Chapter 10

COMMUNICATIONS

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Checklist

1. Decide on primary technology for person-to-person communication.
2. Project how the flow of patients will be tracked in perioperative complex.
3. Plan how equipment will be located and tracked.
4. Determine how emergency situations or calls for assistance will be communicated.
5. Create backup plans and systems for each primary communication scheme.
6. Ensure that the electronic medical records and all hospital information systems are accessible to all who need access.
7. Determine how communication will occur across hospital units (e.g., from the operating room [OR] to the laboratory or intensive care unit, from the surgical floor or emergency department to the OR, etc.).
8. Guarantee that communication solutions are Health Insurance Portability and Accountability Act (HIPAA) compliant.
9. Make sure the noise and interruptions of your communication systems do not interfere with the work of the OR.
10. Determine whether the communication plan is viable in busy environment (i.e., simple and user friendly).

Introduction

Increasingly, the ability to easily and effectively communicate is thought to be the basis of a safe and efficient OR environment. Early in the design process of a perioperative complex, key staff members need to delineate the flow of information and conversation that will improve communication and, as a result, enhance patient care and the working environment.[1,2] Whether in a two- or fifty-room OR complex, the ineffectual transfer of information leads to errors in care.[3,4] The inability to accurately and effortlessly convey information among the perioperative staff leads to decreased efficiency and increased frustration. A communication plan that facilitates specific person-to-person conversation and access to specialized information is just as important as the hallway and room layout that promotes patient movement and flow.

As the size of the perioperative environment increases, so may the intricacies of a communication plan. While a simple, uncomplicated scheme may be all that is necessary for a small perioperative complex, it is likely to be inadequate for a large, hospital-based complex due to the number of people involved, the size of the environment, and the complexity of the

patients and their procedures. Even in a large, complex environment, communications must be kept as simple as possible to minimize disruptions in patient care.[5] Interruptions may lead to diversion of attention, forgetfulness, or errors.[1,6] Individuals can be overwhelmed with information that might have been communicated in a less disruptive way. Charge nurses in the OR can participate in as many as seventy-four communication events in one hour.[7] Deciding what information should be exchanged with an immediate conversation (synchronous) and what data can be transmitted as a text message or icon (asynchronous) on a screen may minimize the disruption and maximize the effectiveness of the transfer.

In all cases, a communication plan needs to address person-to-person, person-to-group, and across-group communication as well as access to patient information, patient location, procedural progress, and equipment location. Each team of individuals in the OR needs to be able to communicate within each group as well as with others outside of their group. Anesthesiologists need to be able to talk to other anesthesia providers and technical personnel, both one to one and one to many, especially if there is a need for additional assistance or help emergently. They also need to be able to contact or be contacted by nurses or surgeons during the course of a day. Every group of individuals in the operating complex has similar needs. How this communication is handled is important and needs to be part of the perioperative complex design planning.

Information must also flow across the preoperative, intraoperative, and postoperative areas to avoid delays and errors in care. Data from the preoperative area must be readily available in the OR, just as operative data must be available to postoperative caretakers. Patient data from outside of the perioperative environment, like pathology reports or radiological images, must also be easily accessible. Whether data are written, printed, spoken, or electronic depends on the specific environment, although as the change to the electronic medical record progresses, most information will be electronically stored. Perioperative information must also flow to areas outside the OR to ensure continuity of care and patient safety. Care must be taken to assure HIPAA compliance of information to be transferred, especially with regard to accessibility and encryption.[8] Yet, crucial patient information, like allergies, must be immediately available to all personnel. The information flow begins with the scheduling of the procedure by the surgeon. Accurate transmission of scheduling information to the proper areas in the operative complex ensures that correct equipment, staff, and time are allotted. Last-minute changes because of initially poor information transfer increase staff frustrations and delays and likely decrease patient safety.

The transfer of information on patient status and location is also important to the efficient flow for those both inside and outside of the OR complex. Preparation of the next patient is based on the progress of a previous patient and the availability of staff and equipment. How and to whom this information is communicated is vital to perioperative flow. Transmittal of last-minute needs, if any, to the appropriate individual is equally important to this process. Finding a patient in a large complex can be easy or difficult, depending on how the patient's location is communicated to the staff. Families of surgical patients are comforted knowing the location of their family member after they are separated from the patient. Hospital staffs arrange assignments,

movement of patients, and bed availability based on patient progress in the perioperative suite. Knowing a patient is coming off bypass may alert the cardiac intensive care nurses to the impending arrival of a new patient, just as the knowledge that a patient is finishing first-stage recovery would alert a regular floor nurse to make a bed ready for an imminent patient arrival. How this information is to be transferred may be different for each operative suite, but designing how the information will flow is easier during the planning process rather than after a suite is renovated or built.

