# Central Venous Catheter Securement: Using the Healthcare and Technology Synergy Model to Take a Closer Look

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## Abstract

*Proper securement provides a safe vascular access device environment for both patients and health care providers. Successful securement protects central venous catheters from several sources of failure until the end of therapy by preventing central venous catheter movement during all phases of care. Movement causes vein trauma, bacterial migration, distal tip location variation, loss of dressing integrity, and even total dislodgement. Any of these events can have serious consequences, including catheter-related bloodstream infection, thrombosis, delay of treatment, catheter replacement, and potential hemorrhage, all of which can be life-threatening events, and increase costs. We review patient issues, practice issues, and the types of securement currently used in clinical settings.*

**Keywords:** *adhesives, subcutaneous catheter securement, sutures*

## Introduction

Central venous catheter (CVC) securement is central to providing safe, complication-free intravenous therapy. Catheter securement has the potential to promote a safe environment for both patients and health care providers, and stimulate successful catheter care and dressing management. To aid in this success, securement must prevent CVC movement. Any movement can cause vein trauma, bacterial migration, distal tip location variation, loss of dressing integrity, and even total dislodgment. Each of these events can have troublesome or serious consequences, including extraluminal catheter-related bloodstream infection (CRBSI), venous thrombosis, dislodgement, delay of treatment, and catheter replacement. These complications may result in increased costs and can ultimately cause life-threatening patient outcomes.[1]

The Healthcare and Technology Synergy framework represents synergy among the conceptual variables of patient, product, and practice components, with each affecting and being affected by the other. It is the combined effect or interaction of patient, product, and practice that affect health care outcomes. The best outcomes can be achieved when there is synergy among all 3 of these health care components as represented by the overlap of all 3 circles in the Figure.[2] The influence of nursing practice on patient outcome is commonly the focus for answers and change. Individualizing a plan of care demonstrates that a patient's influence on outcome is a central tenet. Often products are overlooked as a variable. Yet products that are used in providing care have issues and can affect the success or lack of success within nursing practice. Nurses develop their own so-called work arounds to solve product problems, thereby increasing their success. It is important to identify product issues and to understand how these issues in particular influence practice outcomes. A question that can be asked is, Is this practice something that is positively patient outcome-based or is it being implemented to make a product work better? Understanding the answer to this question can lead to better decision making when developing care practices. Catheter securement is a care issue that includes patient variables, practice variables, and product variables. We provide an overview of the patient, practice, and product issues that can influence successful catheter/central line securement and demonstrate how their interaction influences outcome. It is our hope that this information will foster securement-related discussions and, more importantly, CVC securement-related research.

## Patient Issues

The skin is the primary site for CVC securement today, yet the skin environment is very supple and provides major challenges

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http://dx.doi.org/10.1016/j.java.2014.10.011

