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Prolonging the Life of a Patient's IV: An Integrative Review of Intravenous Securement Devices

Sonya Alekseyev, Melissa Byrne, Austin Carpenter, Charlie Franker, Chelsea Kidd, and Linda Hulton

In this integrative review, current research on the effectiveness of intravenous (IV) securement devices is described and practical implications for evidence-based practice in IV care are provided.

Performing peripheral venipunctures and maintaining peripheral intravenous (IV) therapy sites are daily responsibilities for medical-surgical nurses. Many nurses regularly perform peripheral cannulation as part of their role (Kelly, 2009), and IV access is used routinely for administration of drugs, fluids, nutrition, blood, and blood products (Ahlqvist et al, 2006; Cicolini, Gonghi, Di Labio, & Mascio, 2009). While venipuncture is the most common invasive procedure performed on hospitalized patients, very little research has been done on the best practices for stabilization of the IV site (Frey & Schears, 2006). Nurses are responsible for maintaining peripheral vascular access without complications to the circulatory system or local tissue. Although it is a routine procedure, peripheral venipuncture is a complex, highly skilled process that can pose a risk for patients and health care professionals if not performed properly (daSilva, Priebe, & Dias, 2010). Moreover, IV insertions can be expensive and unpleasant, often causing additional institutional costs and staff time (Delp & Hadaway, 2011; Schears, 2006).

Recent recommendations from the Centers for Disease Control and Prevention (2010) indicate peripheral IVs can remain in place for 96 hours or more, as long as they are functioning properly and the patient is not showing signs of infection. In addition, the Joint Commission's 2010 National Patient Safety Goals highlight the need to reduce risk of health care-associated infections (The Joint Commission, 2010). Strategies such as better IV securement for increased patient comfort and safety are needed to prolong IV function while preventing complications of infections, phlebitis, extravasation, infiltration, occlusion, or accidental catheter withdrawal.

In this integrative review, the current research on the effectiveness of IV securement devices will be reviewed and practical implications for evidence-based practices in IV care for medical-surgical nurses will be provided. In addition, current unresolved questions will be highlighted. Catheter stabilization increasingly is recognized as an important intervention in IV therapy and maintenance. With stabilization, less movement of the catheter occurs at the insertion site, and the catheter is less likely to be dislodged (Gorski, 2007). Despite the routine use of peripheral lines for IV access, very few studies have considered complications related to peripheral IV therapy (Schears, 2007).

For this review, *catheter securement device* was defined as a mechanical device that is "used to preserve the integrity of the access device and to prevent catheter migration and loss of access" (Infusion Nurses Society [INS] 2006, p. S44). The term *stabilization* often is used interchangeably with *securement* when referring to a structure, support, or foundation that makes something less likely to fall, give way, or become displaced (INS, 2011).

Sonya Alekseyev, BSN, RN, is Staff Nurse, Medical Intensive Care Unit, Georgetown University Hospital, Washington, DC.

Melissa Byrne, BSN, RN, is Staff Nurse, Hilton Head Hospital, Hilton Head, SC.

Austin Carpenter, BSN, RN, is Clinician II Staff Nurse, Martha Jefferson Hospital, Charlottesville, VA.

Charlie Franker, BSN, RN, is Staff Nurse, Pediatric Intensive Care Unit, University of Maryland, Baltimore, MD.

Chelsea Kidd, BSN, RN, is Staff Nurse, Cardiac Care Unit, St. Mary's Hospital, Richmond, VA.

Linda Hulton, PhD, RN, is Professor of Nursing, James Madison University, Harrisonburg, VA.

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Types of IV Securement Devices

Catheter stabilization should be used to preserve the integrity of the access device and to prevent catheter migration and loss of access. However, the stabilization method must not impede circulation or interfere with the ability to assess and monitor the access site (INS, 2011). The Infusion Nurses Society (2011) identified three types of products as acceptable for catheter stabilization. These include manufactured catheter stabilization devices, sterile tapes, and surgical strips. Whenever feasible, using a manufactured catheter stabilization device is preferred.