Quickly and easily locating a piece of specialized equipment, like a surgical microscope, a laser, an ultrasound machine for central line insertion, or a fluoroscopy machine, is based on good communication. In a small operative complex, the location of equipment may be obvious, but in a large, complex environment with many ORs and other perioperative locations, finding a piece of equipment may be laborious and frustrating. The ability to quickly find a device, especially in an emergency, is again based on communication and information sharing. Preventing the simultaneous need of a specialized piece of equipment is also based on accurate communication, usually beginning with the surgical booking, but may involve person-to-person communication before, during, and after a surgical procedure. During the design process, an overall plan to access and communicate about specialized equipment needs to be determined.

Guidelines

The American Institute of Architects' Guidelines for Design and Construction of Health Care Facilities, a manual used by most state governments, mandates that each OR has a "system for emergency communications with the surgical suite control station."[9] Additionally, these guidelines require that each preoperative and postoperative bedside at which patients are under constant visual surveillance have the capability for two-way voice communication capable of summoning assistance from the nursing staff. There must also be a mechanism to summon assistance from the code team and, as backup, a mechanism to summon assistance from another staffed area where assistance can be obtained.[10] Bathrooms and changing rooms in patient-care areas must have pull cords accessible from the floor that trigger the nurse call system. In a large perioperative area, visual signals, like an emergency light over each bedside and even directional cues in the hallway directing staff to the correct area, are required. While each system needs individual consideration, the planning process needs to integrate all of the systems to achieve the communication goals. Loudspeakers and audible alarms often form the basis of institutional emergency communications for fires and other catastrophic events. The location of these speakers and alarms as well as access to the system needs to be determined primarily based on fire code regulations.[11,12] Traditionally, regulation mandated separate public address (PA) and fire alert systems. New regulations, recognizing the need to be able to give specific, clearly understandable emergency instructions dependent on the situation, allow these systems to be integrated as long as fire and other emergency communications take preference over other system uses.[13]

Communication Technology

Wired Systems

Historically, wired communication systems have formed the electronic backbone for communication systems. Over time, wireless systems will likely replace many currently hard-wired communication systems. Cost and the ability to easily modify or add functions will be important factors promoting wireless systems. At this juncture, the dependability of current wireless systems is often less than many traditional hard-wired installations. In any case, a communication closet with proper ventilation is often needed to house control equipment for either system.

Public Address Systems

The ability to make public announcements in the perioperative area is unfortunately a communication requirement, especially in emergency situations, for all but the smallest OR complexes. As a communication system, PA systems provide widespread distribution of information at the expense of the pervasive, unavoidable noise pollution. Ideally, usage guidelines and alternative communication devices minimize the need for routine "overhead" announcements. Although PA systems can be wireless in design, the need for the system to work in emergency situations mandates a wired system with emergency power capability. Depending on the design, PA systems can be accessed through a microphone in a central location, like the OR control desk, or through one or more microphones or telephones acting as voice interfaces for the system. These telephones can be part of the general telephone system or separate, functioning simply as microphones for the system. As part of the general system, an access code is often needed to dial into the PA system, possibly making this scheme cumbersome in an emergency situation if not routinely used. Yet, integration into the telephone system may allow access from a variety of locations in the operative suite while not cluttering the wall or desk space with microphones or specialty telephones. While code access from multiple locations is often desirable, care in designing this feature is important since unauthorized access from inside or outside the perioperative area may be extremely disruptive. Paging from outside the perioperative area may need to be blocked entirely. Depending upon the vision for the system's use, multiple groupings of speakers may be desirable. Crucial emergency communications need to be heard throughout the entire perioperative area, while an announcement regarding the towing of an improperly parked car may need to be directed only to the waiting rooms. Specific areas, like the ORs, preoperative and postoperative areas, and waiting rooms, can be set up as individual groups in the system, with the ability to lump them together as necessary. Calling for Dr. Jones for Room 1 may not be an announcement that needs to be heard in the waiting rooms but may be appropriate for the OR complex and perianesthesia areas. Similarly, calling for a family member may be inappropriate for in the ORs but appropriate for the waiting rooms. Careful planning of how the system will be used will minimize noisy interruptions that serve to irritate and impede care. Loudspeakers need to be placed so that all areas of the perioperative area can easily hear and understand any announcements.

