Lynn Hadaway, MEd, RN-BC, CRNI®
Lisa Dalton, MBA, BSN, CRNI®, NE-BC
Lorraine Mercanti-Erieg, BSN, RN, VA-BC

Infusion Teams in Acute Care Hospitals

Call for a Business Approach: An Infusion Nurses Society White Paper

Infusion therapy is complex, invasive, high volume, and risk prone, yet required as a lifesaving therapy for many patients. Registered nurses at all levels of education and experience can perform infusion therapy, whereas the scope of infusion therapy practice for licensed practical/vocational nurses varies among states. Many other types of health care professionals (eg, radiology technologists, respiratory therapists, unlicensed assistive personnel) may have responsibility for some aspects of infusion therapy. Patients of all ages receive infusion therapy across all hospital departments, service lines, and specialties. Although infusion therapy is pervasive throughout the entire facility, the business of infusion services has received very little attention, including using appropriate models for infusion cost analysis; cost-effective distribution of infusion therapy responsibilities among professionals and departments; calculating cost avoidance for positive patient outcomes; cost savings on time, supplies, and equipment used; and return on investment from use of infusion teams.

Hospitals have either disbanded infusion teams or downsized these teams to perform only insertions of peripherally inserted central catheters (PICCs)[1]; however, there is no known method to quantify the actual number of infusion teams that have been lost. When these changes occur, the practices previously performed by the infusion team become the responsibility of primary care nursing staff. Anecdotal information suggests that this shift in responsibilities may occur without adequate time and resources to train the nursing staff for their new role.

The outcomes of disbanding or downsizing infusion teams are virtually unknown. A 1998 editorial used details of lawsuits to highlight the serious complications that can occur when nursing staff lack adequate knowledge and skills associated with infusion therapy.[2] Another report provided details of how an infusion team transitioned from 11 nurses to 2 in a 200-bed acute care facility over a 9-month period using a methodical, planned approach. Positive and negative outcomes were discussed; however, no data were provided.[3] Another study focusing on the quality improvement process reported an increase in infusion-related litigation, along with an increase in complaints and questions about infusion care at a 4-hospital system.[4] Numerous discussions with colleagues indicated that infusion teams were being disbanded, leaving no personnel for data collection on complication rates or medication errors. Additionally, challenges associated with patient and clinician safety or patient satisfaction may not have been addressed. These changes are often made in the name of cost savings; however, those data are also not found in the published literature.

Peripheral catheter insertion requires skills derived from experience to minimize patient discomfort and complications, decrease risk of needlestick injury and blood exposure, and enhance patient satisfaction.[5-7] A recent literature review reported first-venipuncture-attempt success rates between 74% and 88% in the general population and 46% to 76% in pediatric patients.[8] Unsuccessful or failed venipuncture attempts are caused by numerous factors.[8-11] Venous depletion, vein wasting, and vein preservation are concepts gaining attention as a means to increase appropriate use of peripheral veins and reduce the need for central vascular

Lynn Hadaway provides contracted consulting services to the following: 3M, BD Medical, Inc., Access Scientific, Inc., Christie Medical, Inc., Elcam Medical, Linebacker Inc., Infrared Imaging Systems, Inc., Terumo Medical, Excelsior Medical Corporation, Ivera Medical Corporation, Baxter Healthcare Corporation, and B Braun Medical, Inc.

The other authors of this article have no conflicts of interest to disclose.

DOI: 10.1097/NAN.0b013e3182a123a9

access devices (CVADs).[9,10,12,13] Excessive venipuncture attempts also increase the cost to the facility through delays in treatment; waste of peripheral catheters, insertion kits, individual supplies, and valuable nursing time; and the need for central venous access when peripheral access proves too difficult. The cost of inserting a short peripheral catheter on the first attempt using 1 catheter, kit, flush syringe, needleless connector, and 20 minutes of nursing time is reported to be $45.[14] Multiple unsuccessful attempts only increase these nonreimbursed costs. A scoring system for difficult venous access in infants has been published; however, this system includes only patient characteristics.[15] Currently, there are no reliable, validated processes for matching the venipuncture skills of the inserter with the specific level of venipuncture difficulty for each patient, yet numerous studies and publications call for this procedure to be performed by experienced personnel.[5-7,16,17]

