Hybrid Design

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St. Joseph Hospital focused on universal use when choosing the imaging equipment for its hybrid suite.

While every facility's experience building a hybrid OR will be unique to them, learning from others who have completed their project, or are in the midst of it, can help facilitate the process. Here, clinicians, architects and manufacturers discuss their experiences building these advanced suites as well as what to expect and consider as your facility begins a hybrid OR project of its own.

Research and planning

According to Renee Mazeroll RN, MSN, FACCA, Executive Director, Heart and Vascular Center, Respiratory Services at St. Joseph Hospital in Orange, CA, the game plan for her facility's hybrid suite was largely developed through lessons learned from peers. The suite has been in use since April 2010 and supports cardiac, vascular, adult and pediatric patients.

"We called other hospitals. I went to meetings and listened to them," Mazeroll says. "In talking with those who had a hybrid OR, we not only learned from what they shared with us, but also from what was not shared and observed. A clear challenge that was almost universal was utilization."

She recalls visiting a hospital that said they had a hybrid OR. In reality, though, she says, it really
wasn't.

"It was an interventional suite that they put in the operating room," she explains. "It had very poor utilization. It was just a lot of expense with not a lot of return. So, I decided that we could do a better job."

After visiting and talking with other hospitals, Mazeroll says she identified some key goals that drove the planning of their own hybrid OR:

1. Utilization. The room would be used as much as possible.

2. Universal use. To help facilitate maximum utilization, the room was not to be "owned" by any one specialty. "It wasn't going be owned by cardiology or vascular or adult or pediatrics," Mazeroll says. "It really was going to be a hybrid room available to all who were appropriately trained to use it."

3. A hybrid team. One the most crucial lessons learned, Mazeroll says, was the need for a hybrid team. "In speaking with other facilities, it was clear that not having a readily-available, trained team to support the hybrid OR was a key component in poor utilization," she says. "The team needed to be able to support adult, pediatric, cardiac and/or vascular procedures, demonstrate competency with equipment and be able to convert from a closed to an open procedure with as little change in personnel as possible."

For Hoag Memorial Hospital Presbyterian in Newport Beach, CA, part of developing a hybrid OR team meant including a 'hybrid' cardiovascular surgeon to play an integral role throughout the project. Jacques Kpodonu, MD classifies himself as a 'hybrid cardiac surgeon,' meaning he's trained and board-certified to perform both open and interventional cardiovascular surgery thanks to training in general surgery, cardiovascular surgery and endovascular surgery.

Dr. Kpodonu says a facility should identify the procedures that will be performed in the hybrid room, preferably recruit a hybrid surgeon, then develop a hybrid team based on those involved in the procedures. Hoag's hybrid OR project just completed the design of the room and will install in August 2011.

According to Mazeroll, the St. Joseph planning team involved an architect, a director of construction and managers from the different areas of the hospital involved — interventional radiology, the cardiac catheterization lab, the cardiovascular operating room and cardiology. The team worked through the design/planning phase and involved designated physicians, nurses and technical staff who were members of the initial hybrid team.

Once research was completed, procedures to be performed in the room were identified and a planning team was established, the next major challenge was choosing the equipment in the room.

It's important to include hospital stakeholders, architects and equipment vendors in designing a hybrid OR.

For St. Joseph, the final decision for imaging equipment in their hybrid suite was initially focused on equipment that could support all procedures that were planned for the room, in other words, universal. As Mazeroll explains, Siemens' Artis Zeego is a multi-axis unit with seven articulating joints that works in tandem with the table and utilizes robotics. It allows for the ability to do a rotational angiogram for a complete, 3D image, using less radiation and 50 to 80 percent less contrast to the patient.

Mazeroll and physicians from St. Joseph did an on-site visit to look at and evaluate the imaging equipment to make a final decision. "After seeing the Zeego system in place, it was clear to me that getting this one unit would allow us to do everything," Mazeroll says. "It would truly make the room universal."

At Hoag, Dr. Kpodonu says key stakeholders traveled to Germany to examine imaging systems for the hybrid suite and establish its vendor based on the best surgical workflow. From there, the facility made key decisions in terms of other equipment in the room, such as lighting, booms and tables.

"We wanted to make sure we had the best LED technology for the lighting system and that there was seamless control between the light booms and the multimedia system," Dr. Kpodonu says. "A critical point in building a hybrid operating room is having an imaging surgical table that can sync with the imaging system and also be used for an open surgical case. The ability to sync the surgical table and the imaging system is a notable fit of an advanced imaging system, which enables the imaging system to track the patient's movement on the surgical table even when the table is moved."