Likewise, their volume adjustment should be easily accessible so the sound intensity can be tailored as needed to the noise in the environment. Part of the PA plan should include guidelines for when intensity of a loudspeaker should be adjusted since a well-intentioned individual may overlook a not so obvious but crucial function of the system that is voided by decreasing the sound intensity of a specific loudspeaker.

With increasing technology, PA systems can be more and more complicated and intimately associated with telephone and nurse call systems to provide more functionality for the hospital staff. However, with an increasing complexity and dependency on other systems, crucial emergency functions that were once straightforward and dependable may become more convoluted and unreliable. During the design process of a PA system, its role in disaster management can never be forgotten, supporting the need for simplicity and independence.

Telephones

Each perioperative location usually requires a wired telephone. At least at this time, wired telephone systems are less likely to fail. Part of the design process will entail the placement of the telephone, the number of telephones needed in each location, and the capability of the telephone installed. Considering who will need to use a telephone will guide the placement and number of telephones needed. Adding telephone receptacles during the design process is far easier than after the construction is completed. The capabilities of the telephone installed are often based on the telephone system installed in the institution but should be configured based on where the telephones are located and how they will be used. Multiple-line telephones, direct-dial buttons to key areas (e.g., the control area of the suite or STAT laboratory), easy access to an overhead paging system, speakerphone capabilities (e.g., for telephone translation services and pathology reports), and the ability to hold calls are a few of the capabilities that should be considered in the planning stage.

Care should be taken in designing the telephone numbering system. As an example, the circulating nurse telephones for ORs 1 through 10 might be 1001 through 1010, while the anesthesia telephones for those rooms might be 1501 through 1510.

Local Area Networks

Access to wired local area computer networks also needs consideration during the planning stages. Even the smallest surgery center will soon, if not already, need access to computerized electronic records, e-mail, and electronic knowledge resources. Medical monitors may require a dedicated (separate) local area network (LAN), as may anesthesia recordkeeping systems, radiology imaging systems, surgical navigation systems, and others. A key decision that needs to be made early in the design process is whether computers are going to be connected through a wired system, wireless network, or combination system. Likewise, if multiple systems are to coexist on a single LAN , careful attention to normal and peak bandwidth requirements is essential.

If a wired LAN is contemplated, then access points need to be installed. Like wired telephones, the number of access points and placement of these terminals should be determined by who needs access to the computer systems. Consideration should be given to families in the waiting room. Limiting access to electronic information may impede or hinder care. Having one computer shared by circulating nurse, surgeon, and anesthesiologist may be inefficient and frustrating if all need to access the computer at the same time, a phenomenon that often happens at the end of a procedure when there is the need to write patient orders and complete electronic nursing documentation. Installation of an electronic anesthesia information system requires computer access on anesthesia machines and in the preoperative or consultative area where preoperative evaluations are preformed or accessed. The use of electronic blackboards to display the surgical schedule and patient location requires additional computer access as well as specialized display screens in each OR, control office, and preoperative and postoperative areas. Special consideration for wired access may need to be given to radiological data. As radiology departments move to electronic images, large computer display screens are replacing the classic x-ray light box. If large, heavy screens are installed, structural support issues, in addition to the intranet connection placement, will need to be examined by the architects. The move to digital radiographs will also require access points in either the OR or radiology equipment storage areas to permit the transfer of images to central electronic storage systems. Transferring images in reverse from a central electronic storage system to surgical navigation equipment may necessitate special intranet connections near where the navigation equipment is to be used. As we increase the use of electronic information, more and more access will be desired, so careful consideration to both current and possible future needs need examination during the design process.

