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Development of an Infusion Alliance

ABSTRACT

Infusion therapy is one of the most invasive, complex, and pervasive therapies in the current health care system, yet there is very little investment in organizational knowledge management and intellectual human capital required to maintain patient safety. Catheter complications, fluid and medication errors, inadequate nutritional support, and transfusion of incompatible blood products manifest evidence of the ongoing problem. The number of infusion therapy teams has greatly decreased because of questionable cost-cutting strategies; however, it is clear from identified trends in health care that infusion teams and the concept of an infusion alliance has a distinct place within a modern health care organization.

Infusion therapy has never been more complex and pervasive in all health care settings. Virtually every patient in acute care facilities receives some form of infusion therapy, and it has become common in homecare, long-term care, and ambulatory care. Infusion therapy is required in all ages of patients, all service lines, and all medical specialties.

Technology expansion has dramatically increased the complexity. Accessing the vascular system is one of the most invasive procedures performed by nurses at all levels of education and experience. Current estimates indicate there are more than 300 million peripheral catheters and 7 million central vascular catheters sold annually in the United States. In addition, there are infusion devices used for intra-arterial, intraosseous, intraspinal, and subcutaneous spaces. Hundreds of fluids and medications, blood and blood components, and parenteral nutrition, along with rate-control technology and all other components of the system, create a challenge to patient safety.

In addition to being high-volume and complex, infusion therapy is high-risk and problem-prone. Complications and adverse events can result in life-threatening or life-altering consequences, dramatically increasing the cost of care. At present, health care-acquired conditions with no reimbursement for treatment include catheter-related bloodstream infections (CRBSIs), vascular air emboli, and transfusion of incompatible blood.

A therapy with this pervasiveness and complexity should demand a high level of attention to proper education and training, yet we see just the opposite for all health care professionals. Nurses, pharmacists, and physicians do not learn infusion therapy in a standardized manner during their prelicensure formal education. The deficits of basic nursing education in infusion therapy have been documented for at least 30 years.[1-4] Graduate nurses enter the workforce as advanced beginners expecting to gain these needed skills on the job. Many models are available to support nurses in skill acquisition[5-7]; however, this requires subject-matter experts in both infusion nursing and staff development, and resources that may no longer be available because of recent cost-cutting efforts. Studies of skill acquisition for medical students document very few peripheral or central vascular catheter insertions performed.[8,9] Thus, we have performance of the most invasive procedures by professionals without adequate preparation.

Other issues related to nurse staffing influence infusion therapy outcomes. Work redesign efforts during the 1990s resulted in many infusion therapy teams being disbanded. According to the American Hospital Association, the redesign processes resulted in fewer workers doing a greater amount of work and creating a frustrated and dissatisfied workforce.[10] These myopic solutions increase patient risk and cause nurses to leave that employer. Mandatory, fixed nurse-to-patient ratios have not produced the anticipated benefits. In addition,

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cost cutting has decreased the number and type of ancillary personnel, dumping many of these tasks onto an overburdened nursing workforce.[11]

Hospital boards of directors pay scarce attention to quality of care, according to a recent survey of not-for-profit acute care hospitals in the United States. The survey of 1000 US hospitals contained responses from 78% of the board chairs sampled. Only 32% of hospital boards have training in clinical quality, and only 44% of hospitals place a high priority on clinical quality as part of the chief executive officer's job performance. Only 63% of hospital boards place quality performance on the agenda of every board meeting, while 93% address financial performance on meeting agendas. These results demonstrate the lack of attention to quality performance at the board level while emphasizing the importance of financial outcomes.[12]

The link between quality and cost is well established in many industries, including health care. Conventional wisdom has led us to believe that quality care means escalating the cost; however, high quality is associated with greatly reduced costs.[13] More than 10 years ago, Benner et al stressed a strong association between cost and quality in health care stating, "The view that 'a nurse is a nurse' is quickly translated in an era of health care efficiency, productivity, and profitability into the stance that 'anyone can do it.'"[14(p333)]

CURRENT DELIVERY MODELS

In the majority of health care organizations, virtually all staff members perform infusion-related tasks. Primary care nurses in all areas are responsible for peripheral cannulation, regardless of the number and condition of venipuncture sites; safe delivery of all fluids, medications, blood, and nutrition solutions; and complication prevention, recognition, and management. Historically, nurses have been thought of as roughly equal in their abilities.[14] Because infusion therapy is so common, it is often regarded as a commodity service, indicating that the lowest price of the service is the most important factor. Outcomes with CR-BSIs, transfusion of incompatible blood, and medication errors reveal the fallacy of this approach.

Technicians and technologists from radiology and respiratory therapy departments have increasing involvement. Intravenous and intraosseous administration are part of the practice of most emergency medical technicians, yet there are at least 3 levels of preparation with each state directing the scope of practice for each level. Although emergency medical technicians are usually employed outside the hospital, some hospitals are now employing these technicians for patient care within the hospital. Numerous other unlicensed nursing and medical assistants are being given the responsibility for infusion therapy. Nursing assistants typically have several weeks of training, while medical assistant training ranges from 12 to 24 months. Medical assistant education is similar in length to the education for licensed practical/vocational nurses. There is no consistency for infusion therapy practice of licensed practical/vocational nurses due to many variations in rules and regulations from state boards of nursing. Infusion practices by unlicensed personnel require delegation from the licensed staff. Each state board of nursing has guidelines about delegation of tasks, and registered nurses (RNs) must act within those guidelines. Generally, the RN delegating the task is responsible for supervision of the unlicensed staff member and will bear responsibility for the outcomes of the tasks they perform.[15,16] This could include venipuncture and peripheral catheter insertion.

