possible hygiene class for operating rooms.

This presupposes that the requirements in terms of ambient air set down in DIN 1946-4 are fully satisfied – a major hurdle for Hybrid Operating Rooms. With a ceiling-mounted angiography system the prescribed low-turbulence displacement flows in the air can be guaranteed only when it is in the parked position. In operation, the device runs on ceiling-mounted rails to the operating table, which impairs the laminar airflow. However, the Saar Heart Center proved for the first time in 2012 that it was possible to maintain hygiene class 1a in the Hybrid OR and during minimally invasive surgery – using a floor-mounted Artis zeego from Siemens.

Source:
"SHG Clinics in Saarland aim at top hygiene standard in the Hybrid OR", Innovations Report, http://www.innovations-report.de/html/berichte/medizin_gesundheit/saarlaendische_shg_kliniken_setzen_hybrid_op_201121.html, 2012

Quality facts like these have a significant impact – even on your processes and outcomes!

Find out more on pages 24–27.

Quality up!

The Hybrid OR can bring first-class quality in terms of processes, outcomes, and structures to your hospital. These examples are about the changes in emergency case workflows, about the accuracy of pedical screw placement, and many other enhancements that may accompany your decision for a Hybrid Room.

Process quality

The Vascular Surgery Clinic at the Hospital of the Order of St. John of God, Regensburg, has undergone a complete paradigm shift in the patient-centered care of aortic diseases with the implementation of a Hybrid Operating Room.

Emergency patients with ruptured aortic aneurysms in particular are benefiting from the new concept, which enables faster and safer treatment. The Hybrid OR at the hospital is dedicated entirely to vascular surgery, and can be used every hour of every day. This OR has achieved the highest standard of hygiene (room class 1a), which allows open surgical procedures to be performed. After initial diagnosis and stabilization in the emergency unit, patients with ruptured aortic aneurysms are taken directly to the Hybrid OR. Intraprocedural 3D imaging helps the surgeon make the decision for endovascular or open surgical procedures. Both can be performed immediately in the Hybrid OR with the highest quality imaging and hygienic standards.

Ultimately, the OR saves lives – the result has been a dramatic decrease in time-to-surgery and mortality in critically ill patients.

In short:

The positive change in the emergency case workflow and the opportunity to decide for the optimal treatment based on intraprocedural 3D imaging has led to a significant decrease in mortality in time-critical emergency cases at the Regensburg facility. In the longer term, it has also resulted in a substantial increase in patient numbers.

Watch the video

A room for faster and safer treatment: www.siemens.com/faster-and-safer-treatment

Read the QR code with the QR code reader in your mobile!

Source:
Chirurg 2013 | 84:1030–1035 M. Steinbauer, A. Katsargyris, M. Greindl, I. Töpel, E. Verhoeven: Hybridoperationssaal in der Gefäßchirurgie, Möglichkeiten und Perspektiven.

Outcome quality

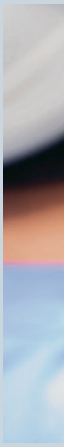
Lower mortality rates

Hybrid ORs can lead to significant improvements in outcome quality. The 30-day postoperative death rate for patients with abdominal aortic aneurysms (AAA) is significantly lower after endovascular procedures (EVAR) than after open repair. The results of three clinical trials (EVAR-1, OVER, DREAM) are consistent and show clearly that perioperative morbidity and mortality rates for patients with AAA are lower with EVAR.

Promising alternative

Major adverse cardiac or cerebrovascular events are a complication for patients with multivessel coronary artery disease. The China & Fuwai Hospital in Beijing compared the midterm clinical outcomes of one-stop hybrid coronary revascularization (HCR) in a Hybrid Operating Room with coronary artery bypass graft (CABG) and percutaneous coronary intervention (PCI) for the treatment of multivessel coronary artery disease.

