

Short Peripheral Intravenous Catheters and Infections

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The following table provides the synopsis of outcome data from published articles meeting the inclusion criteria from an integrative literature review published in the *Journal of Infusion Nursing*, July/August 2012, Volume 35, no. 4.. The references have the same numbers as in the published article. The published article contained a short description of all studies, however space did not allow for publication of the outcome data from each study. See the published study for the complete bibliographical information.

Author, Year Country of Origin Study Purpose	Results
4 Case Studies, INS Ranking V	
Vidal, 2001 ⁴⁷ Spain	88-year old male, 2-year history of enlarging ulcerated nodule left wrist; venipuncture in same site 2 years prior; Pulmonary TB in 1954, treated without active recurrence Skin biopsies showed chronic inflammation with deep tissue necrosis and Mycobacterium TB cultured from site. Venipuncture considered to play a part in cutaneous infection and possible trigger for reactivation of TB
Straussberg, 2001 ¹⁹ Israel	3 children (13 year old male, 3 year old female, 18 years old female) with osteomyelitis in close proximity to PIV sites; not proven by culture results. Author suggests that skin organisms lead to thrombophlebitis and then to the osteomyelitis
Hong, 2008 ⁴⁸ Korea	49 year old male with rectal cancer; erythema in left antecubital fossa vein used for fluids and antibiotics IV; fever treated with multiple antibiotics due to presumed pneumonia. No improvement with removal of peripheral catheter. Purulent material and thrombus found with 20 cm segment of vein excised. Thrombophlebitis in right antecubital fossa veins with same purulence and thrombosis. Both cultured as <i>Candida albicans</i> . Went on to develop fungal spondylitis at T7 and T8 vertebrae.
Katz, 2005 ⁴⁹ USA	31 year old male with multiple trauma from a motor vehicle accident with 2 large bore IV catheters by EMS; multiple organ failure by Day 3. On Day 5, the right upper extremity was erythematous, swollen and had a pustular lesion near the site of original IV catheter. Bedside cutdown of cephalic vein performed without purulence found. Gram stain of thrombotic material revealed gram-negative bacilli. Fever improved but overall condition did not. Extensive venous thrombus found on ultrasounds in cephalic and basilic veins. Cephalic vein excision on Day 10. Purulence was found in both veins just below the antecubital fossa. Cultures grew <i>E.coli</i> . Authors' theory of infection was translocation of enteric microbes to the site of inflammation

	from thrombosis.
22 Descriptive Studies, INS Ranking V	
<p>Siegman-Igra 2005⁹ Israel</p> <p>Retrospective report of bacteremic episodes in adults from 1995-1998 in a 1150 bed university hospital</p>	<p>All patients with hospital-acquired primary BSI at low risk for bacteremia selected according to definitions of primary BSI-</p> <ul style="list-style-type: none"> • 1 or more blood cultures after 48 hours of admission • Organisms unrelated to infection at another site <p>3719 episodes of BSI; 1618 (43%) hospital acquired 96 episodes met study definition of primary BSI in low risk patients</p> <ul style="list-style-type: none"> • 60 were phlebitis-associated bacteremia • 36 were unexpected bacteremia <p>All patients had peripheral IV at time of bacteremia</p> <p>Phlebitis-associated bacteremia</p> <ul style="list-style-type: none"> • <i>S. aureus</i> most common isolate <p>Bacteremic group without phlebitis</p> <ul style="list-style-type: none"> • Gram negative bacteria most common <p>Multivariate analysis showed Gram-negative bacteremia in low-risk patient associated with IV heparin use, absence of phlebitis and on a surgical ward. Unanswered questions related to differences between bacteremia from improper medication preparation versus catheter insertion techniques.</p>
<p>Vandenbos, 2003¹⁸ Italy</p> <p>Prospective study of ED patients to assess inappropriate insertion of PIV based on patient needs over a 14 day period in May-June 2000</p>	<p>769 of 2515 patients admitted to hospital</p> <ul style="list-style-type: none"> • 506 had PIV insertion • 390 followed until catheter removal • 62 (15.9%) with complications • 53 (13.6%) cases of thrombophlebitis • 9 (2.3%) with local infections • No systemic complications <p>No definitions or clinical signs/symptoms reported; no culture reports included</p>
<p>Kagel & Rayan, 2004⁵⁰ USA</p> <p>Retrospective report of minor and major PIV complications seen in patients from the ED of a teaching hospital in Oklahoma City from 1997-1999</p>	<p>64,000 patients treated in ED 10,000 admitted to hospital 67 patients identified in database with PIV complications 56 with minor complications</p> <ul style="list-style-type: none"> • 7 (10.4%) with cellulitis, 2 in hand, 5 in forearm • 11 with major complications <ul style="list-style-type: none"> ◦ 3 (27%) with septic thrombophlebitis; febrile with extensive signs of phlebitis, requiring antibiotics <p>Small number of complications reflects nature of complications and not true incidence Majority of complications in hand or wrist, suggesting the importance of catheter and joint stabilization.</p>
<p>Foster, 2002¹⁰ Australia</p>	<p>Skin prep with 70% IPA and 1% CHG swab allowed to dry Unsterile zinc oxide tape in chevron over site; no dressing</p>