Numerous types of physicians, physician assistants, and nurse practitioners in all clinical areas perform insertion of central vascular catheters (CVCs). The insertion procedure may not be consistent across all specialties, and there are serious deviations in the care of these catheters after insertion. Prescribers may not understand critical issues such as the final pH and osmolarity of infusion solutions and the resulting damage to vascular endothelium. Delayed insertion of a CVC when indicated by therapy characteristics increases the patient's risk for necrotic ulcers, compartment syndrome, and complex regional pain syndrome as the outcomes of infiltration and extravasation. On the other hand, improper management of any CVC can cause a vascular air emboli, leaving the patient with severe neurological deficits or even causing death.

This lack of consistency in clinical practice is easily found in the published literature. Excessive numbers of venipuncture attempts by staff nurses are well documented in the published literature, often with significant treatment delays and associated increased costs.[17-19] Success rates of venipuncture by professionals are reported to be 23% for physicians, while staff nurses were successful in 44% and infusion nurses were successful in 98% of patients.[20]

Door-to-needle time is a critical component of successful treatment of many patients. Community-acquired pneumonia requires administration of intravenous (IV) antibiotics in less than 4 hours after admission.[21] Acute myocardial infarction and cerebrovascular accidents require IV thrombolytic administration within 90 minutes or less.[22-25] It is easy to see how the lack of appropriate venipuncture skills and/or excessive workloads can cause treatment delays that can dramatically increase cost and patient morbidity and mortality.

A study of IV fluid flow rate errors showed that only 26% were administered at the correct rate defined as ± 10% of the prescribed rate.[26] Over a 5-year period, the United States Pharmacopeia documented more than 73 000 IV medication errors with 3% to 5% judged harmful.[27] Frequent interruption during medication

preparation is a known cause of error for both pharmacists and nurses.[28] This level of interruption prevents attention to critical details necessary to prevent medication errors.

Infusion therapy also represents a risk to the nurse. Because this is a high-risk and problem-prone therapy, the risk of litigation following an adverse event can be great. A recent report of claims against nurses' professional liability insurance reveals that 60% of claims are brought against adult medical-surgical nurses, and the most frequent location of the events leading to a claim occurs in the hospital inpatient setting. Claims involving medication administration list infiltration of IV medication with tissue and/or sensory injury at 16.9%, the second largest allegation within this group. One trend identified in this report is the increasing frequency with which nurses are regarded as highly skilled and educated professionals with responsibility for using professional judgment as opposed to a custodial role of simply following doctors' orders. Compliance with the legal scope of practice, standards of care from professional organizations, and the nurse's responsibility to maintain clinical competency are important risk management strategies recommended in this report.[29]

KNOWLEDGE MANAGEMENT IN INFUSION THERAPY

Knowledge is recognized as the basic means of production in a knowledge-intensive world. Health care is one of the most knowledge-intensive industries of our society.

Intellectual capital is the knowledge, information, intellectual property, and experience used to create wealth for an organization. It provides a competitive edge in the market[30] and is divided into human capital and structure capital.[31]

Human capital is defined as the skills, experience, and knowledge possessed by individuals who have economic value to the organization. This is an intangible asset that resides with the individual and cannot be owned by the institution. *Structure capital* is everything that is owned by the institution that supports employees' productivity, including systems, databases, and routines.[31] Within nursing, this would include care maps, policies, procedures, protocols, and practice guidelines. *Customer capital* is the organization's relationship with customers and includes patients, families, and significant others.

What does each organization invest in nursing intellectual capital and, more specifically, infusion therapy intellectual capital? Human capital is owned by the individual but is used to add economic value to the organization. Should the responsibility for developing the human capital of infusion therapy be borne by the organization, the individual, or a combination of both? Nursing productivity data measure tangible costs of labor, materials, and equipment and then calculate how efficiently these costs are converted to goods and services. This process places no value on human capital but instead regards nursing labor as a cost rather than an asset.

Financial pressure on health care organizations has led to decreasing investment in staff development, especially continuing professional education.[31] Orientation to the organization may include some training on infusion therapy products or equipment used within the organization. Periodically, there is training on new policies or technology. Continuing education for staff is usually very limited or virtually nonexistent within some health care organizations. Yet, investment in human capital is directly related to outcomes, and this is certainly true for nursing.[31] In an analysis of the Institute of Medicine's report, *Keeping Patients Safe: Transforming the Work Environment of Nurses*, Hinshaw[32] provides examples of opportunities such as evaluating the effectiveness of educational and mentoring programs, investigating the correlation between continuing education and patient outcomes, and providing interdisciplinary education in school and the work setting.

