Balancing clinical priorities in an era of diminishing resources

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THIS ISSUE OF *Hospital Materiel Management Quarterly* contains contributions from a variety of clinical specialists describing their clinical needs and their current and proposed approaches for acquiring technology. The materiel manager can certainly play a key role in helping these specialists get the best equipment and support that they need. However, there is a much larger role that the materiel manager can play in the process. There is fundamentally an inadequate amount of money to get all these clinicians all that they need and want. While it has always been important to save money, the constraints on the health care system are forcing all hospitals to be much more careful and deliberate in their technology decisions. There are hard choices to make among the demands of each specialty area. In addition, there are critical decisions to make regarding which areas warrant highest priority. Some of these issues are described in the box entitled "Setting of Priorities." Today's materiel managers have a

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Setting of Priorities

Health care technology has radically changed the practice of medicine. In one generation, we have seen incredible advances in all specialties, ranging from imaging to critical care, from lasers to the clinical laboratory. These advances have allowed us to perform diagnostic and therapeutic procedures that would have been unimaginable a generation ago. However, they have also given the public a tremendous appetite for technology, taking every description of new technology as an indication that they must have immediate access to the technology, regardless of its value. In setting priorities for technology throughout the hospital, a number of examples are helpful.

Critical care monitoring

The patient monitor was introduced about 25 years ago to "save labor." It would monitor the patient's electrocardiogram and heart rate and alarm if the heart rate got too low or too high. This labor saver required several layers of labor in the addition of nurses, nursing supervisors, and service technicians. This technology is now in use in almost every patient care area of the hospital, from the intensive care unit to the emergency room. Preparing multiyear plans will maximize the useful life of the equipment and allow for the phased leveraged purchase of equipment in concert with a phased relocation, upgrade, and replacement plan. This will standardize monitors, which will reduce acquisition, training, and service costs.

Infusion therapy

Now a ubiquitous technology, it shows how technology can diffuse rapidly without sound information about its value or whether it improved upon the existing technology it replaced. Infusion pumps require disposable components that significantly increase the cost of ownership and are diffused widely without any criteria for their appropriate use. Such a technology must be subjected to a rigorous life-cycle cost analysis. In addition, value analysis must be periodically performed to assess how the technology is improving care.

Ultrasound unit

The design of such devices often does not end until the device has been on the market for one to two years. In such cases, hospitals are forced to buy technology that has not been fully field tested, often requiring software modifications in the field. In addition, within a few years after purchase, clinicians and manufacturers will be requesting new equipment because the existing equipment cannot accommodate new features. Because such equipment costs as much as $250,000, hospitals cannot afford to replace it every three to four years. Purchases of such technology can be bundled and protected by obsolescence protection owing to the volatile and highly competitive nature of this market.

Anesthesia machine

With some technologies, there are clear standards of care or risk management issues. Anesthesia technology has evolved to the point where there are clear standards of care for the use of certain types of technology to monitor the patient. Therefore, the hospital must ensure that it is providing the same standard of anesthesia care in all areas where anesthetics are used, including operating rooms, labor and delivery rooms, recovery areas, and endoscopy and special procedure rooms. This includes the need to monitor during intravenous conscious sedation. Providing two standards of care exposes the hospital to significant legal risk. Issues of this type require immediate attention in the technology plan.

Lasers

Intensive, often premature, marketing of technologies is often a marker for caution. The incredible activity in the laser angioplasty market and other surgical laser technologies suggests that the marketplace has not settled down. There needs to be careful examination of the value of this technology compared to existing capabilities before investing in it.

larger responsibility to coordinate a technology planning process at their hospitals.

Technology is often simultaneously presented as the solution to our health care problems, a major problem in the escalating costs of health care, and the source of enormous competition for resources within and among hospitals. Despite our understanding of the way technology should diffuse, it has a tendency to diffuse in an unpredictable and sometimes inappropriate way (see the box "The Life Cycle of Health Care Technology"). In addition, it is a continuing source of confusion for hospital decision makers in sorting out what is best for them. There is a lot of discussion about technology planning and assessment in health care. Before describing the materiel manager's unique role in this process, it is critically important to define terms. In differentiating among these terms, the most useful definitions are as follows:

The Life Cycle of Health Care Technology

The life cycle of a health care technology, as described by Banta et al.[3] can be seen as a distinct series of phases through which a new technology or procedure advances.

