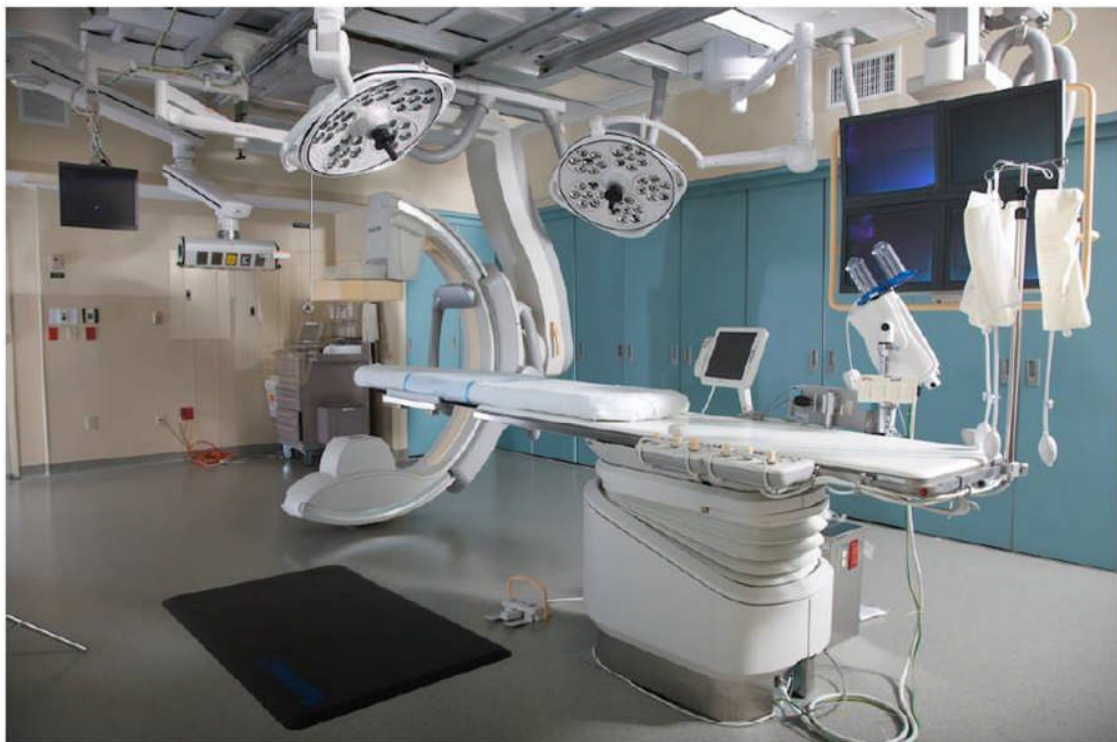


WHITE PAPER: CARDIOVASCULAR HYBRID ROOM CONSIDERATIONS

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INTRODUCTION

The concept of a hybrid cardiovascular room is an emerging trend within the cardiovascular industry. Yet, there are varying degrees of understanding as to the true nature of a cardiovascular hybrid room. This white paper will explore multiple aspects of the hybrid room and will provide a perspective for those considering its implementation.

THE PREMISE FOR THE CARDIOVASCULAR HYBRID ROOM

Today's cardiovascular environment is a complex coexistence of a number of services, systems and devices that are used in the diagnosis, treatment, and management of cardiac patients. Many of the systems and devices have evolved independently of one another, and in some cases overlap with other service areas, making it difficult to achieve a seamless cardiovascular system.

In the case of cardiovascular services, patients are frequently managed on an emergent basis. The patient that presents with chest pain in the ER may be triaged and identified for a cardiac catheterization procedure to assess the reason for chest pain. The result of the catheterization procedure may be the need for open heart surgery. The results of open heart surgery occasionally need to be assessed by a follow-on catheterization.