The American Nurses Association defines *nursing* as "the protection, promotion, and optimization of health and abilities, prevention of illness and injury, alleviation of suffering through the diagnosis and treatment of human response, and advocacy in the care of individuals, families, communities, and populations."[33] Several components of this definition can easily apply to infusion nursing. While the purpose is always to optimize health, infusion therapy can pose great risk to health when not delivered properly. The lack of vascular access is a frequent human response to illness or injury. Moreover, fluids and medications create numerous intended and unintended human responses. The prevention of illness and injury is accomplished by application of the *Infusion Nursing Standards of Practice*.[34] Finally, infusion nurses advocate for patients through the integration of knowledge and skills. Our intimate knowledge of vascular access devices, drug pH and osmolarity, and vascular endothelium and physiology of blood flow is just 1 example.

In addition, infusion nursing involves the convergence of other sciences, including anatomy, physiology, pharmacology, mathematics, physics, geometry, biology, microbiology, chemistry, and mechanical engineering. Performance improvement, human factors, risk management, staff development, infection prevention, information technology, and legal and regulatory requirements are integrated with the sciences to ensure patient safety.

Knowledge management requires attention to transfer of learning and the issues associated with learning curves. Currently, many professionals learn the skill of

catheter insertion through the "see one, do one, teach one" method, although this is not associated with quality care or positive patient outcomes.

Transfer of learning can be regarded in 2 ways. First, we must plan for and implement practices that encourage what was learned in the classroom to be applied in the clinical setting. This may mean changes in patient assignments or relieving the nurse of the patient assignment to perform a new skill under supervision. Managers' support and encouragement is critical to successful transfer and application on the job. The other aspect of transfer of learning can be applied to the organization as a whole and may also be called *knowledge sharing*. Knowledge gained about a problem with infusion therapy in 1 area of the organization must be shared with the remainder of the organization if improvement is to occur. Infusion nurse specialists facilitate this knowledge sharing to enhance outcomes and to improve safety across the entire system. While information technology such as electronic databases or organizational intranets is also used for sharing information, it does not allow for the social interaction required for true learning to occur. Knowledge management processes are necessary to fill in the educational gaps between people and units within any organization.[35]

The learning curve is a critical component of acquiring infusion therapy skills. This is defined as lower-than-expected success rates or higher-than-expected complication rates during acquisition of new skills. Infusion therapy requires a high level of psychomotor skills, a level that not all nurses can accomplish. Some nurses lack the manual dexterity, while others lack the willingness to accept the accountability of such invasive procedures. This period will have a negative impact on patient safety and must be considered when making decisions about which staff members will be expected to perform infusion therapy procedures.[36]

DEFINING AND REACHING THE GOAL

The goal of each health care organization should be to have all patients reach the end of infusion therapy, which could be required for hours, days, weeks, months, or years, with minimal risk to the patient while using the correct amount of supplies, equipment, labor, and other resources. Reaching this goal requires a change in the current structure. More specifically, there must be attention to nursing human capital. Many examples from manufacturing are available to support the idea that attention to quality and reliable processes produces better products. It is well documented that infusion therapy teams produce a reliable service with quality outcomes.[37-47] Another analogy would be to look at the impact of seat belt use on reduction of death and injury during automobile accidents. Infusion therapy teams are associated with a similar reduction in injury and improvement in clinical outcomes. No one is calling for a repeal of mandatory seat belt laws, yet we see infusion therapy teams frequently being disbanded in the name of cost reduction.

INFUSION THERAPY TEAMS

The concept of teams in health care is experiencing a rebirth, especially in areas such as pain management, palliative care, and rapid response units. Teamwork has been associated with improvements in patient care, such as reducing medical errors and improving the satisfaction of patients and providers.[48] A *team* is defined as a group of people working collaboratively toward a shared mission.[49] Thus the definition of an *infusion therapy team* would be a group of infusion nursing experts working collaboratively with all members of an infusion alliance to deliver safe, timely, accurate infusion therapy to all patients.

An infusion therapy team can take many forms because there is no single model that works for all health care organizations. The services provided by each infusion therapy team should be defined by the identified needs of each organization. This may be a centralized or decentralized approach. The organizational structure for a centralized approach could be a standalone department, or it could operate within the nursing or pharmacy departments.

Organization of an infusion team should focus on the scope of practice for each individual member, the roles of each team member, and the scope of service for the team as a whole. The scope of practice for the team members is based on the legal boundaries of practice established by the state practice acts. The legal boundaries for nursing practice differ slightly among states; however, the administration of infusion therapy is within the legal scope for all RNs. There could be additional rules and regulations regarding advanced practices such as peripherally inserted central catheter (PICC) placement or administration of IV conscious sedation. The scope of practice for licensed practical nurses varies greatly among states. Many states also require a comprehensive postlicensure education course in infusion therapy for licensed practical nurses; however, no such requirements can be found for RNs.

The role of an infusion nurse can be extensive. Just like all nursing practices, infusion nursing practices should be based on knowledge application rather than simply performing tasks. Infusion nurses serve as care providers, collaborators, consultants, educators, coaches, mentors, advocates, coordinators, and managers. Infusion nurses act as administrators or leaders in managing the organizational knowledge required for safe clinical practice.[50] This indicates a distinct shift away from the infusion nurse simply performing tasks.

The scope of services for an infusion therapy team depends on the needs of each organization. Data collection and analysis of outcomes will identify the issues, challenges, and deficits of the current delivery processes.[51] This could include, but is not limited to, the number of venipuncture attempts required to establish a single IV site, complication rates for peripheral and CVCs, medication errors, lawsuits involving infusion therapy, nutritional deficits, and population-specific needs such as pediatrics, geriatrics, or oncology. The scope of services should include pretherapy assessments and decision making, catheter insertion and initiation of therapy, proper implementation of preventive nursing interventions, and evaluation throughout the entire course of therapy.