Innovation—The invention of a new product, process, or practice. Little information is typically available on the true value of the technology at this time. Technologies at this point currently include many biotechnologies, biomagnetism, conformal radiation therapy, and photodynamic therapy.

Early diffusion—The major announcements in the mass media and in scientific meetings. This produces a number of reactions, ranging from patient expectations of the technology and of physicians to apply it to the physicians' natural curiosity to use the technology. Technologies that fall into this category are positron emission tomography (PET), stereotactic radiosurgery (the gamma knife), surgical lasers, and high-frequency ventilation.

Incorporation—When recognition as an established technology, often determined by issues such as approval for reimbursement or the results of consensus about its value, typically results in increased utilization. Technologies in this stage include laparoscopic cholecystectomy, automatic implantable cardioverter defibrillators, and multihead single photon emission computed tomography (SPECT) systems.

Utilization—The period of most widespread use of the technology when the most significant information about its benefits, resource consumption, dissemination, and safety is being accumulated. Technologies at this point include telemetry systems, infusion technology, magnetic resonance imaging, and ultrasound.

Abandonment—The phasing out of technologies based on lack of benefit, safety, increased risk, or replacement by more accurate, more efficient technologies. As the rate of innovation has far outpaced the rate of abandonment, there are a large number of competing technologies in use. Two other key issues are critical here, including resistance to change resulting from investments of time, effort, and training and marginal changes in technology that pressure the premature replacement of technology. Technologies in this category include gastric freezing and biliary lithotripsy and, in the case of marginal changes, technologies such as physiologic monitoring and thermometry.

There are many confounding variables affecting the rate at which technologies proceed through this life cycle.

- Technology—a new or emerging device, procedure, pharmaceutical, or protocol.
- Technology assessment is a practical process of determining the value of a new or emerging technology as it relates to existing or competing technologies from efficacy, effectiveness, outcome, risk management, strategic, financial, and competitive criteria.
- Technology planning is the systematic method of determining a hospital's technology-related needs and setting priorities based on strategic, financial, risk management, and clinical criteria.
- Technology acquisition is the rational process of determining which manufacturer provides the equipment and support that best meets the hospital's needs.
- Technology management means ensuring that the hospital's technology is used properly and effectively and is properly supported.

The focus of this review is to discuss how technology planning can help the hospital and the materiel manager make more informed decisions. The issues related to technology assessment, acquisition, and management are beyond the scope of this review and have been discussed elsewhere.[1,2]

Technology planning is so important because hospitals no longer have unlimited resources to invest in technology. While the search to reduce costs and improve services is decades old, addressing technology issues has never been a higher priority owing to cost, reimbursement, and competitive pressures. Many hospitals and hospital executives are uncomfortable trying to manage technology. Some feel technology is outside their realm, something they have always left to physicians. However, with every hospital's capital equipment budget smaller than its requests and reimbursement approvals not guaranteed on technologies, it is time to take action.

Currently, the responsibility for technology decision making is diffused among a great number and various types of people in hospitals. It is rare that anyone sees technology itself as an organizing principle. While most hospitals maintain equipment inventories, few have an established program for systematically reviewing all equipment in order to plan and budget for replacements. Instead, chief executive officers sometimes act on individual physician and department head requests for new or replacement equipment after only limited consideration of the request's relationship to the hospital's overall technology needs, strategic goals, and mission.

Technology must be viewed as an integrating element in hospital planning instead of a divisive one. Technology assessment looks at new and emerging technologies in concert with the hospital's mission, goals, and objectives. Technology planning is a critical element of long-term vision about materiel management that allows hospitals to set rational long-term plans for new and replacement technology.

