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Cost Containment and Infusion Services

Abstract

The implementation of the Medicare Prospective Payment System (MPPS) has placed pressure on healthcare organizations to decrease patient length of stay without adversely affecting outcomes. This article discusses the impact of the MPPS on clinicians who provide infusion therapy, and examines methods for containing costs related to infusion care such as advanced planning and accurate vascular access device selection.

The overall makeup of the healthcare system transitioned after the implementation of the Medicare Prospective Payment System in the 1990s. "Revenue production on a hospital inpatient" became a passé label, and "revenue saving on the DRG [diagnosis-related group]" took its place. The new aim is to decrease hospital length of stay (LOS) without altering patient outcome. What impact does this change have on the skilled infusion professional?

A hospital administrator may envision an infusion team as disposable because it is assumed that any nurse can insert a conventional peripheral catheter. But is it true that all nurses will insert a catheter with the same level of skill? A Press Ganey survey of almost 1.8 million patients in more than 1,000 hospitals shows that this is not true.[1] In fact, 58% of patients are dissatisfied with the venipuncture skill level of their nurse, and 52% are not satisfied with the courtesy of the nurse inserting the catheter.[1] Barton et al[2] and Danek and Kilroy[3] from the University of Florida indicate that a clinician requires 2.18 attempts to achieve a successful catheter insertion. Therefore, it appears that the infusion team is not indispensable.

On the basis of financial data collected at Oregon Health Science University by Santolucito,[4] a successful peripheral catheter insertion costs $32. If that data is integrated with the study done by Barton et al[2] and Danek and Kilroy,[3] a successful peripheral catheter insertion is shown to cost $69.76. At what cost to the hospital is the elimination of the highly skilled infusion team when a legal litigation of an infiltration with resultant nerve injury costs $650,000?[5]

An infusion team can provide the hospital with even greater savings in the form of vascular access planning.

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As Santolucito[4] pointed out, 30% of peripherally inserted central catheters (PICCs) are placed at patient discharge on day 8 of the hospital stay as an "emergency PICC." The patient often has to stay an extra day or two to have a PICC placed in the costly interventional radiology department. This lack of proactive vascular access planning can result in cost losses amounting to 20% of the DRG payment, whereas proactive planning can result in a 2% overall loss of the DRG.[4] Barton et al[2] and Danek and Kilroy[3] indicated that 13% of their study patients had 7 or more days of infusion therapy through short peripheral catheters, and that the vascular access needs of the patient were not met from the outset of a patient's stay. After the implementation of a triage algorithm to plan vascular access, the hospital saved $500,000 in LOS costs in 1 year.[3] This cost savings could have paid for an entire full-time infusion team.

Placement of PICCs in patients at discharge or when all available vasculature has been exhausted are a source of extra cost for a hospital. The vascular access needs of an 82-year-old patient from a nursing home with chronic leg wound infection differ from those of the general short-stay patient. The goal of the infusion team is to recognize and improve vascular access planning by reengineering its process to include vascular access triage. To accomplish this goal and place a PICC at the bedside (instead of a more costly insertion in radiology), the infusion team must incorporate high-tech tools that require the modified Seldinger technique and portable ultrasound. This will provide the team with an 85% to 98% PICC insertion success rate for all orders, not just those attempted, thereby almost matching the success rate of the radiologists. The infusion team of today challenges the perception that it is a revenue loser.

• PAST AND PRESENT HOSPITAL REIMBURSEMENT

In 1972, hospital reimbursement was based on "reasonable" cost. Payment for hospital services from 1972 until 1983 was based on charges for individual line items.[6] Pharmacy departments instituted infusion therapy teams as a means of controlling lost charges for tubings, dressing change kits, pumps, and short peripheral catheters. The greater the volume of charges for material line items, the higher the payment the hospital received. Under a cost basis reimbursement system, there is little incentive to improve on a process.[7] With this system, hospitals benefited financially from the 24-hour intravenous (IV) tubing rotation, repeated peripheral catheter insertions and restarts, routine central catheter dressing changes, and the complete delivery of infusates to the patient while in the hospital setting.

Before the late 1980s, infusion teams produced revenue for the hospital and pharmacy department. This, in turn, catapulted the growth of the infusion professional. However, a cost basis system for reimbursement restricted the opportunity for healthcare improvement unless that improvement used more hospital days and more supplies. Rising Medicare expenditures led to an overhaul of the payment system.

In 1983, the Reagan administration reengineered the hospital payment system to control operational costs and focus physicians, clinicians, and hospital administrators on the healthcare process rather than the consumption of labor and materials. This reengineering led to the implementation of the prospective payment system (PPS) in the late 1980s.[6] Payment for Medicare services by DRGs was initiated as part of PPS.[6] Specific reimbursements have been established for more than 500 diagnostic categories.[6] A DRG has a relative weight that represents the cost of treating such a patient relative to the average for all patients. A dollar figure is multiplied by the weight to give the payment level. For example, in South Carolina in May of 1987, the average relative unit payment rate was $1,263.[7] Coronary bypass with cardiac catheterization represented DRG 106 and had a relative weight of 8.92, which resulted in a hospital reimbursement of $11,272 per patient admission.[7] South Carolina hospitals had to perform a bypass in 1987 for $11,272.[3]

Each year, DRG reimbursements are updated by Medicare to reflect inflationary changes, and may increase or decrease. The reimbursement associated with each DRG is fixed, nonnegotiable, and all inclusive. That is, all materials, services, labor, and the like are provided at a fixed DRG reimbursement. For an infusion team, it is no longer financially feasible to perform 24-hour administration set changes, repeated dressing changes, or multiple peripheral catheter starts and restarts, or to complete the entire infusate delivery in the hospital setting. Performing care in a task-oriented manner is no longer cost effective or outcome oriented. Instead, improving on the process of infusate delivery is cost effective.