A recent development is the appearance of PICC insertion or vascular access teams. Some may equate these groups to an infusion therapy team; however, the scope of services is quite different. A PICC insertion team can be an internal group or an external contracted service. Members of this group focus exclusively on the technical task of PICC insertion and are typically not involved with preinsertion decision making or postinsertion management. Expansion to the concept of vascular access teams includes preinsertion assessment and takes a more holistic approach to choosing the most appropriate vascular access for each patient and may or may not be involved in postinsertion catheter management. While the scope of infusion practices includes these aspects of care, it is a much larger scope involving flow control decisions, medication administration, fluid and electrolyte management, and nutritional and blood component therapy. Insertion of any CVC encompasses only the first hour of the catheter's life, and there are complications associated with insertion that require highly skilled operators. However, the outcome of the catheter dwell time is directly related to the quality of preventive nursing interventions and correct assessment and management of complications during the catheter's use.

PHILOSOPHICAL INFUSION ALLIANCE

An infusion therapy team cannot operate in isolation, and collaboration with numerous other departments and staff members is required. *Alliance* is defined as a bond or connection between families, states, parties, and individuals, or an association to increase common interests of members. Organizations subscribing to the concept of an infusion alliance, depicted in Figure 1 as layers of services organized around the patient and the patient's needs, will establish processes to facilitate communication and collaboration among frontline clinical services such as nursing, pharmacy, and medicine. Other members of the infusion alliance are required to produce clinically effective, timely, and safe outcomes for the patient and caregivers (Table 1).

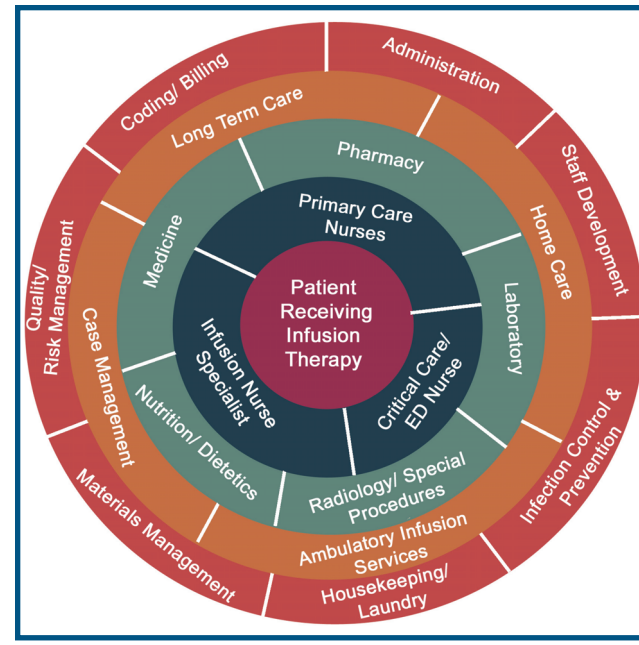

Figure 1 Model of an infusion alliance. ED indicates emergency department. Used with permission from Lynn Hadaway Associates, Inc.

Formal means of communication are commonly established through active participation in standing or ad hoc committees or councils. The advanced knowledge and skills of the infusion nurse specialist are needed on these committees.

This level of collaboration often relies on more informal processes such as communities of practice (COP). This is a self-organizing system that exchanges and interprets information, retains knowledge, and keeps the organization on the "cutting edge." A COP could be a group within 1 organization, across different units of 1 organization, or between different organizations. Membership in a COP includes whoever participates in or contributes to the practice. The informal group is defined by their knowledge and special interest, not by the task performed. Practices are shared because of the collective process of learning.[52] Seeking the opinion or advice of a trusted colleague or posting a question on an online discussion forum is an example of participation in COPs.

BARRIERS TO AN INFUSION TEAM AND ALLIANCE

Before these concepts can be implemented successfully, the "champions" for this approach should have a thorough understanding of the culture of the organization. There can be numerous obstacles to overcome.

The first step would be to investigate the attitudes, beliefs, and values of opinion leaders, managers, and

TABLE 1

Members of an Infusion Alliance

Members	Role
Nurses/physicians	Frontline clinical services to prescribe and deliver infusion therapy
Pharmacists	Preparation of the infusion products and resource for information such as pH, osmolarity, stability, and compatibility
Laboratory	Measuring responses to therapy (eg, therapeutic drug monitoring and critical values)
Nutritional support/dietetics	Parenteral nutrition needs
Special procedures laboratories (eg, cardiac or endoscopy clinics)	Specific infusion needs (eg, moderate or conscious sedation)
Case managers	Facilitate the movement of patients within and between various health care organizations
Staff development/education specialists	Identify education and training needs of staff and work with infusion nurse specialists who serve as the subject-matter experts
Coding and billing staff	Provide updated information on rules and regulations, creation of well-designed processes to capture financial resources, and periodic updates of chargemaster forms
Performance/quality/risk management	Monitoring outcomes of infusion therapy, identifying deficits, reducing risks to patients and the organization
Information technology	Facilitate integration of computerized prescriber order entry, computer-based decision support services, documentation in medical records, and data mining to track outcomes
Housekeeping/laundry	Prevention of downstream sharps injuries and exposure to hazardous medications

staff. Has there been an infusion therapy team in this facility previously? What services were provided? What happened to it? Is there opposition to an infusion team? Is this opposition coming from administration, nursing staff, physicians, or others? Investigate their reasons for the opposition to learn the basis for their concerns. If there is a history of a failed attempt, learn what happened and why. Use organizational change techniques to create a positive experience. Also, learn who supports the concept and employ their assistance. Again, investigate why they support this project and find ways to collaborate with these people.