The treatment of such a patient involves the coordination of a number of hospital resources. The ER must contact the cardiovascular unit and get access to a catheterization lab. Similarly, if surgery is necessary, an operating room needs to be scheduled. Since resources are limited, they may not be directly available when necessary. Scheduling these resources can range from manual processes, to a central scheduling application, to specific departmental applications in cardiovascular or surgery. A procedure scheduled in a cardiovascular service may or may not be accessible to someone in the surgery department if they are different systems.

Figure 1 illustrates an example of the number of individual systems that are potentially involved in the management of cardiovascular and related surgical services. Some procedures such as CT Angiography and the imaging portion of a nuclear stress study may actually be performed and managed by the radiology service. Surgery encompasses a number of systems that are totally separate from diagnostic systems.

The following are examples of the dilemma faced in terms of managing different applications in the context of patient treatment.

Patient Scheduling: In the case of the example presented above, a patient that needs to move from a cardiac catheterization procedure to a surgical procedure requires resource scheduling. If the facility uses a central scheduling application, this may not be granular enough for cardiac and surgical procedures. In the case of cardiac diagnostic procedures, should the facility have a CVIS, scheduling for cardiac diagnostic procedures is most likely handled by the CVIS. In the case of surgery, the surgical service may use a surgical information system (SIS) for scheduling

purposes. At present, there is no coordination between diagnostic and surgical systems that would manage the patient. Most likely, the same patient information is entered separately, and if a diagnostic procedure is delayed, there is no direct means to update the surgical schedule accordingly.

Study Documentation: During various diagnostic and surgical procedures, there is a need to document aspects of the procedure as well as measurements of various parameters. In the cath lab, typically these tasks are handled by a hemodynamic system that captures both devices and medications used, and along with pressure measurements, creates a chronological documentation of the exam. The output of the hemodynamic system is usually fed to a CVIS, and included in the cardiologist report. Electrophysiology (EP) systems perform a similar function for EP studies in mapping electrical impulses. EP systems can typically send report information to the CVIS. In the case of surgical procedures, there may be multiple systems involved. Vitals may be captured, usually using a facility-wide vitals monitoring solution. The anesthesiologist usually creates documentation on the procedure and may either document in a SIS, by dictation, or by paper form. Similarly, the surgeon may create a study summary either by dictation, in a SIS, or by paper form. Ultimately, all or some of this documentation may get inputted to an EMR as part of the patient record, or it may be kept in departmental records. With respect to the capture of vitals, it is significant to note that cardiovascular requirements are unique in terms of measurement requirements, and cannot be accomplished with the facility's vital monitoring equipment, as may be the case in surgical suites or elsewhere in the facility. This can often be a point of staff confusion.

Physician Reporting: Diagnostic procedures are likely to be reported in a CVIS, or perhaps dictated. Similarly, studies done in radiology such as a CCTA study are most likely reported using the dictation/transcription capabilities of the radiology information system (RIS). For surgery, there may be a dictated anesthesiology report, as well as a separate surgical report generated. Most likely, the only place where all this documentation comes together is in an electronic medical record (EMR). The ability to modify information during the course of treating the patient most likely means accessing it within the EMR, and then returning to the originating system for updates. Again, there is no coordination of information across diagnostic or surgical procedures.

Staff Coordination: Coordination of procedures requires the coordination of different staffs when it comes to procedures involving both diagnostic and OR facilities. To complicate matters further, diagnostic procedures and operating room procedures more than likely involve different staff, including physicians, technologists, nurses, and potentially others. Since staff might be from different departments (radiology, cardiology, OR, etc.) there are likely to be operational issues, since the different staffs are likely trained to use different systems.

The consequence of the current state of cardiovascular services is potentially a disjointed and unproductive approach to patient management.