Wireless Systems

Wireless communication systems depend upon either signal transmission to and from an external network, like cellular telephones, or an internally configured communications network. With continued advances in technology, information exchange capability will increasingly be seamlessly incorporated into the OR environment. From the handheld device used for voice and text communication, to information retrieval systems, to patient monitors and surgical equipment, integration of information from all sources will be the norm. To accomplish this, devices will communicate with each other and with one or several networks. How these interchanges will occur is an evolving process. The Food and Drug Administration's Center for Devices and Radiological Health has recently issued an initial draft of a guidance document that discusses the used of radio-frequency wireless technology in medical devices.[14]

Some medical device companies have adopted wireless LANs using The Institute of Electrical and Electronics Engineers (IEEE) 802.11 standards to exchange data using the larger unlicensed Industrial, Scientific, Medical (ISM) frequency band.[15] Other firms have created personal area networks to enable data exchange using Bluetooth® and ZigBee® communication protocols or ultra-wide band technology.

Wireless LANs use an exchange protocol that permits higher overall exchange rates, while these other protocols use technology that is designed to use lower energy, minimize interference, and permit multiple links in the same area. While initial evaluations of Bluetooth have demonstrated minimal interference with medical devices, multiple devices may create signal degradation and interference.[16,17] Careful planning, risk assessment, and thorough testing is still needed in each perioperative environment, especially as new devices are added. Eventually, these technologies may minimize the electrical connections necessary for safe patient care while enhancing wireless transmission of critical medical alarms, physiological waveform data, and real-time control of medical devices.

Handheld walkie-talkies are small radio transmitters and receivers, operating usually with less than 5 watts of power, which provide almost instantaneous communication between one person and a group. Person-to-person communication is also possible, although the number of individual conversations that can be held is limited to the number of channels on the specific model used. To contact a different individual, one has to change to the appropriate person-specific channel. However, a one-to-many call, in an emergency situation, is easily accomplished by pressing a button to talk. Because of the low power of the device, successful use in an indoor environment with many walls and doors, such as an OR complex, requires the use of multiple repeaters to boost the signal. During the design process, placement of these repeaters needs consideration. Adequate signal coverage needs confirmation after construction is completed. Higher power devices are not portable and may interfere with medical devices.[18] Walkie-talkies provide immediate access, although with little privacy, and may be seen by many as noise intrusive. To minimize the number and duration of conversations, rules of use need careful consideration.

Beepers

While slowly falling into obsolescence, beepers or pagers are still widely used in hospitals since newer communication networks often have poor or spotty coverage. Unlike cellular telephone networks, pagers often have better receptive coverage because of the way their signal is transmitted, although local antennas may still be necessary to have complete coverage of a perioperative area. A careful survey is needed to ensure appropriate signal coverage. Pagers permit both one-to-one and one-to-many communication. Modern pagers can be accessed by computer networks, telephones, and other pagers. Pagers can be assigned to an individual person or an individual function, such as anesthesia on-call or anesthesiologist-in-charge. When a pager number is assigned to a function, either the pager can be physically transferred to the responsible individual or the page can be electronically forwarded to the device held by the appropriate individual.

Classically, pagers have been a one-way communication system with many inherent problems. First, the sender does not know if the recipient has received the message and, thus, whether one has to resend the message or try an alternative recipient or communication system to transfer the desired information.

Unpredictable message transmission speed also obscures whether a message has been received since the transmission of a page may be delayed a variable length of time as the paging system deals with multiple, simultaneous pages from several paging sources. As cellular networks improve and less attention and resources are applied to paging networks, the unreliability of the paging network may also increase. Even if the message is expediently received, a delay can arise in response if the recipient has to find a telephone to respond. Delays also occur during the callback process because the number paged may be busy or the person who placed the page may have left the area. Newer two-way text systems resolve some of these issues. Two-way systems have the capability to automatically notify the sender that the recipient of a message has received the message and permit direct responses with short text messages, decreasing patient care interruptions.[19] Additionally, new systems can escalate messages to other systems, like e-mail or cellular telephones, if a page is not opened in a specified time, essentially providing an automatic backup system for message transmission.