A broad vision about approaching technology assessment and planning has to be set and supported by senior management of the hospital. This vision must effectively integrate strategy, operational and management practice, and financial and risk management issues with such qualitative issues as the effect on patient outcome and patient acceptability. It must consider the hospital's goals, mission, objectives, com-

petition, existing technology, and clinical and technical realities.

Today, hospitals can use a variety of methods to assess and acquire technology. They can review criteria related to the value of the technology with regard to outcomes, they can compare new and emerging technology against competing and existing technologies, they can respond to competitive pressures, they can buy what clinicians want, and they can use the manufacturers and clinicians as the prime source of technology information. Unfortunately, most hospitals don't look carefully enough at the value of the technology and compare it against other technologies. They frequently respond primarily to competitive, physician, and manufacturer pressure. This leads to a variety of problems, including the acquisition of inappropriate, excess, or unnecessary technology; distorted consumer and physician expectations; and increased costs.

TECHNOLOGY PLANNING

Technology planning encompasses both technologies new to the hospital and replacements for existing equipment that are to be acquired over a multiyear period. The rapid development of new technologies and other medical advances often outpaces medical training. Acquisitions can be proposed for reasons related to safety, standard-of-care issues, and age or obsolescence of existing equipment. Acquisitions can also be proposed to consolidate several services, expand an existing service, or add a new service.

Such planning optimizes the way the hospital's capital resources contribute to its mission. It encourages choosing new technologies that are cost-effective, and it also allows the hospital to be competitive in offering state-of-the-art services. The planning effort also improves the quality of patient care by ensuring that the appropriate technology is in use at the hospital.

Technology planning works for a single department, product line, or clinical service. It can be limited to one or several high-priority areas. Or it can be hospitalwide. It can also be used for geographic regions.

Increasingly, hospitals are designating a senior manager (e.g., administrator, planner, director of medical affairs) to take the responsibility for technology assessment and planning. That person should have the primary responsibility for developing the strategic technology plan with the help of key physicians, senior executives, and department managers. The materiel manager can play a key role in the planning portion of this process by encouraging the development of multiyear plans and communicating the need to rationally set a priority for technology replacements competing for the same budget dollars.

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Whether technology planning is for one department or is hospitalwide or regional, the steps to take are similar.

Audit existing technology

Review the existing technology base, in technology-based services, by assessing each major equipment item's current condition, capabilities, and history of problems.

Compare utilization statistics with equipment capacities, and review any anticipated increases in volumes.

Involve each department's manager, the clinical engineering director, the risk manager, and other personnel knowledgeable about both the technology and the technical literature that describes other institutions' experiences with it.

A thorough technology audit can reveal, for example, that a piece of equipment does not comply with a standard of care or there is the need for training and/or credentialing of physicians in the use of particular technologies, such as lasers or laparoscopic procedures.

Evaluate other hospitals' technologies

If they are known, review competing institutions' technology-based services and any plans for adding new technologies. This could be a reason to acquire technology, but, more importantly, it builds an understanding of the dynamics of the local environment.

Review technology trends

Determine what new and emerging technologies present strategic opportunities or complement existing services.

A technology planning program can produce significant continuing gains with relatively little effort. It is an accountable, systematic approach to ensuring that safe, efficacious, appropriate, and cost-effective equipment is always available to meet the demands of quality patient care. Technology planning requires close integration of the following elements:

- Meticulously managed equipment service
- A systematic equipment acquisition process with multidisciplinary participation
- Involvement of technology specialists in facility planning and design
- Continuing analysis and management of all equipment service, regardless of the provider(s)
- Intensive efforts to reduce the frequency and severity of technology-related incidents
- Training of all equipment users
- Periodic review of equipment replacement needs
- Ongoing assessment of new and emerging technology

From each department manager's or clinician's perspective, there are enormous differences between their needs and the needs of their colleagues in other specialties. Differences are related to the type of care, how particular technologies are used on patients, the clinical priorities and perceived effect that new or different technologies will have on patients, and the cost, volatility, and number of devices that they need. For example, radiographic imaging equipment is very expensive, has a relatively long service life, is used on a large number of patients for a very short period of time, and, owing to its cost and utilization, must have high reliability. Conversely, patient monitors are far less expensive, are

typically used on one patient for a much longer time, are more technologically volatile (purchasers must distinguish between changes that improve care and those that simply introduce a new product), and, while reliability is desirable, can usually be swapped out quickly for a spare monitor.