Typical Current State of Cardiology Services

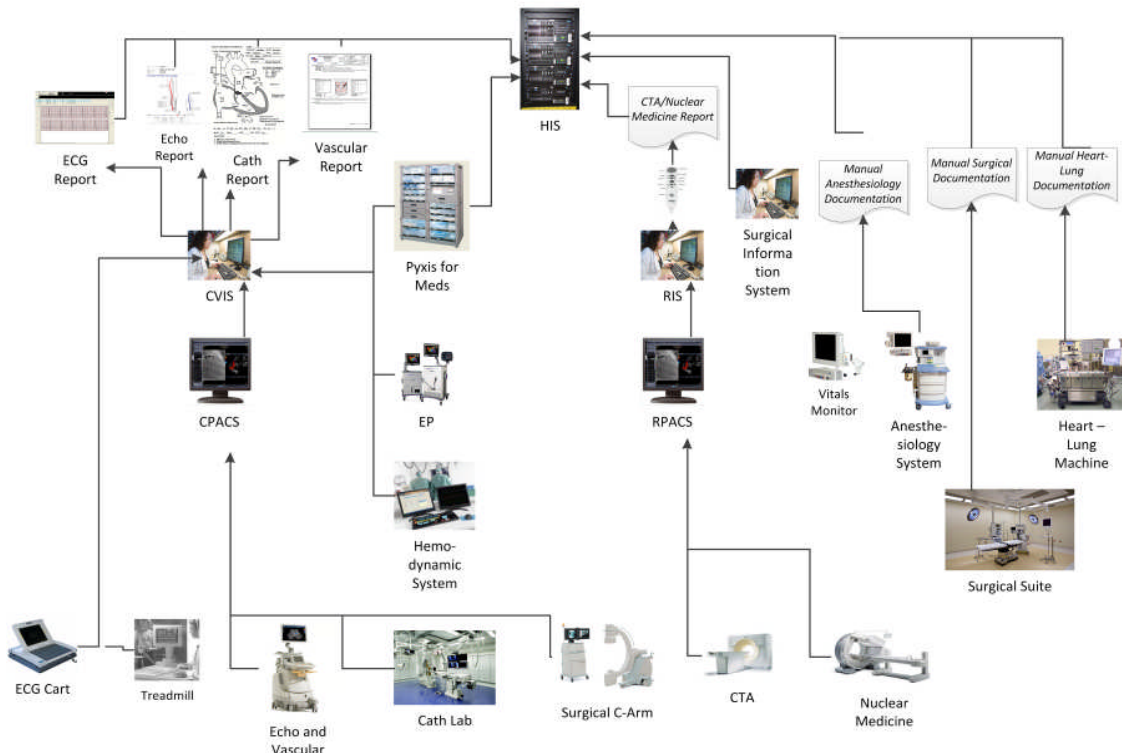


Figure 1 – Current Cardiovascular Services

APPROACHES TO THE HYBRID ROOM

The overall objective of the hybrid room concept is to create a more integrated solution to the management of the patient and procedures across cardiovascular and surgical services. There are a number of factors to consider, as well as a number of ways in which this might be accomplished.

FACTORS TO CONSIDER

Physical Equipment Integration: A cardiovascular suite typically contains a patient table, an imaging system, a monitoring/documentation system (hemodynamics), and various display requirements. Typically, a cardiovascular suite will contain a control room where the imaging and monitoring/documentation system are managed. A surgical suite typically contains a patient table, a vitals monitoring system, an anesthesiology system, possibly a ceiling mounted or portable C-Arm x-ray system, and various displays. Both may also contain some form of inventory control system such as a Pyxis system for medications. The creation of a hybrid room will need to encompass elements of both systems. A key consideration is the patient table, as it will need to address surgical requirements and still be capable of supporting radiography systems. Another key consideration is if existing space is being redesigned to accommodate a hybrid application. An existing surgical suite may not contain any form of control space, and such a space will be necessary for cardiovascular procedures. The sizing of the room will be critical, as

it will need to be able to accommodate monitoring/documentation equipment for both cardiovascular and surgical procedures. In addition, sterile field requirements must be well understood for both applications.

Patient Management Integration: As defined in the current state, there is considerable productivity and safety factors associated with managing a patient between cardiovascular and surgical facilities, in that patient demographic information must be entered into multiple systems. Similarly, there is potentially no point of reference for managing the patient schedule. A centralized scheduling application may not be capable of coordinating resources across cardiovascular and surgical resources. To be effective, the hybrid room will need mechanisms for better managing the patient and resources, as well as to improve productivity from a reduction in patient demographic entry. The hybrid room will need the ability to pass exam and schedule information seamlessly between cardiovascular and surgical systems. This may also have billing implications, as both areas are heavy users of supplies, and these too will need to be accounted for and properly coded.