The result: One-stop HCR provides favorable midterm outcomes for selected patients with multivessel coronary artery disease in each risk tertile. For patients with high EuroSCORE or SYNTAX scores, it could provide a promising alternative to CABG and PCI.



Source: Shen L., Hu S., Wang H., Xiong H., Zheng Z., Li L., Xu B., Yan H., Gao R.: One-Stop Hybrid Coronary Revascularization versus Coronary Artery Bypass Graft and Percutaneous Coronary Intervention for the Treatment of Multivessel Coronary Artery Disease: Three-Year Follow-up Results from A Single Institution, Journal of the American College of Cardiology (2013), doi: 10.1016/ j.jacc.2013.04.007.

Quality benefits:

- Rapid treatment of emergency patients
- Intraoperative 3D imaging for informed decision making in the OR
- Predefined park position of the imaging equipment for unrestricted access to the patient and highest hygienic standard

Enhanced accuracy

Here's another example: One of the main challenges in treating patients with chronic lower back pain is to precisely place the screws into the pedicle while avoiding the inferomedial pedicle breaches. This difficulty is even greater when working percutaneously. Hybrid Operating Rooms with the option of intraprocedural 3D imaging can enhance the accuracy of pedical screw placement. Performing minimally invasive percutaneous techniques under control of intraprocedural 3D guidance allows surgeons to drastically reduce the rate of PPS pedicle breach from 14.2 percent to 4.7 percent when using computer-assisted navigation.

3D imaging for enhanced accuracy

Source: Percutaneous pedicle screw implantation for refractory low back pain from: manual to fully robotic intraoperative 2D/3D fluoroscopy. C. Raftopoulos, F. Waterkeyn, E. Fomekong, T. Duprez, in: Advanced and Technical Standards in Neurosurgery, Vol. 38, p. 75-93, 2012

Structure quality

Staff calculations have shown that a Hybrid Room may contain up to 18 people. Current recommendations for Hybrid Operating Rooms suggest an area of >70 m² compared to 40–60 m² for conventional operating rooms. *"In the Hybrid OR, the position of the angiography system and the table set the stage for the workflow inside the room. Other equipment follows this arrangement,"* says planning expert Clemens Bulitta.

The spaces around the operating area itself are used to securely position medical devices and ensure that staff have enough room to move, as well as to stabilize the sensitive ventilation system. Clean air, air conditioning, and ventilation technologies play an important role in achieving the hygiene standards.

Today this is primarily achieved using dedicated air-conditioning and ventilation solutions that create a limited protection zone, usually called laminar airflow. Reducing the room size would compromise the stability of the TAV system and make the protected area smaller.

Hybeta GmbH in Münster has drafted recommendations for the planning and creation of a Hybrid OR from a hygiene perspective. (The basis for their evaluation: Guidelines for Hospital Hygiene and Infection Prevention, Robert Koch Institute, DIN 1946-4:12-2008). Its findings: A TAV area of 3.30 x 4.90 m provides a protected zone that is large enough to enable the operating table to be swung toward the C-arm, while also guaranteeing sufficient space to keep medicinal products in the base area.

In short:

Workflow efficiency is a key success factor for every hospital. Therefore, the layout and design of the Hybrid OR should be ergonomic and workflow-driven. *"The larger, the better should be the basic principle for planning,"* says planning expert Clemens Bulitta. (See "The road to Hybrid OR" on pages 28-30).

Planning principle: the larger, the better

See also: *HYBETA GmbH, Planning and setting up a Hybrid OR from a hygiene viewpoint. Author: Burkhard Schlautmann. Reference location: Hybrid OR at the SHG Hospital, Völklingen, Germany.*

Bad Krozingen: Quality is freedom of choice

Employees and technology working perfectly together is leading to success in Bad Krozingen. And one thing is crucial to make this possible: Employees must be able to select the treatment that is best for each patient. A Hybrid Room ideally complements the selection of options. And that's why a second one is already being built.