The financial implications of the DRG payment are fairly clear. First, cost control becomes critical to long-term financial viability. At this point, the majority of payers have recognized the DRG payment methodology or have used a generous discounted fee contract with hospital systems.[7]

The DRG system of reimbursement encourages hospital administration to decrease resources such as infusion teams to reduce the direct cost of labor. However, such a decision is short sighted because an infusion team using critical thinking skills can save revenue by implementing a proactive approach to vascular access planning instead of relying on the reactive approach used from the 1970s through the 1990s. In addition, if the team improves on the current delivery model of care, they may be able to control the direct costs associated with multiple or un-

successful venipunctures, catheter-related bloodstream infections, and catheter replacement.

What does the DRG system of reimbursement mean to the infusion team of 2005? The infusion team's goal should be to help the hospital administrator produce a given DRG at a reasonable cost.[7] An infusion team can contribute to cost reduction in the following manner:

- Reduce the prices paid for resources[7]
  - Decrease the number of unsuccessful PICC insertions
  - Decrease the number of PICC insertions referred to the interventional radiology department
  - Maintain an 80% or higher insertion success rate for the first attempt at all conventional peripheral venipunctures
  - Declot rather than replace occluded central catheters
- Reduce the patient's hospital LOS[7]
  - Place a PICC at admission rather than discharge to encourage early discharge planning for alternate site infusion
  - Reduce the cost of incomplete drug infusions or late drug delivery by providing a reliable infusion device
  - Decrease the risk of nosocomial catheter-related bloodstream infection (CR-BSI)
- Reduce the intensity of service provided[7]
  - Reduce the number of unnecessary peripheral starts and restarts by providing a reliable vascular access device at patient admission rather than on the day of discharge
- Improve production efficiency[7]
  - Implement a vascular access planning program
  - Use tools to decrease the time for placement of a PICC and improve insertion proficiency
  - Reengineer infusion teams, dedicating specialized staff to high-tech procedures full-time rather than task-oriented site checks, multiple repetitive peripheral catheter reinsertions, and repetitive timed dressing changes.

COST REDUCTION WITH VASCULAR ACCESS PLANNING

An infusion team can have a significant impact on a hospital's goal for production efficiency: LOS reduction as well as materials and labor conservation. The LOS in the hospital setting has dropped over the past 5 years as a result of inpatient PPS implementation. Hospitals are paid by a fixed DRG regardless of the patient's LOS. For instance, in a study by the Business Council of New York State, Minneapolis had a 4.0 average patient LOS in 2002 and Syracuse had an average of 5.5 patient days the same year.[8] Minneapolis used an average of 1.5 patient days less per patient admission than Syracuse. This resulted in considerable savings for Minneapolis, as both cities are paid a similar DRG rate per patient case.

Taheri et al[9] evaluated the cost savings resulting from LOS reduction in 1998. The results from their study indicate that although larger costs are incurred at the initiation of service, the hospital can save $304 in direct costs or $420 in total costs by decreasing a patient's LOS.[9] This amounts to a 3% reduction of overall direct and indirect costs.[8] Taheri et al[9] stated that the hospital should focus on process changes during the early stages of admission, when resource consumption is intense, to reduce higher costs.

The implementation of an early vascular access assessment program to reduce repetitive peripheral restarts followed by a PICC insertion at discharge would indeed be a process change. Although its day of discharge operational costs are low, Minneapolis is saving 1.5 patient days, or $456 per patient discharge, as compared with Syracuse. If St Joseph's Hospital in Syracuse admits more than 18,000 patients a year,[10] as it does, the savings loss they incur is $8.2 million a year.

Hospital LOS does have a cost impact. According to the National Hospital Discharge Study released by the Centers for Disease Control and Prevention (CDS), the average LOS nationally has dropped from 7.8 days (1970)[11] to 7.1 days (1990)[8] to 4.9 days (2001).[8] The decrease in the average LOS for elderly patients was even more dramatic, from 12.6 days (1970) to 5.8 days (2001).[11] Anecdotal reports indicate that the current hospital LOS (2004) is at an average of 3.4 to 6.0 days, depending on the state and particular hospital. However, the PICC candidate is not the patient who stays an average of 3.4 to 6.0 days. Often, the PICC patient stays 6 or more days and is an outlier consuming hospital resources. Typical PICC patients are those with infections or infectious diseases such as chronic ulcers and postoperative infections. These patients often are elderly and likely to have coexisting medical conditions that do not precipitate an early discharge. Reliable drug infusion via a reliable vascular access device from the onset of therapy can precipitate outcome improvement and the potential for decreased LOS.

Therapy provided with peripheral catheters is not likely to be consistent and uninterrupted, especially if the drug of choice is vancomycin (pH 2.4-4.5), a vesicant. The placement of a reliable catheter for alternate infusion at the start of therapy can prompt case managers to plan an earlier discharge (to an alternate infusion delivery site), instead of an planning for alternate infusion at the end of a patient stay on day 7.