Study Documentation Integration: Throughout the course of both cardiovascular and surgical procedures, there is a need for study documentation. Another key consideration for the hybrid room is how to integrate the various documentations. As with patient management, the ability to singularly identify the patient would be a significant productivity and quality factor, as would be the ability to capture relevant documentation from one area into another. For example, if there is relevance to the medications given during a cardiovascular procedure that should be reflected in the surgical documentation, that information should be easily transferrable. Since the likelihood is that different vitals measurement solutions may be present, it would be advantageous for measurement information to be transferrable as well.

APPROACHES TO CONSIDER

There are several approaches on how to address the hybrid room integration. Figure 2 illustrates possible approaches.

Integrated Solution: The critical aspect of integrating cardiovascular and surgical requirements is probably the data integration application, most notably the CVIS and SIS applications. The dilemma is where such integration makes the most sense. Cardiovascular procedures are self-contained, in that the CVIS and CPACS functionality typically aren't used for any other procedures. Conversely, not every surgical procedure is a cardiovascular procedure, and other surgeries may also be performed in these rooms. Therefore, it would be more difficult to make a CVIS provide all the functionality of a surgical suite than it might be to have a surgical information system provide all the functionality of a CVIS.

In terms of an integrated solution, it could collectively address the ADT and scheduling interfaces singularly, and be able to schedule surgical as well as cardiovascular procedures. Similarly, it could handle all system and physician documentation in an integrated manner, with full accessibility to documentation across cardiovascular and surgical procedures – all without having to close one procedure and open another. Billing and inventory could likewise be integrated.

The integrated solution would reduce the number of separate systems involved, thereby potentially simplifying room layout and workflow. The downside is that few facilities may be able to contemplate the replacement of so many systems in a single acquisition. Also, the question is which vendors are best equipped to address the integrated requirements – cardiovascular system vendors or surgical systems vendors? Replicating the capability of existing systems on either side may be economically cost prohibitive for vendors from a development expenditure perspective.