"For me, high quality means always providing our patients with the best treatment. And the Hybrid OR gives us the opportunity to select the best treatment for each individual patient." This basic principle is put forward by Bernd Sahner, Commercial Director of the University Heart Center Freiburg, Bad Krozingen, where four new operating rooms and a second Hybrid Room are currently being built. It has grown to be one of Germany's largest cardiovascular centers and is turning a profit in the process. Sahner knows that this success can be achieved only with a perfect interplay between employees and technology, and emphasizes, *"We have a highly motivated team here."* Along with continuous process improvement, this is an essential element in the improved performance achieved at Bad Krozingen.

Hospital portrait

- With about 22,000 inpatients a year, 377 beds, and 1,500 staff, the University Heart Center Freiburg, Bad Krozingen, is one of Germany's largest cardiovascular centers.
- Its existing research skills are being enhanced by the planned creation of a biomedical research center in the field of cardiovascular medicine.

A leverage effect

The equipment in the Hybrid Room laboratory gives the attending physicians and nursing staff the benefit of improved workflows and better integration between the disciplines. And word gets around. Says Sahner: *"Quality is what brings our patients here. But they first have to be convinced that we can offer that level of quality."* He believes that the Hybrid OR offers a leverage effect when it comes to public relations. But, in turn, a good reputation is a basic precondition for excellence as a specialist. A further principle, in his view: The University Heart Center now has the subject matter experts and the equipment to research new treatment methods and swiftly turn them into benefits for the patients.

Keeping costs under control

As an example, the Hybrid Room in Bad Krozingen makes it possible to treat patients who would previously have been considered unsuitable for conventional surgical treatment. Thus, for instance, the three-dimensional representation of the heart and blood vessels creates the best possible conditions for planning, performing and checking transcatheter aortic valve implantation (TAVI) procedures. And while the physicians focus on their new tasks, Sahner keeps the costs under control. One way is by drawing on Siemens' leasing option: *"This gives us the opportunity to remain flexible."* Here, too, he has turned the opportunity to make a choice into a benefit for his patients.

The road to Hybrid OR

Hybrid OR projects involve renovation, new construction, or a little of both. Careful planning and professional expertise are key factors for every Hybrid Room project. Today's operating rooms require concepts that address the requirements and needs of different surgical specialties and procedures. Workflow efficiency is a key success factor for the hospital and the surgical program. Therefore, layout and design should be ergonomic and workflow-driven. Frequent, clear, and comprehensive communication by all parties involved during the entire planning and implementation process is vital.

"The balance between workflow demands and technical feasibility is crucial."

Prof. Dr. Clemens Bulitta,
Diagnostic systems and medical technology management,
University for Applied Sciences,
Amberg-Weiden, Germany

Step 1:
Set up your team

Hybrid Operating Rooms can be used by different surgical disciplines, and for interventional procedures also together with the radiologist or cardiologist. The whole OR team includes anesthesiologists, nurses, and technicians, resulting in a multitude of requirements impacting the room design and determining the use of various resources like space or medical and imaging equipment. Therefore, Hybrid Operating Rooms are always individual solutions tailored to the needs and preferences of the team and the hospital. OR equipment layout planning and implementation strategies are challenging. A clear understanding of the project scope and objectives is critical. A qualified, committed, multidisciplinary hospital team is needed to ensure the success of this complex endeavor.

Step 2:
Choose the angiographic system

There are two concepts available to realize a Hybrid Operating Room with fixed imaging systems. Ceiling-mounted systems include moving parts above the surgical field and may impair the laminar airflow system.