Design and construction

According to Shea Reiter, sales representative for Stryker Communications, from the boom/light/integration vendor's perspective, the three key factors that drive the room's design are: the staff utilizing the room, the type of procedures performed and the equipment involved.

"You first need to know the imaging equipment that has been selected and connect with that vendor to collaborate on design," Reiter says. "Our lights and surgical booms must be designed around the imaging equipment. We must also integrate all their video signals with the rest of the room and, in some cases, off-site. Next is confirming the ancillary pieces of equipment that will be used in the room, what staff will be operating them, where they will be specifically located, what power and signal types they require. Hybrid suites have a lot more technology and equipment that need to be integrated than a traditional OR. This requires a unique control system capable of meeting all the customers requirements. It is critical that we communicate with staff and administration on the deepest level to ensure their specific needs are covered. This detail results in a custom design that provides the most functional room possible."

As Guy Le, a medical planner with Taylor & Associates in Newport Beach, CA, a firm specializing in health care and the lead planner on the Hoag Hospital hybrid OR

project, explains, the architectural planning of a hybrid OR project often extends beyond just the room.

“It took about six months [to design the hybrid room at Hoag] but within that six months, we also had to reorganize surrounding spaces like the patient and staff flow to the surgery department, a new pre-op/PACU for the hospital and work in the cath labs, so it is a multiple task project,” Le says.

Le says some distinct challenges or considerations associated with the architecture of a hybrid OR include:

Coordinating the equipment. “You are basically merging the cath lab equipment with the OR equipment, so you’re trying to fit everything into one room. This explains why a hybrid OR requires a bigger space,” Le says.

The ceiling. The ceiling can become very congested with OR equipment, monitors for imaging equipment, the C-arm and more.

The ‘back of the house.’ “The structural, mechanical, electrical, plumbing — all that work that goes behind the scene — are just as important and sometimes more of a challenge than the room itself,” Le says.

Surgeon and surgical staff workflow. “The position of the surgeons in relationship to the patient will determine the location of all the ceiling-mounted monitors and equipment booms,” Le says. “The workflow of the circulating nurse will determine where we locate all the supply cabinets and identify the sterile field.”

Patient flow. Architects must also understand the patient throughput in order to best design the room. “What steps are taken with the patient?” Le says. “How do they determine whether or not the patient is going to be placed in the hybrid room versus a traditional cath lab? We must understand the whole flow of the patient from the time they come through the door to the time they reach the recovery or CCU or get discharged.”

Infection prevention. The hybrid OR poses challenges to infection prevention. There is an issue of how to keep large equipment clean and sterile for each case. Room airflow and keeping horizontal surfaces within reach for cleaning is also taken into account.

“Primarily, it’s a challenge for the whole team to come up with the best solution for the project,” Le says. “By collaborating with everybody, we, the architects, must understand the function and limitations for the equipment. You have to put yourself in the vendor’s shoes and know the equipment so you can challenge them to find the best solution. We are experts in space planning and able to interpret and say, ‘If you put this equipment in this corner, you have enough space, or no, it’s not going to fit there.’”

Dr. Kpodonu adds that during the design planning phase, the hybrid OR review committee at Hoag met to discuss the project’s status and make decisions related

to equipment placement. At St. Joseph, the construction team designed a mock room out of cardboard in the basement of the hospital. “Different managers could visualize what they were looking at,” Mazeroll says. “It was quite clever for them to do that.”

Once the design of the room is finalized, construction begins. Once completed, the installation of the imaging and surgical equipment requires three separate phases — installation, calibration and final testing. Radiation leakage testing is also performed.

As Le explains, before construction, the hospital usually contracts a physicist to do a report based on the equipment and the size and shape of the room to determine in written form the specific requirements for each wall and how much radiation shielding is required. The report is submitted to the state for approval. During construction, the room is lined with lead shielding. Upon project completion, an independent tester ensures there is no radiation leakage from the imaging equipment in the room. Once the room is final, the state licenses and approves the space to receive patients.

Surgeon and staff preparation

Aside from design and construction, there is another aspect of planning a hybrid OR that is vital to its success — surgeon and staff preparation.

At St. Joseph, Mazeroll says the facility established an initial hybrid OR team by holding interviews for experienced staff members to be chosen to train and open the hybrid OR.