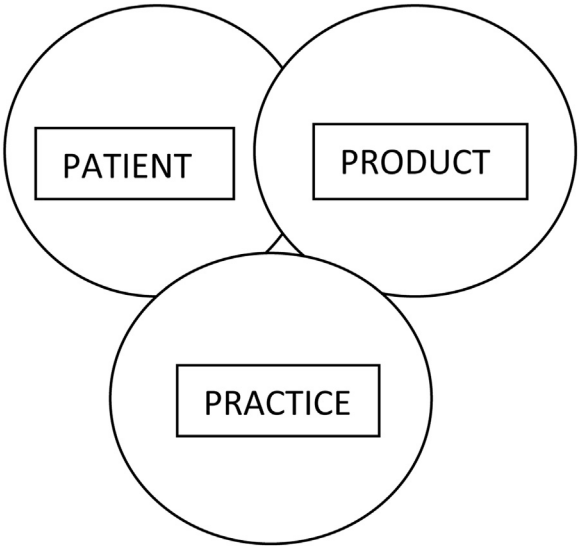


***Figure.*** **The Healthcare and Technology Synergy Model.**

for successful CVC securement. Skin quality varies with age (ie, very young and old), comorbidities (eg, diabetes, cancer, and renal failure), hydration status, and therapeutic regimen (eg, steroids) to name a few. The epidermis is made up of basal and squamous cells. Skin's surface is actually covered in dead cells that are shed and replaced over a few weeks to a month as basal and squamous cells move to the surface. This is a continual, ongoing process. Because skin has 3 different ecosystems—dry (eg, arm), wet (eg, groin), and sebum-rich (eg, jugular and chest)—CVC insertion site plays a large role in securement success. Skin surface moisture allows bacteria to flourish and provides a medium for transit over the skin via capillary action and diffusion.[3] Skin flora type and prevalence vary depending on the ecosystem, with the lowest levels of bacteria on dry areas and highest levels, including fungi, on sebum-rich areas. Skin flora has been shown to be the most common source of CRBSI.[1] Eighty percent of transient microflora live in the first 5 layers of the skin and repopulate the skin's surface within 18 hours.[4,5] Common gram-negative bacteria that reside on the skin have cell surface receptors for fibrin/fibrinectin.[6]

The insertion site creates an opening in the skin and a direct catheter/vein link. The body's response to a puncture site is to heal it. Movement of the catheter at the insertion site causes an inflammatory response of edema and serous sanguineous fluid secretion. This is the body's attempt to reduce friction and enable healing of the insertion site. This edema can result in an enlargement of the puncture site. The enlarged, moist puncture site provides a perfect environment for bacterial migration down the extraluminal pathway.[7] The vein intimal layer promotes platelet adherence to damage on the vein wall, and this is followed by thrombus formation to promote healing. The "healing" thrombus just inside the puncture site provides the perfect location for fibrin/fibrinectin and bacteria to colonize and form biofilm. Colonization of short-term CVCs (< 15-20 days) typically occurs at the catheter exit site.[8] Initially, the thrombus occurs at the point of vein penetration. However, this response occurs wherever and whenever a vein wall is damaged by an indwelling catheter. Although we cannot see this response to friction occur on a vein wall, this interaction, over time, does occur and can lead to venous thrombosis. Additionally, the body responds to the foreign object by coating the catheter with platelets and leukocytes within minutes of placement. Patients produce small pistoning movements of the catheter in and out of the skin with normal movement.[9] The distal superior vena cava is a large vein with a flow rate of 2 L/min. This location provides drug hemodilution. Care is taken at the time of placement to position catheter tips here. It is well known that the higher the tip of the catheter is in the superior vena cava, the greater the risk of developing thrombus. Thrombus development can have a profoundly negative effect on a patient's outcome over time.

### Practice Issues

Once a CVC is inserted, it is secured. From then until the CVC is removed, its care and maintenance is totally a clinical nurse's responsibility. The dressing protects the insertion site. But the catheter securement system directly influences dressing management. Movement disrupts dressing adhesion. Dressing removal is a pivotal period that can affect CVC stability. Remember, slight catheter movements—whether in and out or side to side—can increase the potential of developing securement-related problems. So if a nurse is having difficulty getting a dressing to release, or tape off the catheter, movement of the CVC is inevitable. Once the dressing is removed, in the case of sutures, complete skin antisepsis under the catheter is impossible. After removal of adhesive devices, as a nurse manipulates the CVC with 1 hand and cleans the skin with the other, preventing CVC movement at the insertion site is impossible. With pediatric and neonate populations, 2 nurses may be required to safely implement a dressing change. Even prepping with chlorhexidine gluconate (CHG) does not prevent repopulation, as previously discussed. CHG-impregnated discs and CHG gel dressings maintain significantly lower bacterial counts than skin prepped with CHG-containing skin antiseptic alone, but microflora cannot be totally eradicated.[1] Most CVC dressings remain in place for up to 7 days, allowing bacterial regrowth between dressing changes. If a patient has problematic skin or skin lesions, then use of the skin as the foundation for securement is difficult, if not impossible.

### Product Issues

The Centers for Medicare and Medicaid Services reward hospitals based on the quality of care provided to Medicare patients, how closely best clinical practices are followed, and how well hospitals enhance patients' care experiences during hospital stays. Hospitals are no longer paid solely based on the quantity of services they provide.[9] The new approach of value-based purchasing (VBP) requires looking at products not only by cost alone, but also by how the product positively or negatively influences practice outcomes. Vascular access is heavily dependent on products. Any product is most effective when it helps caregivers provide safe and effective care. Securement products