In the past, suturing was used frequently for central venous catheters and peripherally inserted central catheters (Frey & Schears, 2006). The Occupational Safety and Health Administration (n.d.) now requires leaders at health care facilities to review catheter securement protocols annually and assess suture-free alternatives due to risk of health care provider needlestick. Suturing also has been associated with an increased risk of infection (Frey & Schears, 2006). A number of studies have been performed on the StatLock® (BardMedical; Covington, GA) catheter securement device (Frey & Schears, 2006; Smith, 2006; Yamamoto et al., 2002). This device consists of an adhesive-backed anchor pad with hinged clamps that attach directly to the patient and swivel with patient movement.

Literature Review

In a great deal of the previous literature, the focus of research has been the prevention of infection rather than the stabilization of the IV device (Delp & Hadaway, 2011). This integrative research review was conducted in CINAHL, PubMed, Google Scholar, National Library of Science, and Medline of articles published 2000-2011 to investigate IV catheter securement devices and best practices. Search words included *sutureless securement devices*, *StatLock®*, and *catheter securement*. Inclusion criteria were as follows: (a) the report had to have been research or outcomes-based and published in a peer-reviewed journal, (b) the method of data collection and analysis had to be reported, and (c) the report must have been published in the English language between 2000 and 2011. The articles had to contain statistical evidence, or review of evidence from other studies. Articles were excluded if they provided opinions or discussions that did not represent original research.

The Cooper framework (Cooper, 1998) was used to guide the review. The first two of five steps in the framework are problem formation and data collection of research literature. The next steps are data evaluation, analysis, and interpretation of the studies. The final step is presentation of the results. Information was recorded under salient headings and categorized using color-coded tabs and highlighters. Each article was read, organized, and then reorganized until a systematic and logical connection was found. At least two of the authors had to agree that each article was appropriate for inclusion in the review. Twenty studies were identified initially. Ten of these did not meet the inclusion criteria because IV stabilization was not one of the outcome variables. Two articles were not from peer-reviewed journals and not research based. A few of the articles used central venous access exclusively and not peripheral IV access devices. In the final selection, 13 research articles were identified as the basis for this integrative review. Articles were categorized according to the rating system for the hierarchy of evidence as defined by Polit and Beck (2008). This rating system classifies the strength of the evidence based on the research design and assists to critically analyze the research evidence (see Table 1 for summary of the studies and levels of evidence).

TABLE 1.
A Summary of the Levels of Evidence and Articles Reviewed for IV Securement Devices

Level of Evidence	Definition	Number of Articles Reviewed
I	Evidence from a systematic review or meta-analysis of all relevant randomized controlled trials (RCTs), or evidence-based clinical practice guidelines based on systematic reviews of RCTs	0
II	Evidence based from at least one well-designed RCT or single non-randomized trial	3
III	Systematic review of correlational/observational studies	2
IV	Single correlational/observational study	1
V	Evidence from systematic reviews of descriptive and qualitative studies	1
VI	Evidence from a single descriptive or qualitative study	6
VII	Evidence from the opinion of authorities and/or reports of expert committees	0

Source: Adapted from Polit & Beck, 2008

Results

These studies are summarized in Table 2. The majority of the studies included participants from the United States. Three of the samples were from outside of the United States, including Australia (Callaghan, Copnell, & Johnson, 2002), Great Britain (Bolton, 2010), and Spain (Martinez et al., 2009). Most studies within the United States occurred in