Patients who stay beyond the average LOS are considered DRG outliers. These patients consume hospital resources beyond 6 days and are revenue losses. For special circumstances in which care has been costly, there is additional payment. However, those conditions are limited to a small outlier group. Tables 1 and 2 illustrate the

TABLE 1

Geographic Hospital Length of Stay Comparison 2001[12,13]

Geographic Region	2001 Average Patient LOS
Northeast	5.4
Midwest	5.4
South	5.6
West	5.2

average LOS breakdown in 2000 and 2001 (geographic) for hospitalized Medicare patients. In 2000, 29.5%[12,13] of all hospitalized Medicare patients had a LOS longer than 6 hospital days. In their 2002 guidelines, the CDC indicated that patients who have 6 or more days of infusate delivery are prime candidates for midline or PICC consideration.[14] According to this theory, 29.5% of each hospital's yearly admissions were assessment candidates for a midline or PICC in 2000. It has been projected that this figure may rise by 10% to 20%.

Medicare and Medicaid made up over 50% of the payer base in 1997.[15] Currently, that overall figure, subjected to PPS reimbursement, likely would be higher. What does Medicare pay for a DRG, and how can an infusion team influence that payment? The obvious answer is by facilitating a reduction in patient LOS and multiple peripheral catheter insertions, which in turn would save revenue on the DRG payment. For example, in 2000 the Medicare DRG 079, for respiratory infections and inflammations involving a patient 17 years of age or older with complicating conditions, paid $8,234 and had an average LOS of 8.5 days.[12] In other words, the hospital was working on $968.70 a day to treat this patient. If this patent stayed 10 days, the hospital was working on $823 instead of $968 per day. If the patient stayed 5 days, the hospital was working on $1,646.80 a day and likely to save revenue on the DRG because the cost of treatment would have been less than the Medicare payment, allowing the hospital to make a profit.

This particular DRG (079) often includes patients whose veins are complicated by congestive heart failure, diabetes, oral steroids, and the like. These patients routinely exhaust their peripheral access and need to finish infusion therapy with a PICC. The cost loss and revenue savings associated with a reactive versus a proactive approach to vascular access planning. Late vascular access planning can result in 20% of the DRG 079 payment being used rather than 2% of the same payment with proactive planning.

TABLE 2

National Medicare Hospital Length of Stay Breakdown (2000)[12,13]

LOS	Percent of Patients	Total Percent
1-3 days	41.4	41.4
4-6 days	29.1	70.5
7-14 days	22.6	93.1
15 > days	6.9	100

Placement of a PICC after venous exhaustion and expensive peripheral venipunctures is not a cost-effective method when a hospital is paid on a set rate and the patient's medical condition, diagnosis, or drugs constitute the need for a PICC. In the case of osteomyelitis and cellulitis, which have a lower relative weight, reactive vascular planning could consume 40% of the DRG payment, as compared with 20%. A hospital that does not initiate a vascular access planning program is not financially prudent in its operations. There are proactive planning programs in the United States hospital system for wounds, nutrition, patient fall, and pain control, yet 90% of all patients receive vascular access, and there is no national proactive planning process.

Curran[16] reported that the average patient LOS at one Midwest hospital is 4.7 days for Medicare patients and 3.7 overall. The average payment cost per adjusted discharge for a patient is $4,670.[12] The hospital's operating margin for financial viability is less than 3%.[16] If Medicare patients stay more than 4.7 days, the hospital faces a financial loss. An 82-year-old patient from a nursing home with a chronic leg wound and diabetes is not likely to have a 4.7-day LOS. This patient is a prime target for vascular access planning at admission.

The hospital in Curran's study is working on $993 a day for treatment of the average Medicare patient. If a patient needs to have a PICC placed in interventional radiology, ordered on the day of discharge with an average operational placement cost of $850,[4] the hospital operates at a loss for the last day of the patient's 4.7-day stay. The funds for the entire last day of stay provide the funding for the PICC insertion. The hospital now has no funds for nursing services, pharmacy drugs, meals, housekeeping, and other duties. If that patient stays longer than 4.7, days it is doubtful that the hospital will break even.

Santolucito[4] reported that 30% of PICCs are placed on the day of discharge or the day before discharge at Oregon Health Science University Hospital (OHSU). She noted that the mean LOS before PICC insertion was 8 days, which means that patients have 8 days of peripheral therapy before the placement of a PICC. It is crucial to implement vascular access triage mechanisms to revenue save on the DRG. If Curran's hospital has an osteomyelitis patient with an 8-day LOS, the cost available to treat the patient is $584 a day, and it would take 1½ days to pay for the operational cost of a PICC insertion in radiology at discharge. The main goal is to place a PICC at admission and prepare the patient for alternate infusion services in a timely manner. The implementation of a proactive approach to vascular access decision making allows the in-

fusion team to become a DRG revenue saver in LOS and operational cost losses associated with multiple peripheral catheter insertions and PICC referral to radiology.

Often, the infusion team, overwhelmed with low-level tasks such as repetitive peripheral venipunctures, repetitive central catheter dressing changes, site checks, blood draws, IV push drugs, blood administration, and the like, are unable to find the time for proactive evaluation of patients who are candidates for PICCs. The implementation of an early assessment program involves a process change with a focus on diagnosis, infusate therapy, underlying medical history, alternate infusion needs, and vascular integrity. The adoption of a proactive approach to revenue saves the hospital funds spent for labor, materials, and transport while improving patient outcomes.