Use internal data to support the need for an infusion team. Current rates of catheter-related infections, lawsuits involving infusion therapy, patient complaints and satisfaction survey data, medication errors, and the cost associated with the current delivery structure are rich resources to support infusion team development.

Infusion therapy services could be regarded as a commodity, which is goods or services whose wide availability leads to smaller profit margins. Commodity services use price as the prevailing factor, and the importance of factors such as brand name is diminished. Those regarding infusion therapy as a basic skill that can be performed equally by all nurses often use this approach. Calculating the cost associated with current outcomes can demonstrate the fallacy in this thought process.

The volume of procedures could be used as another barrier. Some may think that the small volume of patients requiring specialty procedures does not support a team. This would depend on how the scope of services for an infusion team is defined. Will the team be providing direct patient care or consulting services to support the frontline staff or both? The team concept can include much more than direct patient care such as quality monitoring, product evaluation, and staff development.

Another barrier is a lack of knowledge about writing a business plan and communication with top-level management by using financial terms. Chief officers of an organization include the chief executive officer, chief financial officer, chief nursing officer, chief operations

officer, and chief information officer. Information provided to this level of management must make a strong business case for an infusion team.

Traditional fee-for-service payment methods supported the goal of revenue generation by charging for all infusion-related procedures. The advent of capitated fees such as diagnosis-related groups (DRGs) from Medicare and 1 fixed annual fee for a certain number of covered lives through health maintenance organizations prevents charging payers for individual procedures. This has changed the goal to containing cost rather than generating revenue. The first step would be to gain a thorough understanding of how the organization gets paid for services. For the revenue paid to an organization, what percentages are fee-for-service, Medicare, Medicaid, health maintenance organizations, and payment directly from the patient? It is also critical to have an understanding of cost allocation within the organization and budgeting processes.

The proposal will need to use creative methods for assessing costs for services provided. One method would be to assess the actual costs for obtaining and maintaining peripheral IV access in patients with a common DRG in your facility (Table 2). The money paid to the hospital under the DRG is a fixed amount. Using these calculations, it is easy to see that excessive numbers of venipuncture attempts and more frequent restarts of peripheral catheters due to complications can consume a significant portion of this fixed amount. This leaves less money for other aspects of necessary treatment.

Another approach would include justification for prefilled flush syringes by assessing the labor costs for nurses to fill these syringes. An average patient assignment on a general nursing unit is usually between 8 and

TABLE 2

Venipuncture Costs as a Percentage of Diagnosis-Related Groups

Factors	Needed Information	Example
Operational costs of inserting a peripheral IV catheter	*Total of* Supply costs including Catheter Start kit Extension set Needleless connector Gloves Catheter stabilization device Flush syringe Labor costs Average hourly wage for personnel performing catheter insertion (length of time required) Markup—a percentage assigned to cover overhead, utilities, insurance, etc	$40 (based on $32 published rate in 2001, adjusted for inflation)
Venipuncture proficiency rate	Average number of attempts required by staff to start one peripheral IV catheter	2.18 (2.18 × $40 = $87.20)
DRG	Select a common DRG receiving infusion therapy in your facility Obtain the specific amount reimbursed for that DRG Obtain average LOS for that DRG	Respiratory infection/inflammation with complications = $4521 Average LOS = 7.6 days
Number of IV sites	Investigate the total number of IV sites required to deliver infusion therapy for the length of stay	5 sites × 2.18 = 10.9 attempts during LOS
Costs of IV sites	Calculate the costs of insertion as a percentage of the DRG	$40 × 10.9 = $436 or $87.20 × 5 = $436 9.6% of the DRG

Abbreviations: DRG, diagnosis-related group; IV, intravenous; LOS, length of stay.

10 patients, and most patients will require at least 1 IV medication per shift. This will require 2 saline flush syringes per patient per shift or a total of 16 to 20 flush syringes that the nurse must prepare. On the basis of the calculation in Table 3, nurse-filled syringes would cost between $44.80 and $74 for an 8-hour shift. The prefilled syringes would cost between $25.44 and $42.40 for an 8-hour shift. This simple substitution would free valuable nursing time for other activities and/or reduce the problem of extended work hours for nurses, reported to be more than 1 hour per day on average. It is well documented that extended work causes serious deficits in work performance.[53]

The written business plan must contain information about how your proposal will reduce costs, reduce wastes, improve the flow of patients through the hospital system, and improve patient satisfaction. Facts from the clinical setting will be necessary to demonstrate how the proposed plan will reduce the hospital's risk. The chief financial officer may not fully appreciate the financial implications when presented only as the number of procedures performed or the number of complications seen. These numbers must be converted to dollars saved or revenue generated. The "right thing to do" is simply not sufficient to garner support especially in the current financial climate for health care. The nurse presenting this plan must anticipate all questions and be prepared to address those questions. This is similar to the traditional nursing process in which nurses anticipate patients' responses and are prepared to manage those situations before they reach a crisis level.