Two studies have shown the inappropriate or unnecessary use of intravascular (IV) devices in hospital patients, also increasing morbidity, mortality, and health care costs.[18,19] One retrospective study analyzed the incidence of bloodstream infections from PICCs after the downsizing of an infusion team. The absence of infusion nurses increased the number of difficult peripheral catheter insertions, resulting in the need for more PICCs and at the same time preventing the care of these PICCs by infusion nurses. An increase in the number of PICCs was identified; however, there was no corresponding increase in PICC-related bloodstream infections.[10]

Vascular access devices (VADs) are not the only concern. A New Zealand observational study found at least 1 error in 69.7% of 568 IV medication administrations, and 25.5% of these were categorized as serious.[20] Introduction of new pump technology requires development of complex drug libraries and implementation of the devices. Infusion nursing knowledge can positively affect this introduction through collaboration with pharmacy, nursing management, and end users.[21] After identifying causes of IV medication administration errors in an observational study,[22] these authors also called for "someone to take the responsibility for the safe and effective use of drug administration technologies."[23] A point prevalence study identified similar error rates of 66.9%, with only one of these errors being preventable by the infusion pump.[24] A failure modes effect analysis identified many problems with the process of IV medication administration and found that standardizing infusion delivery process reduced the risk.[25] An observational study examined flow rates for IV fluids and reported that only 26% were infused at the prescribed rate, with 67% infused too slowly and 8% infused too rapidly.[26]

Regulatory initiatives have an impact on infusion therapy practices. Hospitals benefit when infusion nurse specialists are involved with implementation of these requirements. The Centers for Medicare and Medicaid Services (CMS) require education for all nursing staff who are giving IV medications and blood transfusions. The CMS outline for blood administration training includes fluid and electrolyte balance, venipuncture techniques with supervised practice, blood components, hospital policies and procedures, verification of the right blood product, patient monitoring, transfusion reactions, and documentation. Education on IV medication administration should include drug administration errors, adverse drug reactions, and drug incompatibilities.[27] Additionally, The Joint Commission has recently defined core measures to establish guidance for transfusion practices. These core measures include transfusion consent, blood component indications, documentation, preoperative anemia screening, and preoperative blood type testing and antibody screening.[28,29] Fluid and electrolytes, transfusion, and pharmacology are 3 of the 8 components for the infusion nursing certification examination. Therefore, infusion nurse specialists (ie, CRNI®s) are well suited to be the subject matter experts for this training.

These are just a few examples of challenges, regulatory requirements, and problems with the delivery of infusion therapy, highlighting the serious need for someone or some specialized group to take ownership of this critical therapy. Infusion nurse specialists have mastered this knowledge through the infusion nursing certification examination and provide this expertise to the hospital.

CURRENT MODELS FOR INFUSION SERVICES

Infusion services in hospitals fall into 3 basic models: primary care, vascular access, and infusion team. Many variations can be found, however.

The primary care model is based on the fact that delivery of all infusion therapy is within the legal scope of practice for all registered nurses. No organized teams exist (Table 1).

Vascular access insertion teams are small groups of skilled experts who focus only on the insertion of PICCs and are now beginning to insert other types of CVADs.[30] CVAD insertion is an important aspect of patient care and is now associated with improved outcomes related to ultrasound for venipuncture and electrocardiogram for tip locations. Nevertheless, the insertion procedure represents only a short time frame in the life of that VAD. Successful and safe completion of infusion therapy requires much more than a successful insertion procedure (Table 2).

Infusion teams, commonly known as IV teams or IV therapy teams, have a wider scope of service. These teams are involved with safe insertion of all types of VADs, as well as serving as the resource for other infusion-related services. The role of change agent is a

TABLE 1
Primary Care Model

Organizational structure
• Specific organization structure for each nursing unit
• Nursing staff available 24/7/365
• CVAD insertion limited to physician availability
Personnel involved
• All LIPs (MD, PA, NP) inserting CVADs
• All nursing personnel inserting PIVs and delivering all infusion therapies
Challenges
• Identifying qualified experts in infusion therapy
• Standardization and coordination of care across all departments (eg, nursing, OR, radiology, outpatient)
• Facility-wide data collection on infusion outcomes
• Facility-wide approach to solving infusion-related problems
• Implementation of standards and guidelines