In addition, imaging equipment is typically concentrated in one area of the hospital, while physiologic monitors are scattered throughout many departments with varying needs. However, when it is time to purchase new equipment of either type, hospitals rarely look "housewide" at needs and develop a single, long-term plan for the replacement, upgrade, and relocation of equipment.

Radiology purchases can often be justified based on a "return on investment," as equipment is, with properly trained staff, specifically responsible for the generation of revenue. Thus, equipment that can be shown to improve throughput and quality or to generate revenue is desirable. However, such analyses should not exclude how the technology will improve care or outcomes. With patient monitoring systems, it is far more difficult to demonstrate need based on the generation of revenue. Technology in such situations is typically part of the service's infrastructure and cannot readily be cost justified. However, questions about standards of care, improvement of outcomes, length of stay, how it is better than existing technology, or the quality of information should still be answered.

In the operating room, the need for more technology is often justified by "projections" of increased utilization, inadequate equipment to meet physician demand, or increases in volume if the technology is available. Such requests should not be considered without thoroughly investigating projections of need and use.

Department managers are often under too much pressure to plan for more than the next few weeks, as opposed to the next several years. While many departments now have long-term plans, they are usually goal oriented and not typically detailed down to long-term technology plans. However, planning in this way will reduce the time and cost of decision making in the long run.

If department managers can begin to think long term and develop prioritized three- and four-year plans, hospital administrators and physicians can develop a better sense of long-term needs and be better able to integrate and prioritize needs among services.

Failure to alert hospital administration about needs that are three years away shows that department managers don't have a long-term vision about their needs. Senior hospital management will not be happy with "surprise" requests that should have been anticipated.

The materiel manager can act to facilitate this process in a number of ways:

- Information. Providing department managers with high-quality information about the state of their technology and replacement trends. By working closely with biomedical engineering, the materiel manager can provide department managers with key information about when repair costs are rising and when equipment will need replacement. It is important to distinguish between data and information, as some biomedical engineering departments overwhelm their "customers" about what

was inspected, but provide very little information to help their customers manage technology.

- Integration. Reviewing capital requests for similar types of equipment, like infusion pumps, defibrillator/monitors, patient monitors, and other equipment, to integrate these purchases into single, multiyear purchases to help standardize on equipment, thereby reducing acquisition, maintenance, and training costs.
- Teaching. Helping department managers to look at their technology needs in the long term and to develop long-term plans that will help them get the technology they need and help senior management better integrate these needs into long-term strategic plans.

The technology planning process produces a multiyear plan that identifies, department by department, the institution's total resource needs. Examples of such a plan are shown in the box "Sample Technology Plan." If the available capital funds do not allow any particular year's needed equipment to be acquired in full, properly prioritized unfunded items can be considered in a subsequent year's capital budget.

The prioritized listing of patient care equipment needs, as determined by strategic technology planning, forms the basis for a major segment of the hospital's capital budget in the years covered by the plan. In some cases, renovations are actually an element of a new technology's cost. The hospital must also consider other capital needs for such expenditures as new construction, renovations, and support department equipment.

The development of multiyear plans will allow more control over the entire capital

Sample Technology Plan

Tables 1 through 4 illustrate portions of the work product characteristic of technology planning for an entire hospital. The sample in each table comes from an actual strategic plan in place at one of four different hospitals; data in one table do not relate to data in another. However, the tables do build on one another to develop the technology master plan.