Cellular Telephones

As cellular telephones become more and more ubiquitous, the desire to replace all communication devices with one cellular telephone device will increase as long as the device can fulfill the necessary communication needs. Initially forbidden in hospitals, especially in environments where telemetry and sensitive medical devices were in use, current data suggest that minimal restrictions, approximately 1 meter between cell phone and medical device, are necessary to minimize the possible ill effects of cellular telephone use.[20-22] Cellular telephones send and receive radio transmissions to the nearest relay station, or cell tower. Proportional to the distance to the relay station is the energy produced by the cellular telephone. The cellular telephone will emit energy or radio waves even when no conversation is occurring. This radiation can affect certain medical devices, although a 1-meter separation from the device will usually minimize deleterious effects. Historically, certain locations, especially ORs, had poor reception because of the shielding from the construction and distance from the cellular towers. Hospitals can enhance reception by using wall-mounted relays, or distributed antenna systems, in areas with little cellular signal. In addition to improving reception, less energy is emitted by the cellular telephone to communicate with the closer antenna. Less energy emission decreases the chance of the cellular telephone interfering with medical equipment.

Even the most basic cellular telephone allows person-to-person communication while protecting patient privacy. Some telephones have a broadcast mode, or push-to-talk mode, allowing communication from an individual to a group of individuals. Initially limited by group size and number of groups, individuals with this function can have many specific groups with up to fifty individuals per group, depending on the cellular telephone plan. In either mode, cellular or broadcast, communication is simplified by contact lists that can be maintained, usually on each telephone or through an internet website. By using the list to select a contact or a group with the push-to-talk mode, the caller does not need to know the cellular telephone number of the person to be called.

A system for updating lists needs to be considered since inevitable staff changes and telephone number changes will decrease the effectiveness of the cellular device if no telephone list maintenance plan is in place. Some devices can use voice recognition to even further simplify the call and make the telephone call almost hands free. Text messaging allows certain types of information to be conveyed without the need for a conversation to take place immediately or at all. Information that needs no discussion is ideal for text messaging. Alerting the anesthesiologist about changes in schedule or where the next patient is as well as results of laboratory tests could be communicated by text messaging. At least one OR patient-tracking software has the ability to automatically send text messages at points determined by the user.

The extent of cellular coverage is the key factor limiting the effectiveness of cellular telephones in the perioperative environment. Since each cellular company uses different systems to send and receive signals, all individuals must have a cellular device on a system with reception that is acceptable both in the hospital and also outside of the hospital if one telephone is going to serve as the primary communication device. Some cellular systems have the ability to seamlessly transfer to a local wireless intranet network, or voice over internet protocol (VOIP), when in range of the local network and then transfer to the cellular network when out of range of the VOIP network. This technology may permit the use of cellular telephones where there is poor cellular coverage. Careful consideration of cellular telephone coverage is important, and a distributed antenna system, if necessary, should be part of the design plan. Negotiations and contracts with one or more cellular carriers may be needed to establish and maintain an internal network. Prior to opening a new or renovated facility, the cellular reception needs to be surveyed and tuned since cellular coverage may not be totally predictable, even with the best planning. Cellular telephone devices provide immediate communication between two individuals, but instant communication can increase or decrease efficiency and safety.[23,24] Frequent interruptions can be distracting and divert attention from a critical task. Yet, improved communication of critical information may enhance safety in the OR. A protocol for cellular telephone use in the perioperative environment is crucial for the device to enhance care as well as allow families to use their cellular telephones in a safe manner.

Dedicated Telephone Systems

Several companies now manufacture proprietary wireless telephone systems that can be used in the OR. These systems may or may not allow incoming and outgoing external calls. Coverage areas, compatibility of equipment, and ease of use of the equipment are critical in evaluating such systems.

Backup and Emergency Systems

Regardless of the nature of the telephone system installed, careful consideration needs to be given to what will happen if the system is down or main power is lost for a short or extended period of time. Some hospitals have installed a redundant emergency telephone system, with separate numbers, to be used in case the primary system is inoperable.

Wireless Networks

Initially devised to promote computer-to-computer communication, wireless networks are increasingly being used to promote the interchange of all types of data and voice communication with devices that avoid the traditional tethering to walls and telephone lines. Commonly known as Wi-Fi (wireless fidelity) or WLAN (wireless LAN), wireless networks require access points, antennas, controllers, and connection to a local computer intranet. Devices to be linked to the wireless network must have the ability to permit connection wireless interface cards. Information technologists, architects, and end-users need to plan what types of data are to be exchanged, estimate the volume of data interchange, and decide on the extent of the wireless signal. Based upon these discussions, the configuration of the wireless network can be developed, although prior to final implementation, a careful survey and tuning of the network may be necessary because of the unpredictable interference from other devices and peculiar structures, such as lead-lined walls.[25] One advantage of a well-designed wireless network is the ability to add new devices as they are developed without additional construction since wireless networks and wireless devices conform to international standards.[15] As newer devices are developed, they can be added to the network since manufacturers add backward compatibility to older versions of these network standards.