“The initial hybrid OR team made a six-week commitment to work five days a week instead of our usual four, ten-hour days,” Mazeroll says. “They all were trained on new equipment and worked together as a team to develop policies, practices and protocols to support each other in this true hybrid suite. At the end of three months, we began cross-training the rest of our staff. We wanted to give the initial team enough time to become experienced with the room and the procedures that would be done in the room before we began cross-training additional staff. The cross-training will allow us to decrease the number of staff we currently have on call.”

Meanwhile, Mazeroll says physicians underwent a three-hour applications training course to familiarize with the Zeego equipment. The entire team participated in three different mock cases before the room went live.

As Dr. Kpodonu explains, having the same cross-trained team in the hybrid OR helps reduce the risk for errors and miscommunication.

“I also think it’s better for the patients because they are seeing the same faces, the same nursing staff, the same surgeons,” he says. “The whole cross-training process is a working evolution. You have to start with simple cases that you can get them involved in and then as they get involved with the whole set up, then you can start bringing in the more complex cases.”

Dr. Kpodonu says another staff-preparation consideration is radiation safety. Since the imaging equipment of a hybrid OR requires some form of radiation, staff wear radiation protection devices to monitor radiation levels.

Mazeroll shared that her institution developed a best practice concept that involves three categories for scheduling: Level 1, 2 or 3 and Level A, B or C. Partly as a result of this process, she says St. Joseph is achieving the high-utilization they were striving for, using the room every day.

“By leveling these cases and describing what type of case went into each level, it automatically established if we needed anesthesia or not, what team members needed to be in the room and how long the case would take. The levels were developed into scheduling guidelines that have really facilitated the whole process,” Mazeroll says.

‘Dramatically changing’ patient management

According to Dr. Kpodonu, the hybrid OR is beginning to and will “dramatically change the way we manage patients.”

Mazeroll explains that the hybrid OR has allowed St. Joseph to implant percutaneous valves on the right side of the heart in the pulmonary artery. They hope to get the next-generation of percutaneous valves for the left side of the heart for the aortic valve and also perform mitral valve repairs.

“We have patients who have historically come into the hospital, had different diagnostic testing done, had a procedure done in interventional radiology and then had a surgical procedure done in order to solve the problem with their vascular system,” Mazeroll says. “Now, they come in, have all the imaging and procedure done in one room. Their length of stay is shorter in the hospital and they get care in one setting. They don’t have to have anesthesia twice and we are using less contrast and less radiation.”

Dr. Kpodonu notes the hybrid OR will allow his facility to perform less-invasive, cutting-edge surgery for more positive and effective outcomes. These procedures do not require a large incision or a heart/lung machine, and they result in a quicker recovery and minimal pain. Further, patients will find the best surgeons at a hospital with the most advanced technology. Not to mention, performing procedures without requiring the patient to go to different departments for tests and a shorter recuperation time in the hospital helps lower costs for the hospital.

Still, Dr. Kpodonu says, implementing a hybrid OR is not an easy process. He advises to:

1. Identify the stakeholders. Determine the procedures to be done in a hybrid setting and the stakeholders.

2. Collectively determine the best equipment.

3. Cross-train staff. “Once you start getting staff from different departments into the OR, the room becomes very crowded and you become prone to making errors,”

he says. “Have a group of nurses that will be cross-trained using the room preferably by a hybrid surgeon.”

4. Establish the rest of the collaborative hybrid team, including dedicated anesthesiologists and cardiovascular radiology technologists.

Mazeroll adds:

1. Learn as much as possible from peers.

2. Make sure the room is big enough. St. Joseph started with 1,000 sq. feet and used it all.

3. Get a collaborative team together. Don’t let one service own it.

4. Do site visits to other hospitals.

5. Get a commitment upfront from the hospital administration. “For our training costs, I had to get a commitment from my administration up front that we were just going to 'bite the bullet' on the additional training costs. We invested quite a bit into the training of the staff,” Mazeroll says. “It has paid itself back in spades.”

In the future, Dr. Kpodonu expects the hybrid OR to evolve to where most cardiovascular procedures are done using image-guided procedures. Endovascular robotic technology will advance, using microrobots and micromachines to repair valves under 3D image guidance. Image coregistration, MRI-guided cardiac surgery and wireless technology would enable all heart valves to be changed without open heart surgery.

“A lot of new technology will replace what we do right now,” Dr. Kpodonu says. “To do that, you need the right set up and be cognescente of new technology like 3D transesophageal echochardiography, 3D intra cardiac echochardiography, intravascular ultrasound, wireless technology, MRI and robotics. It all starts with building a hybrid room and, preferably, having a hybrid surgeon to lead the team in the right direction.”

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