SUPPORTING TRENDS

Several trends can be found in the current health care literature supporting the goal of an infusion therapy team and the infusion alliance concept. The patient safety movement, high-reliability organizations, value-based systems, changing reimbursement structures, and a growing emphasis on teams and teamwork are the most applicable trends.

PATIENT SAFETY

Patient safety is the freedom from accidental or preventable injuries produced by medical care. These processes

TABLE 3
Justification for Prefilled Flush Syringes

Factors	Needed Information	Example
Nursing salary	Average nursing salary calculated per min for organization	$57,000 annually $27.40 per hr $0.46 per min
Syringe preparation time	Nurse-filled syringe Gathering supplies Preparing vial Aspirating saline into syringe Labeling syringe Identifying patient Cleaning needleless connector Flushing catheter	2 min and 37 s
	Prefilled syringe Identifying patient Cleaning needleless connector Flushing catheter	1 min and 27 s
Costs for 1 catheter flush	Multiple salary per min × min required	Labor costs Nurse-filled syringe = $1.20 Prefilled syringe = $0.69
	Add costs of supplies Vial of saline Vial adapter or needle Alcohol pad or Prefilled saline syringe	Add supply and labor costs plus markup Nurse-filled syringe = $2.80-$3.70, depending on markup Prefilled syringe = $1.59-$2.12

are based on systems thinking, placing emphasis on problems within the delivery system rather than individual human error. Processes must be built into the system that drives anticipation of errors and prevents or catches these errors before they cause harm. Patient safety is considered a subset of quality or performance improvement. The principles of patient safety are derived from other groups operating under hazardous conditions with very few adverse events, including air traffic control, nuclear power plants, and naval aircraft carriers. A recent survey of more than 900 patient safety professionals revealed that only 41% of their facilities had a strong culture of safety, with 57% responding that their organization was working on this issue.[54]

Patient safety professionals will be instrumental in the efforts for an infusion therapy team and alliance. As previously discussed, patient injuries from infusion therapy and their life-altering or life-threatening outcomes are prevalent in the published literature. A culture of safety is required to prevent these injuries. This means a serious commitment to safety that permeates all levels of an organization from the primary care, frontline personnel to the executive level and the organization's Board of Directors. The Joint Commission is now calling for a strong commitment to safety from the leadership of all health care organizations, stating that inadequate leadership is a major factor in half of the sentinel events reported to it.[55]

The rapid expansion of alternative care settings has led to attention to patient safety in the homecare setting. The need for a good relationship and thorough communication with the entire family becomes more important. The home is an uncontrolled environment presenting numerous physical hazards to patients, caregivers, and providers. Homes may be isolated, causing challenges for providers to find its location and access professional support when needed. Maintenance of provider competence is also challenging because of increasing acuity of homecare patients.[56]

The "Swiss Cheese Model" is a common process applied to prevent these injuries. It is based on the idea that human behavior cannot be made perfect and that most errors are unintentional. Management cannot control what the nurse did not intend to do. Therefore, the system is designed to create multiple layers of protection and shrink the irregular holes through which errors can happen.[35] Figure 2 displays examples of these layers of protection.

Adverse outcomes may be common in health care, such as a patient's lack of response to a carefully planned course of treatment. However, *adverse events*, defined as injury or harm resulting from care, should not be common. Examining infusion therapy processes can easily identify the need for 2 venipuncture attempts as an adverse event. The patient experienced pain and discomfort due to the need to repeat the procedure; nonetheless, this is usually not preventable and there is no error.

A preventable adverse event would include the need for more than 2 attempts to establish 1 peripheral IV site. This is preventable by a high level of operator competency, proper patient assessment for vascular access needs, consistent and strict attention to infection prevention, proper catheter stabilization, and fluid and medication infusion techniques to reduce complications and the need for restarting IV sites.

Preventable adverse events and errors include situations requiring multiple unsuccessful venipuncture attempts. Examples of errors associated with this adverse event include severe delays in treatment for