Wireless networks can be extensions of existing hardwired computer networks or independent, new networks. Computers with wireless connections can be placed in the initial design phase and then later easily moved as functions of new or renovated areas are better understood. New computers or devices can be added to the network without significant construction simply by configuring the wireless interface between device and network. Similarly, individuals can carry portable connected handheld devices that allow access to results data or other medical information and communication. The number of devices and type of information transferred is limited only by the capacity of the wireless network. Voice communication, for instance, requires significant bandwidth and will perform poorly, as well as disrupt other data transfer, if not properly integrated into an appropriate network design.

Wireless telephones functioning locally over a wireless network, or VOIP system, can be used to enhance person-to-person or person-to-group communication. Unlike traditional cellular telephones, wireless telephones can be directly linked to the hospital communication system, essentially functioning as extensions on the hospital system. Services such as local telephone directories, extension forwarding, and attachment to nurse call systems are possible through internal wireless systems. Just as with a cellular telephone system, continued upkeep of directories and maintenance of coverage is needed. At least one company has developed a wireless intranet telephone based on voice recognition.[26] One contacts another or a group by pushing a large button and saying the name of a person or group. Most other functions of wireless telephones, like call forwarding and messaging, can be accomplished with voice commands to the device. Limitations appear to be based on failure of voice recognition, privacy concerns, and the adequacy of the wireless network.

Privacy can be maintained with an earphone with an attached microphone, although in the OR, this may get in the way of the rapid use of a stethoscope. Noise in the perioperative environment also interferes with the device's effectiveness.

With a local wireless system, communication ceases once out of range of the wireless network. To decrease the number of devices that need to be carried, telephones that allow one to communicate on a local wireless network and traditional cellular networks when outside of the local network are being developed. Within the hospital, only one telephone network would need to be maintained, and the hospital could avoid the commercial cellular telephone fees for in-hospital use.

Radio Frequency Identification Systems

As the perioperative environment increases in complexity, electronic positioning devices may facilitate additional communication, especially concerning the whereabouts of equipment, staff, and patients. Radio frequency identification (RFID) has been used in manufacturing and sales settings for a number of years and is slowly moving into the medical environment. The basis of the system is a tag on the device or person to be tracked. Depending on the system configuration, a specific tag either actively reports its position to a computer network or is passively recognized as it moves into a zone with a sensor. Specialized software then interprets the signals and shows the location of the tag. Historically, the passive system can use smaller tags, which are less expensive since they do not have an internal power supply and are powered by the radio signal from the sensor antenna. Passive systems can easily provide information that a device has been removed from a specific area as long as it moves under or through a sensor's emissions. Specific RFID readers need to be positioned to create the zones in which the entry and exit of a device is to be tracked. Active devices can function on their own network or on a preexisting wireless network. Both network systems may need fine-tuning of relays or nodes to enable the desired accuracy in the triangulation of the RFID sensor position.[27,28]

Enormous amounts of time and energy are spent looking for equipment and supplies in perioperative complexes. Being able to see the location of specific devices on a computer screen would likely save time and prevent the usual frustration that accompanies the search for a lost or misplaced device. Eventually, RFID systems will integrate into supply systems to decrease errors in supply, billing, inventory control, and medication management. This integration is not yet widely available.

RFID networks may help in the automatic tracking of staff and patients in a complex perioperative environment.[29] In the OR complex, locating a patient or staff member is often difficult. Depending on the accuracy of the system, RFID can track a patient through the preoperative process—check-in, radiology, and laboratory—and into the OR and then recovery. Similarly, the location of a radiology technician or specialized nurse could be easily ascertained if staff was tagged with RFID devices, minimizing the need for paging, telephoning, or looking around for them.

With the appropriate interfaces, specific time points, like arrival, presence in preoperative area, and arrival in recovery, could be automatically entered into an operative information system, unlike conventional systems that require someone to enter data, making the accuracy of the manually entered data only as good as the effort of those required to enter data.[30] Automated entry into management software, then, would likely enhance the accuracy of reports used to make management decisions.