One aspect of technology planning is determining the technology needs of each unit in a hospital. Table 1 shows the technology needs of the hospital's critical care units. The estimated cost for each technology is noted, as is the priority for acquiring it. Table 2 shows how greater detail can be incorporated. Specific equipment and its cost are determined for each critical care unit in the hospital; acquisition is intended for a specific fiscal year. Note that the plan indicates the relocation and repair of some equipment—a critical part of a sound technology plan.

After priorities for equipment acquisition within each department or service are determined, priorities among all departments or services are weighed, and a master plan is developed. Table 3 shows the acquisition requests from the various hospital departments competing for technology resources.

A master plan provides senior management with the information to understand the direction of their institution and its future financial and service commitment. Table 4 summarizes proposed equipment acquisitions by service and by fiscal year.

The development of multiyear plans will allow more control over the entire capital acquisition process.

acquisition process. The fact that many departments will have developed multiyear plans will allow for much larger purchases to be phased over several years. Because the purchasing will be planned in advance, the entire acquisition process will be flexible and allow more time for bid preparations and negotiations, which will result in better leverage for the hospital in equipment negotiations. Such leverage is not limited to only purchase price, but also to issues related to training, spare parts, service, support, and upgrades. The life-cycle costs of the equipment must also be considered. For multihospital systems, issues related to redeployment of equipment to other departments or facilities and bundling and pooling of capital equipment purchases can also lead to significant cost savings.

To be successful, a technology plan needs ongoing support and continued review by senior management. Even plans for technology replacement may need to be modified as time passes.

TECHNOLOGY ACQUISITION AND MANAGEMENT

There are tremendous opportunities for hospitals to make more informed decisions about technology by rethinking how technology is acquired and managed.

Technology acquisitions are often based on personal preference among physicians who may not be the primary users of the technology. However, decisions should be based on actual clinical needs, technical realities, the user's needs and preferences,

Table 1. Technology needs for critical care units, hospital A

Need	Estimated Cost	Priority
Acquire 12-channel dedicated telemetry unit monitoring system	$120,000	High
Upgrade cardiac care unit (CCU) monitors (arrhythmia)	$ 48,000	Medium
Replace monitors in anesthesia	$100,000	Medium
Acquire monitors (short procedure) (recovery)	$120,000	Medium
Standardize defibrillator/monitors	$ 50,000	Medium
Determine cost-effectiveness of continued use of disposable pressure transducers	Unknown	Medium
Acquire oxygen monitors for infant ventilators ($1,000 each)	$ 8,000	Medium
Add monitors to emergency department	$ 25,000	Low
Replace existing monitors in neonatal intensive care unit (NICU)	$100,000	Low

Table 2. Technology needs for critical care units, hospital B

Area	Need	Cost
3E Pulmonary ICU	Purchase five-bed monitoring system	$117,000
	Relocate defibrillator/monitors from hospital F	$0
3E Pulmonary stepdown	Purchase 10-bed monitoring system with telemetry transmitter	$171,000
4E Neuro ICU	Purchase five-bed monitoring system	$117,000
	Relocate defibrillator monitor from emergency room	$0
4E Neuro stepdown	Purchase 10-bed monitoring system	$171,000
Emergency Room	Purchase eight-bed monitoring system with two telemetry modules to transmit to central station	$135,000
	Purchase transcutaneous pacer for Trauma 1 and Trauma 2	$ 8,500
	Purchase three defibrillator/monitors—one with pacing (two for adult crash carts and one for pediatric crash cart)	$ 25,500
	Relocate defibrillator/monitors to 5E, and surgery	$0

the technical capabilities and support available from the manufacturer, and other factors.[1]

Technology management issues are often the most frequently overlooked, but they are possibly the area offering the largest potential for cost saving. Many hospitals do not carefully review the costs of equipment support, how well it is done, and whether there are less expensive alternatives, including time-and-materials agreements, maintenance insurance, in-house support, or the use of third-party service organizations. There are often opportunities for savings between 10 and 30 percent of current maintenance costs on clinical equipment.