1 Team setup

- Set up a clearly defined and agreed-upon project organization
- Involve stakeholders with clearly defined roles and responsibilities

2 Angiographic system

- Floor-mounted systems, especially robotic systems, require fewer compromises
- Monoplane systems are clearly recommended for most rooms
- Decide on detector – note: a large detector offers additional options regarding imaging volume
- Consider radiation safety requirements

3 Patient table

- Free-floating angiography tables are best suited for hybrid operating
- Consider the position in the room, radiolucency, compatibility, and integration of imaging devices
- Decide on accessories, such as rails for mounting special equipment

4 Lights and visualization displays

- Choose two light heads for optimal illumination
- Ideally two displays for visualization
- Independent movement and stable positioning
- Modular suspension system with options for extension

Such systems usually require compromises regarding hygienic standards and can hardly move out of the surgical field without colliding with other equipment in the OR. Ceiling-mounted systems require substantial ceiling space and, therefore, reduce the options to install surgical lights or media booms. Floor-mounted systems, especially robotic systems, require fewer compromises regarding highest hygienic standards, installations of other fixed mounted equipment, and workflow; for example moving from a parking to an imaging position during surgery is easier, because the C-arm just turns in from the side and does not interfere with the anesthesiologist. In an overcrowded environment like the OR, biplane systems add to the complexity and interfere with other fixed mounted equipment and anesthesia, except for neurosurgery, where anesthesia is usually not at the patient head end. Monoplane systems are therefore clearly recommended for most rooms. In-room 3D imaging is more and more important for intraprocedural 3D guidance and postprocedural assessment of complex image-guided procedures. Therefore, a large detector offering additional options regarding imaging volume including portrait imaging is recommended. Radiation safety requirements must also be observed.

Step 3:
Choose the patient table

The selection of the OR table depends on the primary use of the Hybrid Operating Room. Interventional tables with floating tabletops as well as tilt and cradle functionality compete with fully integrated flexible surgical tables. Surgeons, especially orthopedic, general, and neurosurgeons, usually expect a table with a segmented tabletop for flexible patient positioning. For imaging purposes a radiolucent tabletop allowing full body coverage is required. Therefore, nonbreakable carbon fiber tabletops are used. Cardiac and vascular surgeons, in general, have less complex positioning needs. Thus for Hybrid Operating Rooms that are primarily used for endovascular procedures an angio table could be sufficient. But if the Hybrid OR is also intended to be used for conventional open surgical procedures, an integrated OR system table allows for a higher utilization. To further accommodate typical surgical needs, side rails for mounting surgical equipment like retractors or limb holders should be available for the table. The position of the table in the room also impacts surgical workflow. A diagonal position in the OR may be considered in order to gain space and flexibility in the room, as well as access to the patient from all sides.

Step 4:
Decide on lights and visualization displays

In general, two different light sources are needed in an operating room: the surgical (operating) lights used for open procedures and the ambient lighting for interventional procedures. Particular attention should be paid to the ability to dim the ambient lights. This is frequently needed during fluoroscopy or endoscopy. For the surgical lights it is most important that they cover the complete area across the operating room table. Moreover, they must not interfere with head heights and collision paths of other equipment. The most frequent mounting position of OR lights is centrally above the OR table. If a different position is chosen, the lights usually are swiveled in from an area outside the OR table. Because one central axis per light head is necessary, this may lead to at least two central axes and mounting points in order to ensure sufficient illumination of the surgical field. The movement range of the angiography system determines the positioning of the OR lights. Other aspects in the planning process of OR lights include avoidance of glare and reflections. Modern OR lights may have additional features, like built-in camera and video capabilities.

5 Hygiene aspects

- Involve experts who know the local requirements to discuss details with the responsible authorities

6 Room layout and planning process

- Define your current and future workflow and setup
- Start with a generic standard layout of a Hybrid Room
- Note: Planning should always be done in 2D and with CAD; 3D visualization supports the planning process

Watch the interview

Project Hybrid OR – here are the milestones: www.siemens.com/room-planning

Read the QR code with the QR code reader in your mobile!