From a safety perspective, if computer software was correctly configured and available, an alert could go off if a patient wearing an RFID device entered the wrong OR. Likewise, surgical sponges tagged with RFID devices may enhance patient safety by making it more difficult to leave a sponge in a patient.[31,32] Matching blood products and medications to the correct patient may also be possible as software interfaces mature.

Unfortunately, RFID and cellular telephones have similar risks in interference with existing medical equipment and with communication devices sharing like frequencies. Both passive and active RFID devices can significantly interfere with a wide range of medical equipment at distances up to 6 meters.[33] Before implementing a RFID system, careful planning and examination of the proposed use, the environment, the software, and the hardware is necessary to minimize unwanted effects.[34]

Other technology can also be used to perform similar functions. Low-energy, battery-powered disposable identification tags have been used, as have bar codes that can be read at a distance.

Patient Tracking Software

Efficient patient flow is important to a safe and profitable perioperative environment. As the complexity of the OR complex increases, knowing the patient's location and progress decreases the frustration of staff and enhances the safety and efficiency of the system. Computerized tracking displays allow staff to avoid making telephone calls or walking to another location to find a patient, determine if a patient is ready for surgery, decide if a room needs to be cleaned, or determine if a patient is soon to be transferred outside the OR complex. Several of these systems are integrated with scheduling and documentation systems, eliminating the need for dual data entry. Electronic visual alerts can be incorporated into the tracking system used. By tapping specific keys or key combinations, names can flash and/or change colors and icons can appear or disappear, signaling a desired action to be initiated. These alerts may be used to indicate a variety of actions, including the need to premedicate a patient, transport a patient, clean a room, or make a patient bed ready at another location. These visual signals may eliminate the need for one or multiple telephone calls since the data can be made available on a computer display to all individuals who may need the information. Tracking information can be accessed from each computer in the perioperative complex as well as from other specified locations connected to the information system and software.

Some systems can be configured to send e-mails, text messages, or pages to specific individuals when an alert or time point is entered. A surgeon can be alerted that his/her patient has been called to the OR or that the previous patient has left the OR. Most current systems require some manual entry of time points, although RFID input or bar code scanning may eventually simplify the data input. Large display screens, like those seen at an airport showing departures and arrivals, can be mounted in various locations to provide easy and ready access to the information contained in the tracking system. Displayed information can be configured to be HIPAA compliant, if necessary. Waiting areas can have screens to allow families to monitor the progress of their family member, with a code used to represent the patient name. For instance, patient names can be coded as initials or "handles" (e.g., Bubba, Coach, Dancer, etc.). For each large display, network access and mounting issues need to be considered to ensure that both the wall structure will support the heavy screen and access to power and a network server is available. Additional space in the OR complex may need to be allocated to computers or servers to enable a patient tracking system. Considerable effort is needed to plan for the necessary hardware as well as in selecting and configuring the software so that it provides the information needed by each specific OR setting.

Real-Time Display of OR Activity

Patient flow and procedure progression in an OR can also be followed with the use of real-time video of the OR.[35] An observer with OR experience may have enough visual cues to avoid the need to visit or call for certain information. Displayed in area or areas frequented by OR staff, real-time OR video can show whether staff, specialized equipment, and patients are in an OR as well as whether the patient is positioned, draped, or undergoing surgery. In addition to a video camera in the OR, a video network, image processor, and display unit or units are necessary. Several of the new OR image systems have the capability to provide these room images. Protecting privacy, maintaining patient confidentiality, and restricting access to images are paramount concerns with the use of these video systems.[36]

Conclusion

As the complexity of medical care increases, information takes on increasing importance. How and when information is transferred or exchanged affects safety and efficiency. Communication system design, thus, needs to be an integral part of a perioperative plan. Retrofitting communication systems is expensive, time consuming, and disruptive. Since technology has the capacity to be both informative and disruptive, careful consideration of needs is paramount. Future considerations also need to be addressed in the communication design. Adding empty communication conduits to ORs ceilings and hallways during initial construction may save significant money and disruption in the future as new technology is implemented. Just as important, the communication plan must also deal with technology failure and how critical and noncritical information will continue to be communicated in the perioperative environment in the event of a disaster or catastrophic event.

Input into the planning process from representatives of all of the different perioperative groups is necessary to ensure a workable plan that addresses all communication issues. Once a plan is designed, the technology to facilitate that plan can be incorporated into the OR construction project.

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