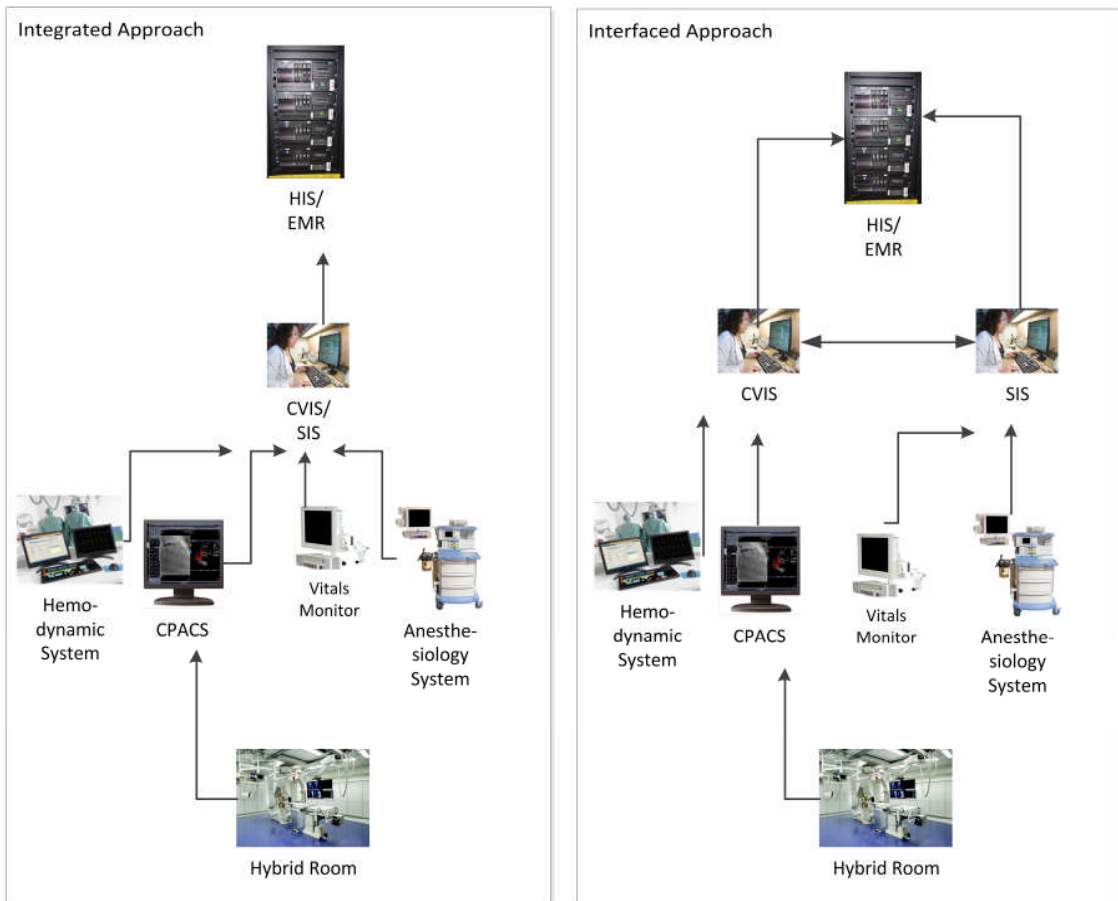


Figure 2 – Hybrid Room Approaches

Interfaced Solutions: A more likely scenario would be for interoperability standards or vendor collaboration that would accomplish the same result as an integrated CVIS-SIS, through interfaces between systems. In this approach, a cardiovascular procedure could be transferred to the SIS in terms of ADT, schedule, study and report documentation, so that the surgical procedure could be initiated based on the results of the CVIS input. Conversely, the SIS could pass surgical documentation to the CVIS to begin a cardiovascular procedure.

A key question in working out these interfaces will be – is one system subservient to another? Given the broader nature of a SIS, it may make sense to have the SIS be the master system, and a CVIS a subset to the SIS, rather than have parallel paths for ADT, scheduling, reporting, etc. Another option as illustrated in Figure 3, would be to have some form of interface engine/broker as a buffer between the HIS and the CVIS and SIS. The broker could handle common information such as ADT and scheduling with the HIS, as well as relevant information

between the CVIS and SIS and the Broker. Another advantage of this approach might be to enable broader interface options between different CVIS and SIS vendors.

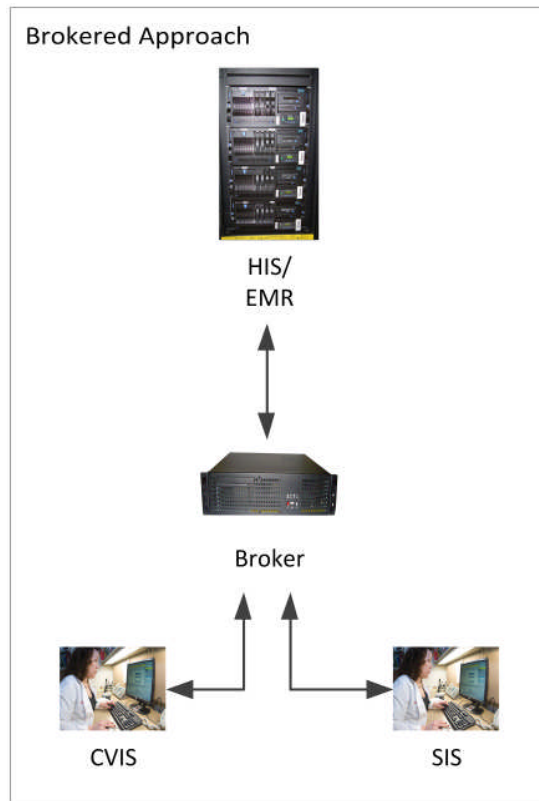


Figure 3 – Brokered Interface Approach

Regardless of how the CVIS and SIS are interfaced, the key advantage would be added flexibility in configuring a solution for the hybrid room. Should the SIS and CVIS vendors already have an interface relationship, it might mean that an existing system could be adapted rather than the wholesale replacement of both.