According to the American Hospital Guide 2003, OHSU, where the study on timeliness was conducted, admitted 23,655 patients in 2003.[10] If 5% (1,183) of these patients needed a PICC and if the infusion team proactively inserted that catheter at admission, resulting in a 1-day LOS savings, the infusion team would contribute to a $496,860 LOS savings a year. An average nursing position without benefits cost a hospital in the Pacific region $58,213 a year.[17] The cost savings with proactive vascular assessment and LOS reduction pays for 8.5 full-time infusion nursing employees. This savings attributable to early vascular access planning does not include elimination of repetitive peripheral restarts or the complications and unreliability in medication delivery associated with them.

The value of an infusion team is not in the performance of routine tasks, but in the process change involved with proactive vascular access planning at patient admission. Few hospitals have implemented a proactive approach to vascular access planning on the front end of therapy.

A nursing study performed at the University of Florida exemplifies the implementation of a proactive approach to vascular access planning and the subsequent LOS cost savings.[2] The study findings indicate that 22,589 patients received infusion therapy in 1995, and that 25% of these patients had infusion therapy for 7 or more days. Peripheral infusion therapy was used exclusively for 2,878 patients who had 7 or more days of therapy. Of all the patients admitted to the hospital, 13% had peripheral therapy for 7 or more days accompanied by restarts. A review of the data from 371 patients showed that the mean number of insertion attempts for successful venipuncture was 2.18, and that 27% of the patients had a treatment delay because of vascular access. To provide reliable infusate therapy, the hospital implemented a vascular access planning algorithm with physician and clinical education. The results, published in the hospital newsletter, indicate a 6- to 4-day decrease in LOS for the study patients and a projected savings of $500,000 per year associated with that decrease in LOS. In addition, the direct variable cost per patient declined from $2,528 to $1,734. One of the study's authors stated that good decision making regarding types of vascular access helps to improve overall patient satisfaction, avoid delays in therapy, and reduce LOS.[3]

According to the financial example previously given for DRG 079 (pneumonia with complications), the LOS in 1994 for pneumonia in Arizona, a state with a large elderly population, was 5.7 days, whereas the LOS for New York, a state without a notably large elderly population was 9.8 days.[18] Arizona has, as determined by the author's 10-year experience in the PICC marketplace, one of the highest usage rates of PICCs per patient admission in the United States, and New York has one of the lowest. It is doubtful that this is the only rationale for the lower LOS in Arizona. However, the proactive vascular planning process that has become commonplace in Arizona certainly is not a detriment to achieving a shorter LOS. The cost of delivering antibiotics for the average pneumonia case has been cited at $228.70 per case.[18] The total cost of a case in 1994 averaged $5,855, with Arizona having an average cost of $4,957 per case and New York having an average cost of $6,074.[18] The study was adjusted for employee wage rates because New York has higher wages than Arizona.

As with all process changes, some areas of the country embrace changes sooner than others. Arizona hospitals have high-tech PICC insertion teams and infusion teams that have reengineered their process to include vascular access planning. Their thought process shift is likely to have contributed to their LOS decline. It is interesting to note that the cost of parenteral antimicrobials is low, at $228.70.[18] However, the cost to deliver those antibiotics in New York could be $1,338[4] for a 9.8-day LOS (nine peripheral catheter insertions and a PICC placement in radiology after exhaustion of vascular access).[18] In Arizona, the cost to deliver $228.70[18] worth of parenteral antimicrobials might be an overall cost of $200[4] for a nursing-based PICC placement at admission.

• COST REDUCTION WITH INCREASED PROFICIENCY IN VENIPUNCTURE

Barton et al[2] stated that the mean number of insertion attempts needed to place a successful peripheral catheter was 2.18 in their study at the University of Florida. Each patient had approximately two attempts for every successful cannulation. She also stated that patients experienced 1 to 14 insertion attempts, with 27% of patients requiring three or more insertion attempts.[2] This data came from a study of 371 patient charts. On the basis of OHSU figures, the operational cost for each successful peripheral catheter insertion is $69.76.[4] If this study holds true nationwide, the insertion success rate for peripheral cannulations is 40% at the first attempt.

One of the largest studies based on patient satisfaction was conducted recently and published in 2003 by Press Ganey.[1] The study included 1,137 hospitals and 1,759,472 patients. One of the 10 issues most highly correlated with the likelihood of the patient recommending the hospital was the skill of the nurses (2003 study). The top 10 patient parameters associated with dissatisfaction in 2003 were not clinical complaints (room temperature, food quality, noise level, speed of admission process, equipment function). The findings for the first clinical parameter (number 11) show that 58% of the patients surveyed expressed dissatisfaction with the skill level of the person inserting their catheter. A total of 47 parameters were measured, and the 11th complaint was venipuncture skill. In addition, 52% of the patients were dissatisfied with the courtesy of the nurse inserting their catheter. Overall, only 37% of the patients were dissatisfied with nursing skill, yet those who required vascular access had a 21% higher dissatisfaction rate. These findings are significant, and they correlate with the University of Florida study that found only a 40% insertion success rate for peripheral catheter insertions at the first attempt.[2]