TABLE 2.
Summary of Studies Investigating Intravenous Securement Devices

Author/Year	Sample	Study Purpose	Level	Variables	Study Outcomes
Callaghan et al., 2002	407 catheter dressings; ED and three general medical and surgical wards of urban Australian hospital	To compare the effects of two methods of peripheral catheter securement (Tegaderm® 1633 dressing and traditional adhesive tape) on incidence of patient complications	III	Complications of peripheral IV therapy; securement devices	Study group using Tegaderm 1633 had better dressing adherence and less dressing reinforcement, and had some advantage over time. Very few differences found in observed incidence of phlebitis or extravasation.
McMahon, 2002	Tracking logs of 1,212 PICC lines at tertiary care facility in Seattle, WA	To evaluate use of StatLock® anchoring device for PICC securement	VI	Successful placement and longevity of PICC lines; complications including phlebitis, infection, line occlusion, migration, or leaking	Reduced incidence of catheter migration from 6% to 1.5% of all lines. Rate of catheter repair and exchange due to breakage reduced from 11% to 1%.
Yamamoto et al., 2002	170 patients requiring peripherally inserted central venous catheters (PICCs) at a tertiary care center in Minnesota	To evaluate the performance of a sutureless adhesive-backed device, StatLock for securement of PICCs	II	Suture vs. StatLock and PICC-related complications, including dislodgment, infection, occlusion, leakage, and central venous thrombosis	The sutureless anchor pad was beneficial to both patients and health care providers. Average securement time was significantly shorter with StatLock and was associated with fewer total complications, including fewer PICC-related bloodstream infections.
Royer, 2003	122 IV sites at a tertiary care center in Washington	To report on a clinical trial using StatLock securement device vs. the chevron method of taping short-term peripheral catheters	VI	Use of two different catheter securement devices and outcomes of phlebitis, leaking, infiltration, dislodgement, and occlusions	StatLock IV securement device performed better than tape in reducing complications and unscheduled restarts, including 100% reduction in phlebitis, infiltrations, and occlusions, and 42% reduction in total complications.
Penney-Timmons, 2005	1,345 intravenous sites at a tri-state hospital in Michigan	To report phlebitis and infiltration rates following conversion to a standard IV start kit that included chlorhexidine gluconate with isopropyl alcohol, a new site dressing, and IV securement cushions	VI	Outcomes of phlebitis and infiltration rates	IV phlebitis and infiltrations rates were virtually eliminated and dwell times were extended from 72 to 96 hours.
Stephenson, 2005	995 arterial catheters secured using a hospital protocol in Florida	To evaluate clinical and cost consequences of securing arterial lines with a precision-engineered securement device compared with tape and transparent membrane dressing	VI	Three methods of securement (tape, membrane dressing, precision-engineered securement device); clinical consequences and restart rates	Use of tape and transparent membrane dressings resulted in an unscheduled catheter restart rate of 25%; use of precision-engineered securement device resulted in an unscheduled catheter restart rate of 12.8% (significant difference, $p \leq 0.001$).

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TABLE 2. (continued)
Summary of Studies Investigating Intravenous Securement Devices

Author/Year	Sample	Study Purpose	Level	Variables	Study Outcomes
Frey & Schears, 2006	Review of seven studies to help practitioners make informed decisions and encourage more scientific investigation	To review available prospective data comparing standard methods of catheter securement with a securement device	IV	Securement devices for peripheral short catheters, peripherally inserted central venous catheters, and standard nontunneled central venous catheters; complications including dislodgement, infiltration, phlebitis, and occlusion	Devices specifically engineered for catheter securement significantly reduced the overall catheter-associated complications. This appeared to be the result of improved securement and reduced catheter motion.
Schears, 2006	Pooled data from prospective product trial at 83 hospitals, including 10,164 patients	To determine whether catheter stabilization device can reduce rate of peripheral IV restarts and peripheral IV-associated complications	V	Use of peripheral IV catheter securement for IV stabilization and catheter-related complications	A 67% reduction ($p \leq 0.001$) in total patient complications in the stabilization group as compared to the traditional tape group; the need for unscheduled peripheral IV restarts was reduced by 76% with the stabilizing device ($p \leq 0.001$). Annual cost savings of $18,000 per hospital on IV materials and a combined savings of $277,000 on materials, complication costs, and nursing times were estimated.
Smith, 2006	73 adult patients at a Florida hospital	To determine if any of three methods (nonsterile tape, HUB-guard, and StatLock of peripheral IV [PIV]) catheter securement would extend the average survival time of catheters to implementation of a 96-hour change-protocol	VI	Three methods of IV securement; average survival time of peripheral IV catheters	Use of nonsterile tape securement resulted in an 8% PIV survival rate, HubGuard produced a 9% PIV survival rate, and StatLock produced a 52% PIV survival rate ($p \leq 0.001$).
Martinez et al., 2009	721 patients with peripheral IV catheters in an infectious disease ward of a 700-bed university hospital	To assess the role of add-on devices for the prevention of phlebitis and other complications associated with the use of peripheral catheters	III	Use of add-on devices and incidence of phlebitis and other complications	The beneficial effect on mechanical or all complications was noticeable after 6 days of catheterization. Add-on devices did not reduce the incidence of phlebitis but may prevent mechanical complications. However, the impact of add-on devices on the incidence of all complications was small and only apparent after the 6th day of catheter use.