SUMMARY

The process of technology planning is not complex; it is really organized common sense. It centers around asking basic questions and reviewing information about technologies and procedures and comparing them to existing approaches and other priorities in the hospital. Hospitals should demand good information on the value and efficacy of technology, objective information on competing technologies, information on cost-effectiveness, and information to educate consumers on technical and clinical realities. Sound technology decision making is composed of four basic components:

- Technology Assessment—The determination of the need for, appropriateness of, and value of a new and emerging technology for considering its impact on quality, outcomes, competing technology, and costs.
- Technology Value Analysis—The periodic review of existing technology to be sure it is being used properly and

Table 3. Technology needs for fiscal year 1991–1992 for all departments, hospital C

Need	Cost
Radiology and diagnostic imaging	
Acquire new CT scanner to replace one of the Picker systems	$950,000–$1,100,000
Decommission one of the R/F rooms	$0
Subtotal	$950,000–$1,100,000
Anesthesia services	
Purchase automated record-keeping/quality assurance/ communication network to link outside anesthesia group with hospital	$100,000
Acquire transesophageal echocardiography (TEE) system for open-heart surgery	$150,000–$225,000
Purchase EEG/evoked-potential monitoring for use in carotid procedures	$20,000
Purchase four new anesthesia machines for OR expansion project	$120,000
Subtotal	$390,000–$465,000
Laser technology	
Allow contingency for investigating feasibility of acquiring a multispecialty argon, Nd: YAG, CO_2, or KTP laser	$100,000
Subtotal	$100,000
Cardiology	
Upgrade 12-lead ECG system to perform late potential analysis	Unknown
Subtotal	Unknown
Respiratory therapy	
Overhaul or upgrade existing ventilators to allow for pressure support ventilation ($2,000 or $7,000 each)	$30,000
Subtotal	$30,000
Clinical laboratory	
Purchase chemistry analyzer	$65,000–$85,000
Pursue the possibility of providing consultation services to local physician offices for compliance with CLIA '88	
Begin to acquire in-house laboratory equipment servicing ability	
Subtotal	$68,000–$85,000
Subtotal fiscal year 1991–1992	$1,538,000–$1,780,000
Contingency (10% of equipment acquisition costs)	$153,800–$178,000
Total fiscal year 1991–1992	$1,691,800–$1,958,000

has not overdiffused to the point at which it represents new risks or costs.

- Technology Planning—The systematic method of determining a hospital's technology-related needs and setting priorities based on strategic, financial, risk management, and clinical criteria.
- Technology Management—The ongoing review of how well and cost-effec-

Table 4. Summary of expenditures by service and fiscal year, hospital D

Service/technology	1991–1992	1992–1993	1993–1994	1994–1995	1995–1996 (Incomplete)
Radiology and diagnostic imaging	$1,920,000	$3,950,000	$1,835,000	$1,230,000	
Radiology oncology					
Critical care	$76,500	$17,000	$355,300	$975,000	$600,000
Infusion technology			$750,000		
Anesthesia services	$535,000	$670,000			
Laser technology	$110,000	$325,000	$150,000	$300,000	
Cardiology	$100,000	$250,000	$500,000	$400,000	
Rehabilitation services					
Respiratory therapy	$120,000	$30,000			
Clinical laboratory	$165,000	$77,000	$155,000	$37,000	
Subtotal	$3,026,500	$5,319,000	$3,745,300	$2,942,000	$600,000
Contingency (10% of subtotal)	$302,650	$531,900	$374,530	$294,200	$60,000
Total	$3,329,150	$5,850,900	$4,119,830	$3,236,200	

tively technology is serviced and supported at the hospital.

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By learning to ask both manufacturers and clinicians why a technology is needed, how it compares to the existing technology, and whether it will eliminate the need for the existing technology and by demanding specific answers, much more rational decisions can be made, which will be in the best interests of the community the hospital serves. Materiel managers can play a key role in fostering this process. In addition, by helping department managers develop long-range multiyear plans, materiel managers can help hospitals better manage their existing assets and make better long-term purchasing decisions.

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