Sometimes even a third light may be required, in cases where more than one surgical activity takes place at the same time, e.g. vein stripping of the legs. Special attention has to be paid to the visualization of imaging information. The display of various video signals is required in Hybrid Rooms. Frequently two displays on either side of the table are installed to achieve best visualization for the entire team during procedures, irrespective of different setups and workflow scenarios.

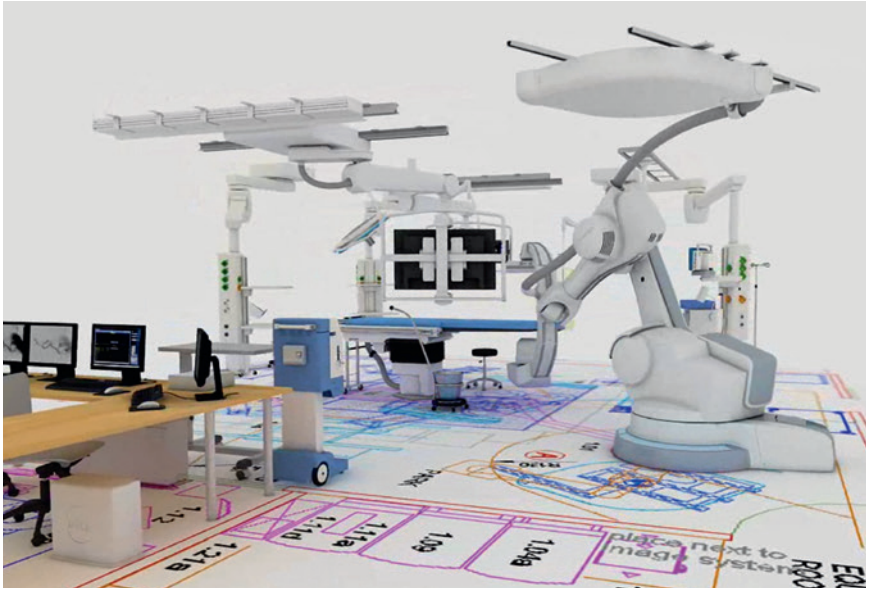
Step 5:
Consider hygiene aspects

The operating room has to meet different and stricter hygienic requirements and standards than an interventional suite. Several workflow-related aspects are crucial for achieving optimal hygienic conditions in operating rooms. A surgical scrub facility immediately outside of the OR is mandatory to allow proper scrubbing in for all procedures. Hats, gloves, face masks and proper gowns are mandatory, as well as access to sterile processing facilities for the disposal of soiled material from open procedures. Finally, clean air, air conditioning, and ventilation technologies play an important role in achieving these hygienic standards. Today, this is mainly achieved with dedicated air-conditioning and ventilation solutions that create a limited protection zone, usually called "Laminar Airflow", even though this terminology might sometimes be technically misleading. These ventilation systems need to cover the entire aseptic environment of surgery in operating rooms, including the tables for materials and instruments. This zone allows for clean-room handovers of sterilized materials and shields the surgical team in sterilized garb, usually by a sufficiently large low turbulence displacement air flow.

Step 6:
Design room layout

The standard OR layout is defined by the centrally positioned OR table and required access areas to the patient for anesthesia and surgery. In the Hybrid OR the position of the angiography system and the table set the stage for the workflow inside the room. Other equipment follows this framework. Planning should always be done in 2D and with CAD, because this is the only way to identify all technical interdependencies and to allow for a reliable check of the technical feasibility of the installation. Visualization in 3D helps to illustrate the 2D plan so that full understanding from all parties involved is ensured. "The larger, the better" should then be the basic principle for planning. Staff calculations have shown that up to 18 people can be in the Hybrid Room. Current recommendations for Hybrid Operating Rooms suggest >70 m^2 compared to 40–60 m^2 for conventional operating rooms. The main objective of OR design is to improve the OR workflow and enhance safety by ensuring good access and clear walkways. This sets the stage for equipment planning in the OR. Devices should be easy and quick to position. Ergonomic aspects are to be considered for layout and design, which should enable flexible device management to cater to the needs of the various users and procedures. A clear floor and optimized cable management allow for efficient cleaning and easier maneuvering of devices. Camera and monitor systems for displaying patient data, for educational purposes, or for telemedicine may be necessary. Data integration and IT are becoming more and more prominent for documentation, archiving, and information provision. Last but not least material storage capabilities for devices, sutures, etc. are especially important. Built-in glass cabinets have proven to be particularly useful because they allow the nurses to quickly locate materials.