Abbreviations: CVAD, central vascular access device; LIP, licensed independent practitioner; PIV, peripheral intravenous catheter.

prominent one for infusion nurses through staff development and performance improvement (Table 3).[31]

Large consulting companies are often called in to analyze ways to reduce hospital costs. Anecdotal discussions with nurses from disbanded teams support the idea that eliminating infusion teams is high on companies' planned lists of changes in the name of cost reduction. When challenged, some infusion team managers have provided excellent clinical outcome data that were very useful in avoiding the loss of the team. However, absence of outcome data

TABLE 2
Vascular Access Team Model

Organizational structure
• Nursing, radiology, respiratory therapy
• Limited hours of regular service, on-call after hours
Personnel
• Registered nurses
• Radiology technologists
• Respiratory therapists
Challenges
• Exclusive focus on insertion procedures
• Adequate staffing to support other aspects of infusion services
• Administration support for expansion of services

TABLE 3
Infusion Team Model

Organizational structure
• Nursing, pharmacy
• Service hours vary; 24/7 is common
Personnel
• Registered nurses
• Licensed practical/vocational nurses
• Unlicensed assistive personnel
Challenges
• Lack of published data on return on investment for team
• Vulnerable to cost-cutting processes
• Questionable perceptions of benefits of infusion team

and an exclusive reliance on productivity data alone may outweigh efforts to save the team. Low rates of catheter-associated bloodstream infections, catheter-associated venous air embolism, and other costly complications are more powerful data than the number of peripheral catheter insertions or CVAD dressing changes performed. There are positive clinical outcomes from infusion teams,[32] but we have found no attempt to calculate return on investment from these teams.

Currently, there is a growing emphasis on patient safety and measurement of patient satisfaction, the urgent need to rein in costs by driving waste and inefficiencies from our delivery systems, and radically changing reimbursement structures for health care. At the same time, there is minimal prelicensure education on infusion therapy and vascular access for nurses, pharmacists, and physicians.[33,34] Additionally, the technology of infusion therapy continues to expand without support from well-designed clinical trials to guide appropriate implementation of these devices.

ADDRESSING THESE UNMET NEEDS

In early 2011, the Infusion Nurses Society (INS) formed the Infusion Team Task Force to analyze this current situation. Beginning with a lengthy list of project ideas, it quickly became clear that there had never been an effort to define *IV team*. A frequently asked question is, How many such teams exist in US hospitals? Without a standard definition, there was no way to answer this simple question.

The group's first task was to conduct a survey of the roles, responsibilities, and structures of current teams. This survey was conducted among INS' membership. Based on these responses, "infusion team" was chosen as the most comprehensive and appropriate name for teams

in acute care hospitals and medical centers. The definition that evolved addresses the organization structure, role, and scope of services and clearly states the goals for infusion teams.

Infusion Team Definition

The *infusion team* is defined as a group of nursing personnel centrally structured within an acute health care facility charged with the shared mission of outcome accountability for the delivery of infusion therapy. Although this team may not be directly providing each infusion, it provides the advanced knowledge for safe practices to support the primary care staff. Thus, the roles of infusion team members include direct care providers, educators, consultants, coaches, mentors, advocates, coordinators, and managers.

This team is led by infusion nurse specialists (eg, CRNI®s) and may contain a staff mix of registered nurses, licensed practical nurses, and unlicensed assistive personnel. Unlicensed team members work under the direction of the licensed professional infusion nursing staff.

The scope of services for the infusion team consists of a variety of activities related to the safe insertion, delivery, and maintenance of all infusion and vascular access therapies, including fluids and medications, blood and blood components, and parenteral nutrition. The identified services of this team should be based on the fact that infusion therapy is needed in all areas of the organization and by all ages of patients/clients. This team will provide guidance for establishing policy and practices according to the nationally recognized *Infusion Nursing Standards of Practice*.[5]

Goals for this team include accuracy, efficiency, and consistency for safe delivery of all infusion services, along with reduction and/or elimination of complications. Meeting this goal will reduce liability, lower costs, and decrease length of stay while promoting vascular preservation, greater patient satisfaction, and better outcomes.