Seven years before the aforementioned Press Ganey study, the company's 1996 study indicated that dissatisfaction with venipuncture skill was at 18%, and that only 8% of patients were unhappy the courtesy of the person performing their venipunctures.[19] Overall, dissatisfaction with the skill of nursing was at 8%, but things have changed from 1996 to 2003. Patient dissatisfaction with the venipuncture skill level has increased significantly, from a dissatisfaction of 18%[19] in 1996 rising to 58% in 2003.[1]

What caused the increase in dissatisfaction with the venipuncture skill level over 7 years? Some possibilities include the following:

1. Specialized infusion teams have been eliminated or downsized.
2. Current nursing staff lacks education and skill in performing venipunctures.
3. As a result of the nursing shortage, the nursing staff may lack the time to be courteous and skillful in performing venipunctures.
4. Patient vessel integrity has declined as patients live longer, have chronic illnesses, and experience comorbidities
5. There has been an increase in patients with a diagnosis of diabetes and those receiving steroids, both of which destroy vessel integrity.
6. There are more than 500 injectable drugs with very acidic or basic pHs and high osmolarities that cause phlebitis, infiltration, and extravasation, often in fewer than 48 hours of dwell time.
7. Patients are receiving multiple and incompatible drugs in a given day.
8. There is a lack of vascular access planning at patient admission.

The author believes that the problem cannot be blamed on one condition, but is attributable to all eight of the preceding conditions. The cause lies in the fact that patients are aging, getting sicker, and becoming chronically ill. At the same time, their vascular integrity is diminishing, infusates are harsher on the vasculature, and the number of full-time vascular access professionals is declining in the hospital setting.

What is the cost of this patient dissatisfaction to hospital executives? If each peripheral catheter requires 2.18[2] cannulations at a cost of $69.76,[4] as Barton pointed out, a short-term hospital stay can become a very costly enterprise. Press Ganey states that the average LOS in 2001 was 4.9 days.[1] If the *Infusion Nursing Standards of Practice* are met, that means the average patient has one start and one restart (for every 72-hour change).[20] The cost for peripheral catheter insertions based on the University of Florida's insertion success[2] and OHSU costs[4] is equivalent to $139.52 for this stay, and the patient experiences about five needlesticks, without considering phlebotomy, which may increase the needlesticks to 10. It is no wonder that the average patient is dissatisfied with the venipuncture skill of the nurse. This leads to the question whether patients are becoming pin cushions and whether legal ramifications are associated with this practice.

In the current era of medical error and litigation, the cost of complications during venipunctures and infusate delivery in a court of law must be taken into consideration. What is the legal cost of a peripheral catheter infiltration that causes nerve injury? In a Texas case, a $650,000 settlement was reached for a patient who sustained permanent nerve injury from a catheter in her right hand.[5] The patient tried to alert nursing staff of her arm pain, swollen extremity, arm numbness, and hand discoloration, but her complaints went unheard.

What is the legal cost of a peripheral extravasation? At St Peter's Medical Center in New Jersey, the jury awarded a patient $1.5 million dollars in damages for a hand extravasation of a vesicant that caused disfigurement and required orthopedic surgery. The judge later reduced the award to $500,000.[21] The infusion site from which the doxorubicin hydrochloride and vincristine sulfate were administered was in the patient's right hand, a location not recommended for a vesicant administration according to the Oncology Nursing Society Chemotherapy and Biotherapy Guidelines and Recommendations for Practice.[22]

What is the most recent cost for infiltration of a vesicant drug resulting in loss of a limb and permanent nerve injury if the drug is promethazine hydrochloride? In a Plainfield Health Center case, settled out of court, the patient obtained a settlement from Wyeth Pharmaceuticals for 7.4 million dollars.[23] Considering that this patient was

younger than 30 years and lost a limb, it is doubtful that the healthcare facility settlement was less than $1 million.

The cost of one legal case per year involving hand infiltration could provide a hospital with enough money to maintain a staff of 10 full-time infusion nurses (benefits not included).[17] At what cost and risk does a facility overlook the need for a skilled professional with knowledge of the guidelines for drug administration and vascular anatomy site selection? The three aforementioned case examples show the legal liability and the costs of medical errors involving infusion therapy.

What is the real cost of disbanding or downsizing an infusion team considering the expense for venipunctures in terms of labor, materials, complications, and patient dissatisfaction? The author, as a former peripheral catheter sales representative, has seen catheter usage double in hospitals that eliminated their infusion teams. Although there was a significant increase in personnel income, the elimination of infusion teams left hospitals with the question of how to implement cost-effective vascular access planning programs. Hospitals often have used the "two sticks and you're out" program. That is, they allow a nurse two sticks per attempt. "Two sticks and you're out" can mean three nurses each try two times for a total of six venipunctures to every successful start.

Proficiency level in venipuncture is not innate, but rather involves repetition and education. There is no standard associated with venipuncture skill or any benchmark for comparison of a clinician's proficiency level. According to the University of Florida study,[2] the benchmark for acceptability would be 40% proficiency at the first attempt. It is unlikely that most hospitals would consider this to be an acceptable benchmark, although it might be the current reality. A desirable benchmark should be in the 80th percentile, meaning that 80% of venipunctures would be performed at the first attempt, leaving 20% as difficult sticks requiring multiple venipunctures or the need for vascular access planning and a central catheter.