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TABLE 2. (continued)
Summary of Studies Investigating Intravenous Securement Devices

Author/Year	Sample	Study Purpose	Level	Variables	Study Outcomes
Bausone-Gazda et al., 2010	302 patients with peripheral IV catheters at a Level I trauma center	To compare the percentages of securement-related complications of two peripheral catheter-stabilization systems; to assess the potential cost implications	II	Two catheter-stabilizations systems and IV complications	The investigational stabilization system was noninferior or similar to the control stabilization system with respect to overall securement-related complications. The cost of the investigational system was approximately 75% of the cost of the control stabilization system.
Bolton, 2010	Internal audit of more than 1,000 cannula insertions in a hospital system comprised of one pediatric and two adult hospitals	To assess the impact of a cannula stabilization device alongside the currently used securement strategy of IV dressing	VI	IV stabilization device and complications of phlebitis and restarts	On initiation of the use of the stabilization device, the infiltration rate was reduced from the baseline level by 100%. There was also an 81% reduction in the rate of unscheduled IV restarts. The data demonstrated considerable benefits of using a cannula stabilization device compared with the current hospital practice of using IV dressings only for securement.
Flippo & Lee, 2011	109 medical-surgical patients with peripheral IVs at a 365-bed non-profit hospital	To determine if peripheral IVs secured with the SorbaView® SHIELD stayed in place for 96 hours and to collect patients' perceptions of comfort of the IV site	VI	Use of Sorbaview SHIELD securement device and IV site complications	The peripheral IVs of 91.5% of the patients maintained patency for 96 hours with only eight patients requiring unscheduled restarts; 86% of the nurses surveyed rated the device as excellent to good; 91% of patients reported no discomfort of their peripheral IV site.

tertiary care centers in major cities.

Various IV securement devices were used in the studies. Only one study compared surgical tape and a transparent polyurethane film as securement methods (Callaghan et al., 2002). One study evaluated use of IV securement cushions (Penney-Timmons, 2005).

The majority of the studies included the StatLock anchoring device as a variable (Bausone-Gazda, Lafaiver, & Walters, 2011; Bolton, 2010; Frey & Schears, 2006; Martinez et al., 2009; McMahon, 2002; Royer, 2003; Schears, 2006; Smith, 2006; Stephenson, 2005; Yamamoto et al., 2002).

Twelve of the studies found IV securement devices to reduce the overall complications of IV therapy. Only one study (Martinez et al., 2009) did not find the use of add-on devices reduced the incidence of phlebitis. While the authors concluded add-on devices may have prevented mechanical complications, the overall impact was minimal and only apparent after the 6th day of catheter use.

The majority of studies showed significant improvements in reducing IV complications by using securement devices other than sterile tape or surgical strips. Callaghan et al. (2002) found Tegaderm had better dressing adherence and some advantage over time. However, very few differences were observed in the incidence of phlebitis or extravasation. Smith (2006) reported the use of nonsterile tape securement resulted in an 8% peripheral IV survival rate, while the use of StatLock produced a 52% peripheral IV survival rate ($p<0.001$). Royer (2003) reported a 42% reduction in the total complication rate and a reduction of 63% of unscheduled restarts when using the StatLock securement device. Schears (2006) pooled data from 83 hospitals and found a 67% reduction ($p<0.001$) in total patient complications in the stabilizing device group as compared with the tape group. Bolton (2010) and Flippo and Lee (2011) reported reductions in the rate of unscheduled IV restarts.