Responsibility for performing direct clinical practice should be divided between the infusion team and the primary nursing staff based on documented clinical outcomes, patient populations and their specific needs and risks, and the complexity of the knowledge and skill(s) required to perform each nursing intervention.

The Centers for Disease Control and Prevention and published research recognize that the use of teams in the health care setting reduces mistakes and enhances patient safety, thereby indicating that the use of an infusion team is strongly recommended for all health care organizations.

THE BUSINESS ASPECTS OF INFUSION SERVICES

Given the current rates of complications, costs, waste, and inefficiencies in our current processes, there is little doubt that each hospital or medical center must devote attention to infusion therapy—an invasive therapy that touches virtually all patients entering the facility. We propose that each facility make an assessment of its current outcomes related to infusion services. This assessment should include peripheral and central catheter-associated infections; catheter-associated air emboli; and infiltration and extravasation and the resulting compartment syndrome, necrotic ulcers, and nerve injuries related to all VADs. Consider the fact that the first list of 10 hospital-acquired conditions included 3, or 30%, that are infusion related: vascular device-associated infection, air emboli, and blood incompatibility. Moreover, the ECRI Institute's 2012 list of health technology hazards includes 3 of 10 hazards that are infusion related—alarm hazards, medication administration errors using infusion pumps, and needlesticks and other sharps injuries.[35]

The current fiscal constraints of health care require a careful assessment of the current methods for delivery of these vital infusion services. Delivery methods for providing safe patient care with positive, lower-cost outcomes may vary between facilities. For some, it may mean continuation of a primary care model, although improving outcomes will need to be facilitated by a heavy investment in staff development. For others, the most cost-effective method may be to invest in the development or expansion of an infusion team. Regardless of the chosen approach, it is clear that a lack of attention to this invasive and potentially dangerous therapy increases problems, complications, patient dissatisfaction, and costs. A focus on the business aspects of infusion delivery in acute care hospitals is required. INS believes that this attention will serve to concurrently improve clinical outcomes as well.

REFERENCES

1. Quarello F, Bonello F, Boero R, et al. CAPD in a large population: a 7-year experience. *Adv Perit Dial*. 1989;5:56-62.
2. Ryder M, Scott W, Helm A. Is downsizing and disbanding specialty care teams a counterproductive strategy for cost reduction in health care? *Nutrition*. 1998;14(9):725-728.
3. Miller PK. Downsizing. Use intravenous clinicians to maintain quality venous access care. *J Intraven Nurs*. 1998;21(2):105-112.
4. Eisenberg P, Painter JD. Intravascular therapy process improvement in a multihospital system: don't get stuck with substandard care. *Clin Nurse Spec*. 2002;16(4):182-186.
5. Infusion Nurses Society. Infusion nursing standards of practice. *J Infus Nurs*. 2011;34(suppl 1):S1-S110.
6. O'Grady N, Alexander M, Burns L, et al; and the Healthcare Infection Control Practices Advisory Committee (HICPAC).