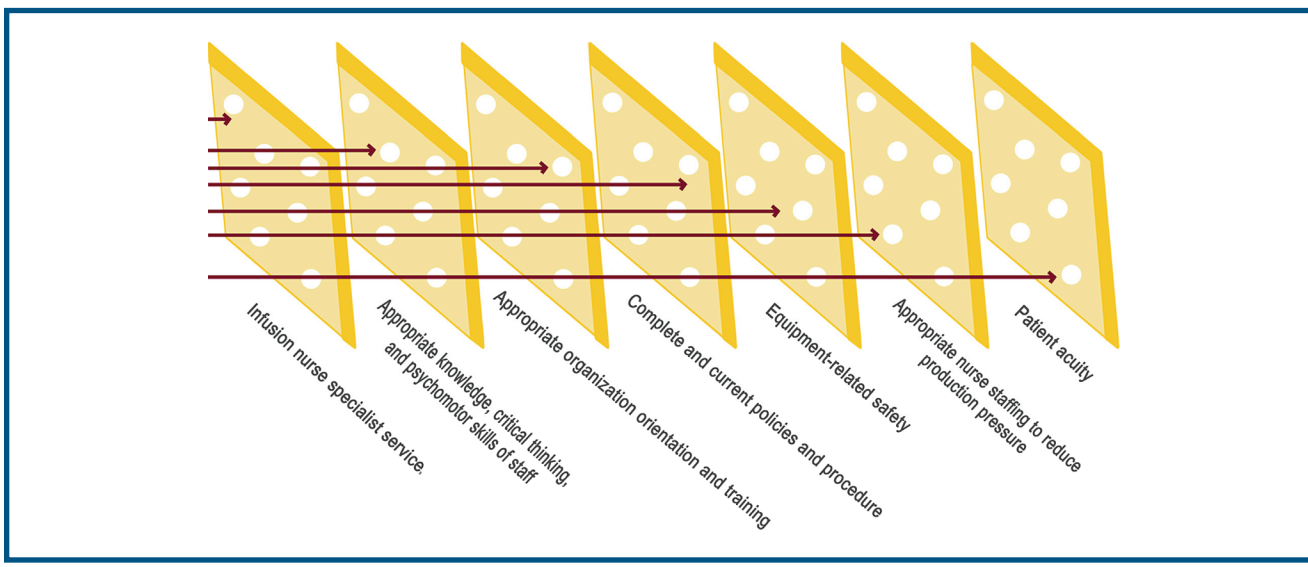

Figure 2 Control measures for preventing infusion-related adverse events. Used with permission from Lynn Hadaway Associates, Inc.

infection leading to sepsis and death, severe delays in treatment for dehydration leading to death, or the final successful IV site distal to other puncture sites leading to extravasation injury and necrotic ulceration.

Trigger tools to screen for these errors could incorporate the number of CR-BSIs, the need for stat or urgent PICC insertions, excessive use of peripheral catheters indicating multiple unsuccessful attempts, orders for vesicant antidotes for extravasation injuries or thrombolytic agents for catheter clearance, surgical procedures for debridement or fasciotomy related to compartment syndrome from infiltration, and surgical procedures for amputation related to intra-arterial injection.

HIGH-RELIABILITY ORGANIZATIONS

Reliability in health care means that patients receive the intended tests, medications, information, and procedures at the appropriate time and in accordance with their values and preferences.[57] High-reliability organizations (HROs) have a preoccupation with failures such as excessive venipuncture attempts, medication errors, catheter complications, and incompatible blood transfusions. There is a reluctance to simplify problems; HROs listen to everyone involved, including all professionals. There is also sensitivity to operations by building in the capacity to shift resources as demands of the system change. High-reliability organizations are also committed to resilience by constantly learning from errors and make a deep obligation to staff development. Finally, but certainly of great significance, is their deference to expertise. Problems are referred to experts, and consultation with experts is readily available. The knowledge, skills, and experience of these experts drive decision making.

A report from the Agency for Healthcare Research and Quality states their interest in HROs and explains their work with senior leadership of many health care systems known to be early adopters of new concepts. While the leaders of these systems were very knowledgeable about patient safety with many initiatives for safety in place, the HRO was not the established basis for their patient safety efforts.[58]

Teams and teamwork are definitive components of HROs, with some researchers stating that a true HRO cannot happen without effective high-reliability teams rooted within the organization.[59] Although more research is required, the need for high reliability is a most pressing demand in the current health care setting.

VALUE-BASED SYSTEM

Currently, the emphasis and financial incentives attempt to limit resources and restrict services as a means of minimizing the cost of each intervention. However, this approach of shifting costs and restricting services only creates false "savings."[60]

Value is the relationship between costs and quality of health care. The emphasis should be on maximizing value over the entire care cycle. The current uncoordinated system of sequential visits to multiple providers serves to work against value. Restructuring the delivery system around a full cycle of care for each medical diagnosis has been suggested. Integrated teams of providers would deliver care defined by patient needs. Measurement of outcomes would be required for all components of the system and would be based on the full cycle of care rather than just 1 intervention.[60]

Although this system promotes care organization around a medical model, there are numerous systems currently in use to measure nursing-related performance. These include the National Database of Nursing Quality Indicators organized by the American Nurses Association with more than 1200 hospitals participating, along with military and regional outcomes databases.[61] These indicators establish the values for nursing practice.

CHANGING REIMBURSEMENT STRUCTURES

Currently, the federal government is the largest single-payer group, with more than two-thirds of hospital reimbursement coming from the Centers for Medicare & Medicaid Services (CMS).[62] Private insurance companies, other private sources such as charitable funds, and individuals are also sources of reimbursement.

The reimbursement structure for health care has a history of change. Prior to 1983, a cost-based approach was used. The prospective payment system began in 1983 with the introduction of DRGs. This is a fixed, predetermined fee based on groupings of diagnoses. In fiscal year 2009, the average DRG base payment rate was $5552.58.[62]

Negotiated rates involve a discounted percentage from the hospital's normal rates, usually in exchange for a guaranteed number of patients. The prospective payment system and negotiated systems have huge implications for the amount of supplies used and length of hospital stay. The payment for services is fixed; therefore, the consumption of more supplies greatly increases costs of care without any additional reimbursement. This has led to significant pressure on nursing and hospitals to conserve supplies and discharge patients more quickly.[63]

Pay-for-performance is a relatively new concept in which payment is based on performance of the health care providers. This could be determined by improvement in patient outcomes, financial performance, or other internal processes.[63]