Three studies addressed cost effectiveness. Schears (2006) reported an annual cost savings of $18,000 per hospital on peripheral IV materials and a combined savings of $277,000 on materials, complications, and nursing time when using StatLock. However, Bausone-Gazda and coauthors (2010) reported the cost of a new stabilization system was approximately 75% of the cost of the

control stabilization system which included StatLock. Conversely, Royer (2003) found use of StatLock devices was cost neutral. He noted it was difficult to assign cost savings to patient comfort and the decreased use of nursing time to assess problems with IV catheters.

Discussion

Catheter stabilization is recognized increasingly as an important intervention in reducing complications of phlebitis, infection, catheter migration, and catheter dislodgment (Gorski, 2007). In the reviewed studies, a significant decrease in the rates of complications was associated with the use of IV securement devices versus use of traditional tape and surgical strips methods. These results substantiate changes in the standards of practice endorsed by the Infusion Nurses Society (2011). Recommendations included preferred use of manufactured catheter stabilization devices but not a particular device (Gorski, 2007). However, the majority of studies in this review used the StatLock device as the stabilization method. Some authors identified it as the only device that meets the national standards by the INS (2011) based on scientific evidence (Smith & Royer, 2007). See Figure 1 for a summary of these standards.

A major limitation of many of the reviewed studies included a nonrandomized design. Over half the referred articles used simple descriptive designs with no randomization of cases. Selection bias could have occurred because participants often were enrolled sequentially and not concurrently in a prospective study. Also, none of the studies controlled for types of infused medications that could be irritating to veins and thus affect the longevity of the IV site, such as chemotherapy agents or intravenous medications.

Another limitation might be the Hawthorne Effect or the *observer effect* (Polit & Beck, 2008). The process of drawing attention to a new method of securement could have changed how meticulously IV catheters were placed, secured, and maintained in many of the studies. This effect could have improved the observed outcomes. Only one study identified this as a potential limitation (Schears, 2006). Performance of an integrative review involves some threats to validity that differ from other research methodologies, including the limitation that only published studies were reviewed and different journals have more varying levels of statistical rigor for publication. In addition, incomplete reporting by the primary researcher may have occurred in selected articles identified for the review process. This is a threat to validity that the integrative reviewer cannot control (Cooper, 1998).

FIGURE 1.
Infusion Nursing Standards of Practice: Standard 36.
Vascular Access Device Stabilization

Standard	
36.1	Vascular access device (VAD) stabilization should be used to preserve the integrity of the access device, minimize catheter movement at the hub, and prevent catheter dislodgment and loss of access.
36.2	VADs should be stabilized using a method that does not interfere with assessment and monitoring of the access site or impede vascular circulation or delivery of the prescribed therapy.
36.3	The use of stabilization methods shall be established in organizational policies, procedures, and/or practice guidelines.
36.4	The nurse shall be competent in proper use and application of VAD stabilization methods and devices.
Practice Criteria	
A.	The use of a catheter stabilization device should be considered the preferred alternative to tape or sutures when feasible.
B.	Transparent semipermeable membrane (TSM) dressings or other dressings are often cited as helpful in stabilizing the catheters; however, there is insufficient evidence supporting their benefits in stabilization at the intravenous catheter hub alone.
C.	The use of alternative methods of VAD stabilization in lieu of sutures should be considered to mitigate the risk of needlestick injury; the use of staples has been cited in the literature as an alternative to sutures, reducing exposure to contaminated sharps.
D.	Use of any stabilization method should be based on evidence as well as analysis of risks versus benefits. While sutures may increase risk of needlestick injury and/or risk of infection due to the presence of suture wounds near the insertion site and development of biofilm on the sutures, sutures may be considered appropriate in special populations such as pediatric patients or those with skin integrity problems, precluding use of tape or an engineered stabilization device.
E.	If sutures used to stabilize a VAD at placement become loosened or no longer intact, they should be removed and the VAD should be secured using another stabilization method or resutured as appropriate.
F.	Removal and replacement of the engineered stabilization device or tape should be done at established intervals according to the manufacturer's directions for use, and/or in conjunction with replacement of the VAD, or with routine site care and dressing changes.
G.	A catheter that migrates externally should not be readvanced into the vein prior to application of a catheter stabilization device; the VAD should be stabilized at the point of external migration and assessed for proper placement in the vasculature before further use.