Guidelines for the Prevention of Intravascular Catheter-Related Infections. http://www.cdc.gov/hicpac/BSI/BSI-guidelines-2011.html. Accessed April 1, 2011.
7. Jacobson A, Winslow E. Variables influencing intravenous catheter insertion difficulty and failure: an analysis of 339 intravenous catheter insertions. *Heart Lung*. 2005;34(5):345-359.
8. Sabri A, Szalas J, Holmes KS, Labib L, Mussivand T. Failed attempts and improvement strategies in peripheral intravenous catheterization. *Biomed Mater Eng*. 2013;23(1):93-108.
9. Hawes M. A proactive approach to combating venous depletion in the hospital setting. *J Infus Nurs*. 2007;30(1):33-44.
10. Ajenjo MC, Morley JC, Russo AJ, et al. Peripherally inserted central venous catheter-associated bloodstream infections in hospitalized adult patients. *Infect Control Hosp Epidemiol*. 2011;32(2):125-130.
11. Kuensting L, DeBoer S, Holleran R, Shultz B, Steinmann R, Venella J. Difficult venous access in children: taking control. *J Emerg Nurs*. 2009;35(5):419-424.
12. Pettit J. External jugular cannulation in infants and children. *J Infus Nurs*. 2009;32(2):93-97.
13. Dychter SS, Gold DA, Carson D, Haller M. Intravenous therapy: a review of complications and economic considerations of peripheral access. *J Infus Nurs*. 2012;35(2):84-91.
14. Roszell S, Jones C. Intravenous administration issues: a comparison of intravenous insertions and complications in vancomycin versus other antibiotics. *J Infus Nurs*. 2010;33(2):112-118.
15. Yen K, Riegert A, Gorelick MH. Derivation of the DIVA score: a clinical prediction rule for the identification of children with difficult intravenous access. *Pediatr Emerg Care*. 2008;24(3):143-147.
16. Larsen P, Eldridge D, Brinkley J, et al. Pediatric peripheral intravenous access: does nursing experience and competence really make a difference? *J Infus Nurs*. 2010;33(4):226-235.
17. McGowan D, Wood S. Developing a venous assessment tool in IV chemotherapy administration. *Br J Nurs*. 2008;17(3):158-164.
18. Tiwari MM, Hermsen ED, Charlton ME, Anderson JR, Rupp ME. Inappropriate intravascular device use: a prospective study. *J Hosp Infect*. 2011;78(2):128-132.
19. Barlow G, Palniappan S, Mukherjee R, Jones M, Nathwani D. Unnecessary peripheral intravenous catheterisation on an acute medical admissions unit: a preliminary study. *Eur J Intern Med*. 2002;13(6):380.
20. Westbrook JI, Rob MI, Woods A, Parry D. Errors in the administration of intravenous medications in hospital and the role of correct procedures and nurse experience. *BMJ Qual Saf*. 2011;20(12):1027-1034.
21. Harding AD. Increasing the use of 'smart' pump drug libraries by nurses: a continuous quality improvement project. *Am J Nurs*. 2012;112(1):26-35.
22. Taxis K, Barber N. Causes of intravenous medication errors: an ethnographic study. *Qual Saf Health Care*. 2003;12(5):343-347.
23. Taxis K. Who is responsible for the safety of infusion devices? It's high time for action! *Qual Saf Health Care*. 2005;14(2):76.
24. Husch M, Sullivan C, Rooney D, et al. Insights from the sharp end of intravenous medication errors: implications for infusion pump technology. *Qual Saf Health Care*. 2005;14(2):80-86.
25. Apkon M, Leonard J, Probst L, DeLizio L, Vitale R. Design of a safer approach to intravenous drug infusions: failure mode effects analysis. *Qual Saf Health Care*. 2004;13(4):265-271.
26. Rooker JC, Gorard DA. Errors of intravenous fluid infusion rates in medical inpatients. *Clin Med*. 2007;7(5):482-485.
27. Centers for Medicare and Medicaid Services. Revised Appendix A: Conditions of participation and interpretive guidelines for hospitals. http://www.cms.gov/Regulations-and-Guidance/Guidance/Transmittals/downloads/R72SOM.pdf. Published November 18, 2011. Accessed April 11, 2013.
28. Tolich DJ, Blackmur S, Stahorsky K, Wabeke D. Blood management: best-practice transfusion strategies. *Nursing*. 2012;43(1):40-47.
29. The Joint Commission. *Implementation Guide for the Joint Commission Patient Blood Management Performance Measures*. Oakbrook Terrace, IL: The Joint Commission; 2011.
30. Robinson MK, Mogensen KM, Grudinskas GF, Kohler S, Jacobs DO. Improved care and reduced costs for patients requiring peripherally inserted central catheters: the role of bedside ultrasound and a dedicated team. *J Parenter Enteral Nutr*. 2005;29(5):374-379.
31. Harpel J. Best practices for vascular resource teams. *J Infus Nurs*. 2013;36(1):46-50.
32. Rutledge D, Or M. Effectiveness of intravenous therapy teams. *Online J Clin Innov*. 2005;8(2):1-24.
33. Hadaway L. Development of an infusion alliance. *J Infus Nurs*. 2010;33(5):278-290.
34. Huang GC, Newman LR, Schwartzstein RM, et al. Procedural competence in internal medicine residents: validity of a central venous catheter insertion assessment instrument. *Acad Med*. 2009;84(8):1127-1134.
35. ECRI. Top 10 technology hazards for 2012. *Health Devices*. 2011;40(11):358-373.