Value-based purchasing is a form of pay-for-performance initiated by the federal government as

required by the Deficit Reduction Act of 2005. This law requires CMS to select hospital-acquired conditions that no longer qualify for reimbursement. This change represents CMS' approach to become an active driver in quality care rather than a passive payer for services. The criteria for these conditions include those that are high-cost, high-volume, or both; those that are reasonably prevented through the application of evidence-based guidelines; and those that are assigned to a higher-paying DRG when present as a secondary diagnosis.[64]

As of October 1, 2008, a list of 10 preventable complicating conditions no longer qualifies for reimbursement from CMS. The medical record must be very specific about whether this condition was present or was not present on admission. Three of these 10 conditions are directly related to infusion therapy, including vascular catheter-associated infections, air emboli, and blood incompatibility. Several of the remaining 7 conditions also require intensive infusion therapy to either prevent or treat manifestations of poor glycemic control, surgical site infections, and deep vein thrombosis. The complete list and details of these conditions can be found at http://www.cms.hhs.gov/HospitalAcqCond/.

This list of complicating conditions and payment restrictions applies only to hospitals at present. To receive payment, the condition must be present at the time the order for inpatient admission occurs. Conditions that develop during an outpatient encounter, including emergency department or outpatient surgery, are considered as present on admission.

The total reimbursement paid by CMS for these complicating conditions in fiscal year 2007 was more than $22 billion. Centers for Medicare & Medicaid Services records document the payment of more than $3 billion nationally to treat 29 536 vascular catheter-associated infections.[62] An analysis of Medicare payments for selected adverse events in 2002 revealed that less than one-third of the cost was reimbursed to hospitals.[65] This same trend was also identified in a 2006 study by Shannon et al.[66] Fifty-four patients experienced a CR-BSI in medical and coronary intensive care units of 1 hospital from 2002 to 2005. The study analyzed the amount of money reimbursed to the hospital for treatment compared with the actual costs incurred for treating these infections. On average, the payment per patient was $64,894 while the average cost was $91,733 or a loss of $26,839 per patient. The total documented loss for all 54 patients was $1,449,306.[66] These data represent a strong opportunity to make the business case of infusion therapy teams with a strong infusion alliance within an organization.

TEAMS AND TEAMWORK

The use of teams in health care is growing. The knowledge, skills, and attitudes of team members are similar, allowing them to work together effectively while performing interdependent tasks. Teams may be composed of a single discipline or multiple disciplines, but all members share a common goal. Teams are critical to patient safety, with many documenting that teams make fewer mistakes than individuals.[67,68]

Teams are characterized by certain traits. They create plans for action and are adaptable to revise those plans as needed. Effective teams manage conflict through good communication and deal appropriately with poor performers. They are self-evaluating, understand the roles of each team member, and anticipate the actions of other members. Mutual trust and a strong belief in teamwork allow for their success.[67]

As previously discussed, teams are a critical component of HROs and are mandatory for patient safety. There are numerous articles documenting the effectiveness of nutrition support,[69,70] surgical,[71] orthopedic and rehabilitation,[72] pain management,[73] intensive care,[74] and diabetic teams.[75] A systemic literature review of interprofessional collaboration indicates that these efforts produce positive changes in health care. While additional research is needed, factors such as drug use, length of inpatient hospital stay, and total hospital charges have shown improvements with collaboration between professionals.[76]

IMPLICATIONS FOR THE FUTURE

The goal is not to restore what was, but to reform what is. The infusion teams of yesterday were commonly assigned the task of starting and restarting peripheral IV catheters. A few teams were on the opposite end of the spectrum and performed all infusion services for patients on the general medical-surgical units. Neither of these models withstood the tests of time. The team doing only peripheral catheter insertions was not a good use of the complete knowledge and skills of the infusion nurse. Nurses focused on the technical tasks and had such large workloads that there was no time to assess the patient for his or her vascular access needs with regard to the specific fluids and medications being infused. The teams doing all infusion therapy provided an intense learning environment in which the infusion nurse was responsible for all fluid and medication delivery, parenteral nutrition, blood transfusion, and all catheter care. This situation allowed the infusion nurse to function at a high level; however, the primary care nurse was typically not aware of the infusion therapy being provided. Many times, infusion nurses can become embroiled in turf battles between other nurses who want to be involved with the patient's infusion therapy.

Moving forward, the goal is to reform the current delivery system. This article has highlighted the problems with increasing patient complications, the lack of

investment in intellectual capital required for safe infusion therapy, the serious need for intensive communication about infusion therapy among many departments within the organization, and the rapidly changing reimbursement structure. It has assessed barriers and obstacles as well as the trends that support the concept of the infusion therapy team and a supporting alliance.

There is no single model of an infusion therapy team that works for all organizations. Each organization must assess its problems and challenges by collecting and analyzing internal data. These data are then used to determine the appropriate structure needed to improve the identified problems to ensure safe delivery of infusion therapy to patients. This involves making decisions about which professional is the right one to perform infusion-related tasks. Infusion nursing needs clinical outcome data; however, infusion nursing is also seriously lacking financial outcome data from hospital systems where the infusion team is working well.

The infusion nurse specialist sits at the crossroads of most patient-centered services, because infusion therapy is so pervasive. Patient safety, improved clinical outcomes, and strong financial results can be attributed to the work of this vital specialty. The specialty just has to be smarter in making the business case. Patients' lives may depend upon it.

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