Source: Infusion Nurses Society, 2011

Nursing Implications

The use of catheter stabilization devices may represent a significant change in practice to many hospitals and home care agencies. Success in the peripheral venipuncture procedure depends on factors such as the

nurse's technique and practical skills when selecting the appropriate vein, catheter selection, and stabilization devices (daSilva, Priebe, & Dias, 2010).

Components of evidence-based practice include external evidence from research, theories, opinion leaders, and expert panels; clinical expertise from quality improvement projects; outcomes management; use of available resources; and patient preferences and values (Melnyk & Fineout-Overholt, 2010). Many models can guide the successful implementation of new evidence-based guidelines (Larrabee, 2004; Melnyk & Fineout-Overholt, 2010; Rycroft-Malone et al., 2004; Schultz, 2008; Stetler, 2003). These models share an approach that recognizes the need for a systematic process to change clinical practice. Common steps include identification of change agents to lead the change, problem identification, comprehensive search of the literature to find high-quality evidence, attention to potential organizational barriers, use of effective strategies to disseminate information about the practice change, and evaluation of the outcomes (Melnyk & Fineout-Overhold, 2010).

The nurse's role in the management and care of IV access devices is changing dramatically with the new guidelines and advances in technology and device selection. Intravenous care is an integral part of the nurse's role and takes significant time and expertise. The results of this integrative review demonstrate the new guidelines for use of IV stabilization devices can bring significant gains for patients, nursing professionals, and the health care institution by reducing infectious cases, increasing patient comfort, decreasing time for unnecessary and costly restarts, and increasing safety of practitioners by decreasing needlestick injuries. Introducing new health care practices requires an institution to pay substantial costs for new supplies and set up procedures to monitor outcomes (Schears, 2006). However, these gains are factors that also may decrease overall costs by a reduction in overall materials consumptions and nurses' time as the longevity of peripheral lines is enhanced (Flippo & Lee, 2011).

Future Research

Future research is needed on the topic of intravenous securement devices, including new randomized clinical trials. New studies also are needed to evaluate additional factors that may contribute to prolonging the longevity of IV peripheral lines, including the establishment of IV teams to standardize protocols and reduce materials consumptions as a cost-saving measure. However, the current data suggest the use of new IV securement devices demonstrates significant reductions in IV complications and restarts that will improve outcomes and be beneficial to both patients and health care professionals (Gorski, 2007; Schears, 2006).

Conclusion

This integrative review described current research on the effectiveness of IV securement devices. Overwhelmingly, results demonstrated use of IV securement devices decreased complications associated with peripheral IV catheters, and prolonged their longevity and patency. However, future studies are needed to identify which securement devices produce the most cost savings while also decreasing the risk of needlesticks in health care workers. MSN

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Instructions For Continuing Nursing Education Contact Hours

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Objectives

This continuing nursing educational (CNE) activity is designed for nurses and other health care professionals who care for and educate patients and their families regarding intravenous (IV) securement devices. After studying the information presented in this article, the nurse will be able to:

1. Discuss the types of IV securement devices.
2. Describe the literature regarding the use of IV securement devices.
3. Explain the nursing implications of the use IV stabilization devices.

Note: The authors, editor, and education director reported no actual or potential conflict of interest in relation to this continuing nursing education article.

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