Moving a catheter laboratory inside an operating theater is no easy matter. While hybrid interventional operating rooms (ORs) carry the promise of increased revenue and patient safety, they also come with a sizable price tag, technical considerations and potential turf battles.

**Enthusiasm with a price tag**

Proponents for hybrid ORs can be very sure of the necessity of them. “We can’t move forward with improved patient care without the hybrid suite," says Wilson Y. Szeto, MD, surgical director for transcatheter cardio-aortic therapies at University of Pennsylvania Medical Center-Penn Presbyterian Medical Center in Philadelphia. Yet, these hybrid models of intervention and surgery collaboration come with a fairly hefty price tag, in the range of seven figures.

“The return on investment is a question mark and no one can guarantee that it will be cost effective for the hospital," says Niv Ad, MD, chief of cardiac surgery at Inova Heart and Vascular Institute in Falls Church, Va.

Despite the cost, pioneers like Inova, Penn Presbyterian and Cincinnati Children's Hospital make a compelling case for the hybrid lab, explaining that the suites are essential for cutting-edge procedures such as transcatheter valve repairs, while boosting throughput and enhancing patient safety.

**Procedures, economics, safety**

The Heart Institute at Cincinnati Children's Hospital houses one of the U.S.'s only pediatric hybrid labs. The suite is unique from other perspectives as well, says Russel Hirsch, MD, director of the cardiac cath lab. "We are an academic facility and don't have to justify everything on the profit motive," he explains. However, Hirsch and colleagues had to demonstrate that the lab would be income-neutral and that it was necessary for essential procedures. At the same time, the administration insisted that the new suite could not displace bread-and-butter cardiac cath procedures.

When Penn Presbyterian started evaluating a potential hybrid lab in 2006, the planning team homed in on procedures. Percutaneous valve procedures were a major selling point during the planning stage as a hybrid suite makes the process easier. "To convince the administration of the importance of the hybrid lab, we had to demonstrate that it would be fully utilized, which meant designing the room to accommodate coronary procedures and vascular work, and more importantly, conventional open heart operations," recalls William H. Matthai, MD, an interventional cardiologist.

Today, the Penn Presbyterian hybrid lab is used in hybrid mode about 40 percent of the time, and vascular and surgical procedures round out the case mix. Vascular procedures also complete the procedure list at Inova Heart and Vascular Institute, which uses its hybrid suite for transcatheter valve procedures, revascularization and electrophysiology procedures, including atrial fibrillation and ventricular tachycardia ablations. Although vascular procedures don't require a hybrid suite, they help keep the room busy and can be moved to a standard OR equipped with a C-arm as demand for the hybrid room increases, says Ad.

At Cincinnati Children's, which retrofitted existing spaces into two hybrid rooms in 2007, staff have realized that the hybrid model confers multiple advantages including enhanced patient safety, process improvement and quality control, says Hirsch.

For example, the team has multiple options for a newborn requiring stenting of ductus arteriosus to maintain pulmonary blood flow: a percutaneous procedure, hybrid stent or surgical shunt. With the hybrid lab, the team can plan for the least invasive option. However, if it becomes apparent that the percutaneous procedure is not possible after the patient is in the lab, the team can call the cardiac surgeon to complete the procedure without waking the patient from anesthesia, moving him or her back to the unit and prepping for surgery the next day. "We can assure the family that one way or another the patient will be taken care of that day," says Hirsch.

Cincinnati Children's has employed an open model in the lab. Children with high-risk cardiac lesions or medical issues like severe pulmonary hypertension incur tremendous risks with the induction and reversal of anesthesia at every cardiac catheterization to assess hemodynamic function. "During those procedures, we ensure that everything that can and should be done under anesthesia is completed at that time," says Hirsch.
Recently, Hirsch and colleagues completed four procedures in a single patient under one anesthetic: a diagnostic cardiac cath to assess hemodynamic function, general surgeons removed a catheter, dentists extracted three teeth and a gynecologist conducted an exam. "We could not have done this without a hybrid facility," says Hirsch.

The clinical case for a hybrid suite seems clear. New procedures such as percutaneous valves and hybrid procedures are attracting patients, says Matthai. For example, the hybrid configuration may transform an aortic valve replacement surgery requiring a full sternotomy and coronary bypass surgery into a hybrid procedure with a limited sternotomy combined with concomitant PCI. "It's a smaller incision, and may be as good or better as the traditional full sternotomy approach. It's certainly less morbid," says Matthai.

**Setting the stage**

The level of versatility offered by a hybrid suite does not occur in a vacuum. "The design process involved very flexible, broad-minded thinking by all stakeholders, who need to understand and embrace the versatility of the hybrid suite rather than try to confine it to a few procedures," says Hirsch. "It needs to function as an institutional facility and an everyday cath lab." A staff-intensive design process generated multiple wish lists. Hirsch culled the lists and as a result, "everything in the room is used almost every day." Only a handful of considerations were deemed non-essential. For example, the team downgraded high-resolution cabling to regular fiber for remote locations because there were no plans for remote diagnosis on cath procedures.

Also, there is a danger of an overly inclusive design process. Matthai admits that one of the major planning mistakes at Penn Presbyterian was to comply with a request to outfit the room for other procedures. "We designed a huge room and added a standard OR table at one end. Our configuration squishes the hybrid equipment, but we don't need the backup table because we can do virtually any case on the hybrid table."

Although hybrid labs should be flexible, they can't be a solution for all users. "Define the use the room. Otherwise, you will run out of space if you keep adding different pieces of equipment for each additional procedure planned," says Matthai. The delicate balancing act requires strong upfront planning, collaboration and communication, notes Szeto.

Penn Presbyterian started on the right foot with a collaborative relationship between cardiology and cardiac surgery and opened the discussion to all stakeholders including anesthesia, perfusion and nursing. "You might not build a perfect room, but you can build a room in which everyone is comfortable," says Szeto.

For example, as the team discussed the merits of a 9-, 18- or 40-inch imaging plate, cardiologists lobbied for the smallest plate, while vascular surgeons advocated for the largest one. After reviewing the case mix and volume, everyone agreed to deploy the larger, more versatile panel.

Indeed, multidisciplinary collaboration is the final, but critical ingredient in the recipe for a successful hybrid model. Szeto notes that cardiologists and cardiac surgeons had a solid collaborative foundation prior to the technology. "The hybrid OR allows us to take our established collaboration to the next level. We're doing cases side-by-side hybrid cases including hybrid coronary bypass grafts and PCIs, hybrid valve PCIs, transcatheter valves and thoracic aortic stent grafts."

Will hybrid ORs serve as a niche solution or are they the wave of the future? The clinical and economic data suggest that it may be too soon to tell. Developing a successful program requires strong leadership, as well as ongoing multidisciplinary commitment, collaboration. The benefits include increased procedure volume and improved patient care. It just may be the best of both worlds.

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