It is time to institute a proficiency benchmark, and the CDC, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO), and Magnet should be evaluating this quality improvement initiative. This is not just a patient satisfaction and cost savings initiative, but a patient safety initiative. When proficiency is not adequate, what is the result in terms of peripheral arterial punctures, secondary wall venipunctures, premature venipunctures, nerve injury, and infection risk? Press Ganey showed a 45% rate for patient dissatisfaction with pain control, yet venipunctures had a dissatisfaction rate of 58%.[1] Could this be because pain control is a Magnet and JCAHO performance improvement goal for a lower dissatisfaction rate? Because 90% or more of all hospitalized patients have catheters, the skill level for venipunctures should be high on the radar screen as a nursing performance improvement initiative.

• USING HIGH-TECH TOOLS TO IMPROVE PICC INSERTION PERFORMANCE

Six nursing studies on the cost effectiveness and the insertion performance improvement associated with use of the modified Seldinger technique and ultrasound to place a PICC at the bedside have now been published. Table 3 indicates that an 85% to 98%[4,24,28] proficiency in PICC insertion can be achieved at the bedside for all orders received, not just for attempts. Have 100% of hospital infusion teams implemented this performance improvement? The answer to that question is "no." Teams continue to use traditional 14- to 16-gauge introducers and the landmark technique to insert PICCs at the bedside, with the result that 30% to 50%[4,24,28] of patients are sent to radiology for a PICC insertion.

Not all teams have embraced this new process, citing time constraints, administrative barriers, increased short-term costs, and the lack of desire to learn a new technique. As mentioned previously, a team cannot show revenue savings without process change. This process change takes

TABLE 3

Performance Improvement in PICC Insertion Associated With High-tech Tools by Nursing at the Bedside (Benchmark)

Author	Insertion Success Prior to Addition of Tools	Insertion Success After Addition of Tools	Documented Savings With Decreased IR Referrals
Dobson[24]	65%	86%	$125,273 (1 year)
Royer[25]	74%	93%	$52,640 (9 months)
Santolucito[4]	Not documented	94%	$383,000 (1 year)
Kokotis[26]	50%-65%	85%-93%	Literature review
McMahon[27]	65%	91%	Not documented
Anstett[28]	76%	98%	$823 per PICC not sent to radiology

*Based on 301 cases not sent to radiology.
†Based on 696 cases not sent to radiology

PICC insertion from the radiology department (OHSU cost of $850) to the bedside (OHSU cost of $200), for an estimated revenue savings of $650 per insertion.[4] There is no greater cost initiative than to decrease the PICC referral rate to radiology to less than 10% of overall orders. With the 2004 Medicare professional reimbursement guidelines, interventionalists are no longer eager to place a PICC ($101 reimbursement), nor is a surgeon eager to place an acute care catheter ($118 reimbursement).[29]

Orders for PICCs will not decrease in 2005, but infusion teams that do not embrace this process change likely will end up with increasing orders in their radiology departments and possible outsourcing of their PICC insertions to outside contractors. To be a participant in the proposed revenue-saving process, infusion teams must shift their focus to high-tech PICC insertion and away from the traditional approach. This shift also may mean reengineering staff and shifting one or two infusion team members away from the integration of task-oriented functions to PICC insertion full-time. To maintain full staff competency in PICC insertion, these full-time PICC nurses could have rotating positions, with all members of the team working in that role within a given month or week.

There are risks to patient safety when a patient is transported to the radiology department for a PICC insertion that could have been performed at the bedside with high-tech tools. It is risky to transport a patient on a ventilator and IV fluids from the intensive care unit (ICU) to radiology for a PICC insertion. In addition, transporting a patient ties up a respiratory therapist and nurse from the ICU for at least 1 hour. Pope[30] stated that in a study of a neurological population, 40% of the patients experienced technical mishaps during transfer, and 14% experienced more than one mishap. Pope[30] also said it is clear that patients did not receive the same level of care as they did in the ICU, and that they were at risk for condition compromise.

In another study cited by Pope,[30] researchers observed physiological changes during the transport of ICU patients, with 17% experiencing baseline changes, 3% of which were severe. Yet in another study, Pope[30] explained that 53% of critically ill transport patients experienced changes in oxygen saturation, heart rate, and blood pressure during transport. In conclusion, Pope[30] stated that according to the American Association of Critical Care Nurses, "the period of transfer is a period of potential instability." Pope[30] provided a decision tree for transport and specifically stated that if the procedure can be performed at bedside, a patient should not be transported.

In its patient safety recommendations, the Agency for Healthcare Research and Quality has recommended the use of ultrasound to place PICCs.[31] According to the Agency, studies indicate that ultrasound improves the insertion success of a PICC and decreases the complication risk. In addition, the Society of Interventional Radiology has created Quality Indicator Benchmarks, and has suggested that an insertion success of 90% without complications should become the threshold indicator.[32]

Although radiologists have fluoroscopy, the nursing literature provided in Table 3 indicates that nursing can have a minimal threshold insertion benchmark of 80% for all PICCs ordered, not just for those attempted. At this point, a tough question must be asked. Does the reader's hospital offer two different standards of care for the patient needing a PICC? If nursing is using the landmark insertion technique with a 14- to 16-gauge introducer at a 50% to 73% insertion success rate,[4,24-28] and radiology is using ultrasound and the modified Seldinger technique with approximately a 90%[4,24,25,27,28] insertion success rate, it is true that the reader's hospital is offering two different standards of care for PICC patients. The use of high-tech tools at the bedside for PICC insertion approximates as nearly as possible the service provided by interventional radiology.