WORKFLOW CONSIDERATIONS

As facilities and vendors wrestle with how to implement the hybrid room, understanding the workflow requirements of the hybrid room will be critical. Figure 4 is an example workflow for what may be a typical procedure – treatment of an emergent case through bypass surgery. Within the EMR, it is assumed the patient would be admitted as a “John Doe” so that there is ADT information available. The ADT would in turn be forwarded to the CVIS and SIS systems. The CVIS may in turn pass ADT to the CPACS and Hemodynamic systems. The hemodynamic information and image information would be passed to the CVIS so that the cardiologist could complete his procedure.

Scheduling information from the CVIS could be sent to the SIS such that should surgery be necessary, the SIS is updated in terms of the room schedule. Once it is known that a surgical procedure will be done, the SIS would pass the ADT to the Anesthesiology system.

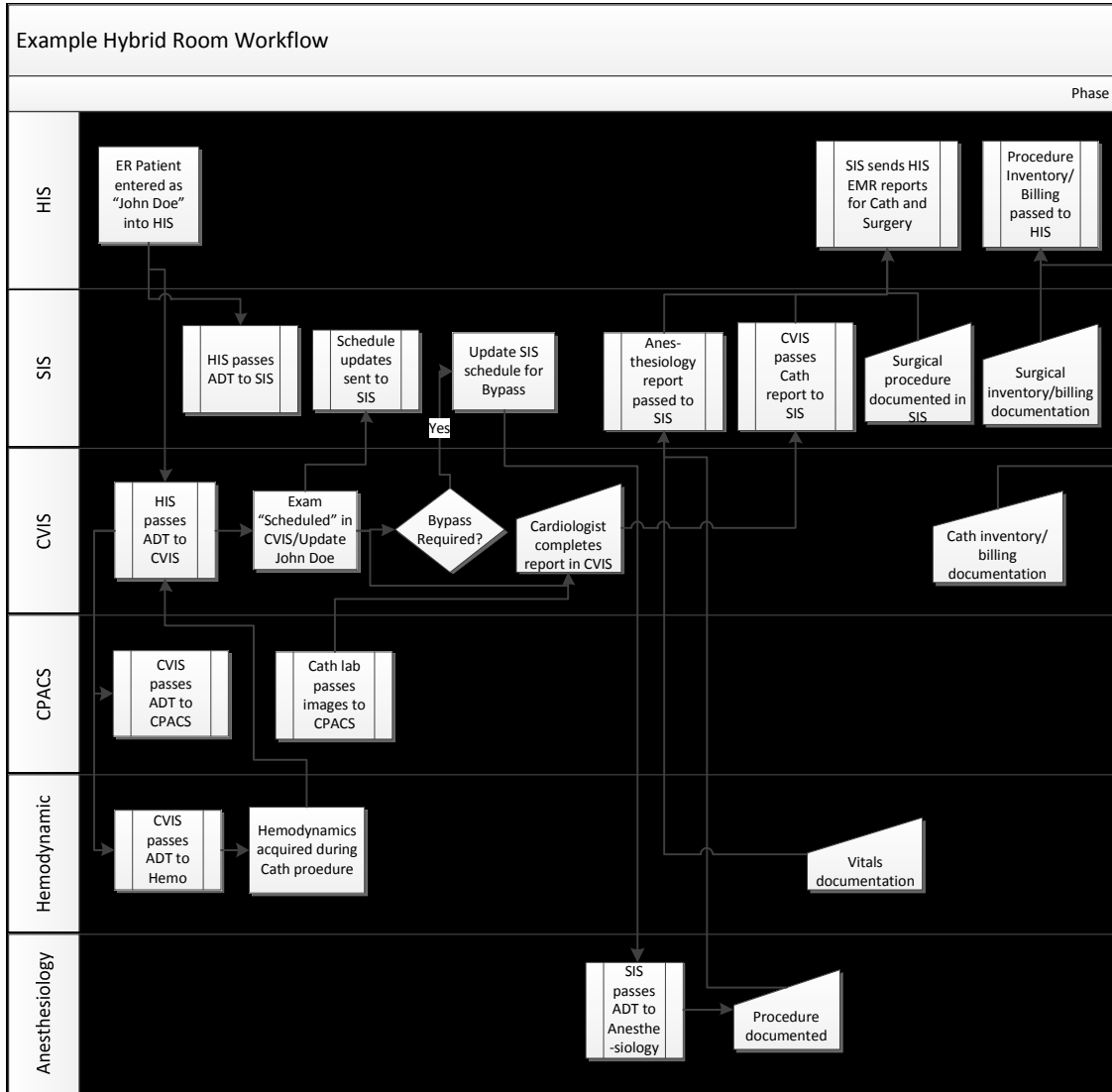


Figure 4 – Hybrid Room Workflow

During the surgical exam, vitals measurements from the hospital vitals system would be sent to the SIS as part of the surgical documentation. Upon completion of the exam, the cardiologist might complete the cath report in the CVIS, which would be uploaded to the SIS, so that documentation would be available to the cardiac surgeon for their report. Similarly, the Anesthesiologist's documentation and report would be completed in the SIS. The SIS would then update the EMR with all documentation, which depending on how the EMR handles it, could be linked as an integrated procedure report. Similarly, all documentation would be passed through the SIS in terms of inventory and billing, and then passed to the HIS for reordering supplies and billing verification of the procedure.

STAFFING CONSIDERATIONS

Cardiovascular and Cardiac OR procedures typically involve different staffs that are possibly members of different departments. Procedures may involve radiologic technologists, cardiac technologists, nurses, and physicians. Of these staffs, the nursing staff is likely the one with the most commonality between procedures and with a *patient* focus, while the rest of staff likely has a *procedure* focus.