"The larger, the better should be the basic principle for planning."



3D visualization helps to illustrate the 2D plan.

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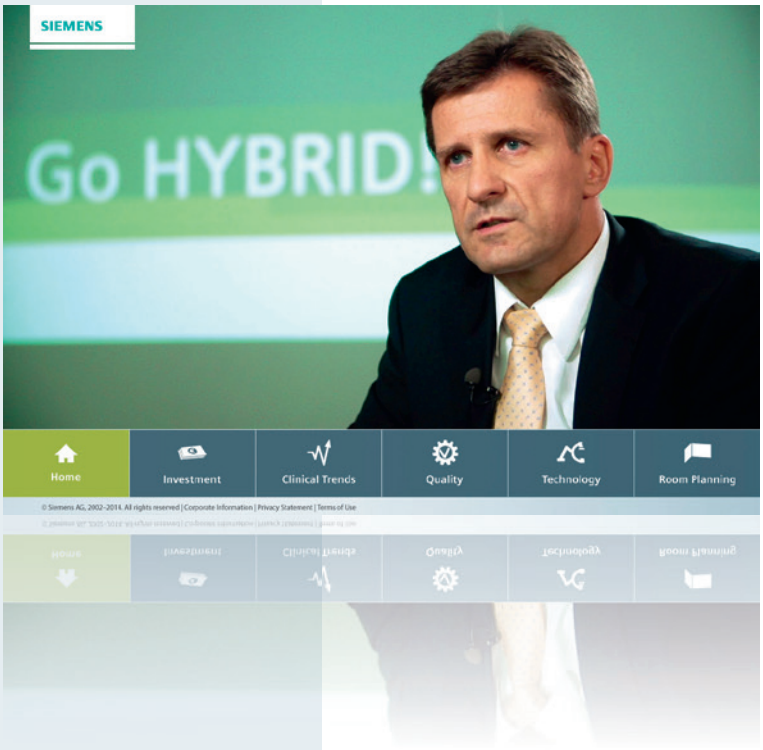

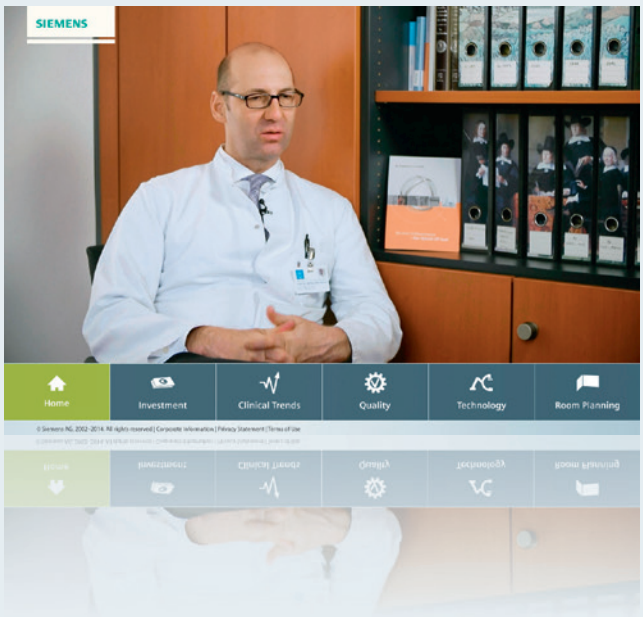

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