• REVENUE SAVED BY REDUCING CATHETER-RELATED BLOODSTREAM INFECTIONS

The 2002 CDC *Guidelines for the Prevention of Intravascular Catheter-Related Infections,*[14] concluded that

- the estimated number of catheter-related bloodstream infections (CR-BSIs) per year in the United States is 250,000[14]
- the attributable cost of a CR-BSI per patient is an estimated $34,508 to $56,000[14]
- possibly 80,000 CR-BSIs occur per year in the ICU[10]
- coagulase-negative *Staphylococci* and *Enterococci* followed by *Staphylococcus aureus* were the most common organisms associated with CR-BSI from 1992 to 1999[14]
- specialized infusion teams have shown unequivocal effectiveness in reducing the incidence of catheter-related infection and associated complications and costs.[14]

How does the cost of a CR-BSI have an impact on the cost of a patient's DRG? If a patient acquires a CR-BSI during hospitalization, there are no additional DRG funds provided to pay for this complication. In other words, the cost of an infection must be offset by the revenue savings from several other patient stays. It is in the best interest of the hospital to reduce CR-BSIs, and if possible, to eliminate them. A look at the ongoing National Nosocomial Infections Surveillance (NNIS) System Report for 1992-2003 indicates that the average CR-BSI rate in the medical-surgical ICU is 5/1,000 catheter days for teaching hospitals and 3.7/1,000 catheter days for all others.[33] Pittet et al[34] stated that the increase in patient LOS for a CR-BSI was 8 to 20 days, at a cost of $40,000 per case. An infu-

sion team must prove that its care and maintenance in the form of dressing changes, declotting, and troubleshooting have an impact on the hospital bottom line operational losses associated with CR-BSI.

The following facts are examples of cost savings attributable to an infusion team:

- hospital placement of 1,500 central catheters per year (ICU)
- community hospital of 400 beds
- CR-BSI rate with infusion team support of 1.5/1,000 catheter days (ICU)
- NNIS data showing a national average of 3.7/1,000 days (ICU)[33]
- IV team hospital with a CR-BSI infection rate of 2.2/1,000 catheter days in relation to NNIS ICU data
- cost savings attributable to this IV team-staffed facility as follows: .022 rate savings × 1,500 lines × $34,508[10] dollars per CR-BSI case = 33 lines × $34,508[14] = $1,138,764 year in revenue savings or the cost for 19 full-time infusion nursing employees without benefits.[17]

The infusion team at this hospital would save more than $1 million by reducing the medical-surgical ICU infection rates by 2.2% below the NNIS average for a community hospital. This hospital would have to revenue save DRG money to pay for more than $1 million to manage catheter-related infections if it did not have a skilled infusion team to handle central catheter dressings and educate clinical staff on central catheter care and maintenance.

How can an infusion team reduce CR-BSI? What tools can they use? A metaanalysis performed by Chaiyakunapruk et al[35] shows that chlorhexidine gluconate used for catheter site care has a 1.1% lower rate for CR-BSI than povidone-iodine solution and a 7.1% lower colonization rate. There were 8 studies and 4,143 catheters in this metaanalysis. An infusion team can use full-barrier precautions during a central catheter insertion or assist physicians in the use of full-barrier precautions. Findings from the study by Raad et al[36] show that the CR-BSI rate was 0.6% with full-barrier precautions (mask, sterile gown, large sterile drape, sterile gloves) and 3.6% with sterile gloves and a small drape.

Studies also have indicated that the Biopatch (Johnson and Johnson) on catheter insertion sites inhibits bacterial growth under the dressing. The Biopatch is an antimicrobial dressing comprising a hydrophilic polyurethane absorptive foam with chlorhexidine gluconate. A study of 1,699 central venous or arterial catheter insertion sites indicates that the Biopatch resulted in a 44% reduction in the incidence of local infection and a 60% reduction in the incidence of CR-BSI.[37] In a study of 325 catheter-related local infections, Biopatch saved the treatment costs for 107 infections, as compared with the control cases. Biopatch also saved the treatment cost for 11 of 589 CR-BSIs.[37] According to CDC, the cost of a CR-BSI is $34,508,[14] and the increase in LOS, according to Pittet et al,[34] is 8 to 20 days for each patient. If this is the case, Biopatch saved this facility $379,588 a year (11 × $34,508) in nonreimbursed treatment costs and 64 to 220 hospital treatment days.

Infusion teams that keep abreast of new technology and studies can provide valuable expertise and recommendations for process changes that will reduce operational losses and result in revenue savings of the DRG. If the pneumonia patient in this example should acquire a CR-BSI, the cost of treatment would be four times the cost of the original DRG payment. This patient case would be a significant revenue loss for the hospital (Figure 1).