Because of the dual nature of a hybrid room, facilities will need to address how to staff the room from both patient and procedure perspectives. The nursing staff will probably have the most overlap between procedures. Cross-training the staff to deal with both cardiovascular and OR procedures is one approach to creating a seamless workflow, and will require that they have operational knowledge of both cardiovascular and OR systems.

One example is vitals monitoring. For the cardiovascular portion of the procedure, a hemodynamic system will be used. For the OR portion of a procedure a vitals monitoring system will be used. The ability of the staff to transition from one system to the next will enable uninterrupted monitoring of the patient's vitals.

Ideally, integrated systems would aid the workflow, but for facilities unable to achieve an integrated solution, the staff will bear the brunt of the "integration." This can best be managed by a thorough assessment of the combined cardiovascular-OR process, and cooperation among the service units as to how best to handle transitions procedures. Organizations willing to consider possible changes in staffing protocols may be more successful. Creative thinking will be necessary to consider the "bigger picture" in terms of the combined procedure.

CONCLUSIONS

The hybrid cardiovascular/surgery room promises potential cost, productivity, and quality improvement for cardiovascular procedures. Those considering the hybrid room option will need to assess facility, workflow, staffing and cost factors before concluding on a course of action.

At present, there is no completely integrated solution available. The likelihood is that evolving methods for interfacing cardiovascular and surgical systems will yield workable solutions. Because of its broader application, surgical information systems are likely to play a greater role as the focal point for integration. Facilities contemplating a hybrid room today should stress the value of integration with prospective cardiology and surgery vendors. Similarly, they will need to look introspectively at how they are organized, and develop staff integration plans that best address both procedure and patient needs.

GLOSSARY OF TERMS

CVIS	Cardiovascular Information System
CPACS	Cardiology Picture Archive and Communications System
EMR	Electronic Medical Record
HIS	Hospital Information System
SIS	Surgical Information System