• SALVAGE OF AN OCCLUDED CENTRAL CATHETER

One of the functions performed by an infusion team is the declotting of a central catheter with alteplase. Should a central catheter such as a port, tunneled catheter, PICC, or acute care catheter become clotted, the team can attempt to reopen the device with alteplase. The cost of a catheter replacement far outweighs the $65 drug cost for the alteplase. The cost of salvaging a PICC placed in radiology is $850, and the cost of salvaging a PICC placed by a nurse is $200. However, the cost of replacing a surgically placed tunneled catheter or port is $850 to $1,500.[4] If an infusion team is able to declot and salvage 100 ports or tunneled catheters a year, the replacement cost savings (minus the drug cost) is $143,800. If they salvage 100 radiology placed PICCs, the revenue savings for the hospital is $78,500 (minus the drug cost) a year. Figure 2 examines vascular access device replacement costs, as compared with the costs of declotting with alteplase. The infusion team can justify one to two full-time infusion nursing employees per year by their ability to salvage central catheters.

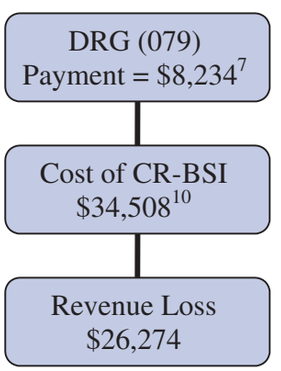

FIGURE 1.
Medicare Payment DRG (079) versus the cost of a CR-BSI.

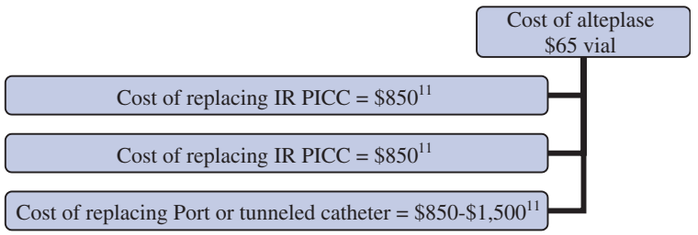

FIGURE **2.**
Cost of vascular access device replacement versus alteplase.

• CONCLUSION

In the current reimbursement system of DRGs, the elimination or downsizing of infusion teams is not in the overall best interest of the hospital. In fact, the creation of a full-time infusion team is in the hospital's best interests in terms of revenue saving on DRGs. For the infusion team to contribute to the overall financial health of the hospital, it must embrace process change in the form of vascular access planning, high-tech tools to insert PICCs, and a focus on those skills that result in hospital cost savings.

Under the current structure, infusion teams often are tied up in task orientation and lack the time or initiative to reengineer their process, thereby bypassing the implementation of a proactive vascular access planning program. This is the main reason why hospital executives consider the infusion team a direct labor cost and possibly unnecessary. They may assume that any nurse can start a short peripheral catheter. Press Ganey's 58% patient dissatisfaction rate shows that this is a false assumption, and also indicates that patient satisfaction declines with a longer LOS.[1] This alone is an impetus for implementing early vascular access planning and the use of high-tech tools to reduce the occurrence of the emergency PICC on the day of discharge or PICC referral to radiology, both of which extend a patient's LOS. Not only is it not cost effective to place a PICC late in a patient's stay or in the radiology setting. It also is a patient safety transport issue for the ICU patient.

The object under PPS is to maximize reimbursement by minimizing the number of vascular access devices a patient needs to complete infusate therapy. In other words, it is advantageous to place the vascular access device that completes the entire therapy with one stick and the least amount of complications. Reversing the low level of patient satisfaction, proficiency, and proactive vascular access planning is the only answer. It takes a skilled professional to attain a rate of 80% for insertion success at the first attempt, declotting of central catheters, reduction of CR-BSI, use of high-tech tools (ultrasound and Modified Seldinger Technique) for PICC insertion, and triage for the vascular access needs of the patient.

The use of PICCs will continue to grow only as reimbursement changes continue to lead the marketplace and affect practice decisions, often for the better. The patient is not going to get younger and attain better vasculature. In fact, over the next 5 years, the patient dissatisfaction rate with venipunctures may climb into the 70th percentile if change is not implemented.

Patients between the ages of 35 to 49 years report the least satisfaction with overall care, according to Press Ganey.[1] This is the generation described as distrustful of institutions, more informed than previous generations about healthcare, and harder to please because of their high expectations.[1] This generation is aging and will constitute the greatest number of healthcare consumers in the year 2016. However, this generation currently is involved in the healthcare arena as the protectors of their parents' healthcare. These patient in this generation often asks, "Why didn't they place a PICC at the beginning of my parent's or my infusion therapy if it is so good?" The common answer to that question, "We have always done it that way!" is not acceptable to the Baby Boomer generation, some of whom fall at the top of the 35 to 49 age range.

Change is inevitable, and only the reengineering of the process is the answer. Preparation must be made for the year 2007 when the IV team professional will be placing tunneled central venous catheters in the United States. This is not as far-fetched as it may seem because it already is occurring at the Royal Liverpool and Broadgreen University Hospital in the United Kingdom.[38] Reimbursement and the drive for patient safety also will impel this process change.

Millie Lawson, the registered nurse who managed the infusion team at MD Anderson and was one of the first nurses in the country to initiate central catheter declotting and PICC insertion with the modified Seldinger technique in the late 1980s, helped to pioneer this practice change to empower nurses to place PICCs at the bedside. In 1988, Millie was asked whether nurses would ever place tunneled catheters or ports. She laughed and said, "If you asked a nurse if it would become commonplace for a nurse to place a PICC at the bedside with the tip terminating in the subclavian vein, what do you think their answer would be?" Millie this one is for you. It is inevitable, and you are a true visionary.

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