<p>Prospective convenience sample of 496 peripheral catheters in neonates and pediatric patients, June to Oct 2000 in Australian hospital</p>	<p>applied over exit site 6.6% with some degree of phlebitis Cultures obtained if indicated by clinical signs and symptoms 29 blood cultures positive, most commonly <i>S. aureus</i>, thought to be a normal skin contaminate in most cases No cultures taken in these cases but 2 neonates thought to have CRBSI from peripheral catheter</p>
<p>Norberg, 2003⁴⁰ USA To compare contamination rates in blood cultures taken from a separate venipuncture site or from a new peripheral catheter insertion; observational study in patients 18 years and younger in the ED of a tertiary care children's hospital in OH</p>	<p>Baseline phase</p> <ul style="list-style-type: none"> • Blood cultures from a newly inserted peripheral catheter with 5 mL syringe attached to catheter hub • 2108 patients with 223 positive specimens • 32 specimens grew a pathogen • 191 categorized as contaminated • 243 organisms cultured • False-positive rate was 9.1% • True positive rate – 1.5% <p>Intervention phase</p> <ul style="list-style-type: none"> • Blood cultures from a separate direct venipuncture site • 2000 patients with 101 positive specimens in post intervention period • 45 grew pathogen • 56 contaminated specimens • 65 organisms <ul style="list-style-type: none"> ○ False positive rate – 2.8% ○ True positive rate – 2.3% (P-<001) <p>Skin antisepsis protocol was described as “standardized” but study did not provide details of agents or techniques No CVCs in patient in this study</p> <p>70% decrease in false positive rate</p> <p>Possible differences could be related to the ease of drawing from a peripheral catheter leading to indiscriminate ordering in baseline period</p>
<p>Palefski, 2001³¹ USA Assessment of complication rates for PIV catheters in adults inserted by generalist nurses compared to infusion nurses at 2 hospitals and 1 home infusion agency over 3 month period</p>	<p>776 total PIVs</p> <p>Infusion nurses inserted 639 20% removed for complications</p> <p>Generalists nurses inserted 137 36% removed for complications (p=<0.001)</p> <p>No culture data reported All infections listed on 1 line of table as cellulitis, infection, or sepsis; none by either group of inserters</p> <p>Predisposition for phlebitis reported Patients with phlebitis with the 1st catheter were 5.1 times more likely to have phlebitis with subsequent PIVs</p> <p>Pain on infusion with 1st catheter was 11.7 times more</p>

	<p>likely to have pain with subsequent PIVs. No predisposition for other complications Implications of predisposition to phlebitis and pain are unknown. No connection to infectious causes of phlebitis can be made without further research.</p>
<p>Catney, 2001 ⁵¹ USA</p> <p>To evaluate extending peripheral catheter dwell time beyond 72 hours and the associated increase in phlebitis and infiltration Surgical male patients age 33-88 years with stay greater than 48 hours, at teaching VA facility in Iowa.</p>	<p>411 patients Insertion rate was 1.13 attempts per insertion by IV nurses and IV technicians</p> <p>30/411 (7.3%) with phlebitis</p> <p>Study team worked with infection control nurse but no reports of septicemia or bacteremia during study.</p> <p>Reported catheter survival analysis by day to find that PIVs can safely be left in beyond 72 hours</p>
<p>Bhananker, 2009 ⁵² USA</p> <p>Outcome analysis of malpractice claims for peripheral catheterization from anesthesia practice; data from 35 professional liability insurance companies</p>	<p>140 claims for injuries related to peripheral catheter insertion from 1975 to 2000</p> <p>Represents 2.1% of all claims filed 127 or 91% for PIV catheters 13 or 9% for arterial catheters 22 (17%) cases categorized as “swelling/inflammation/infection” No deaths from this group 4 listed as substandard care 8 claims resulted in payment Median payment in 2007 dollars was \$11,580, range \$342 to \$43,932 Extravasation was most frequently reported injury</p>
<p>Grune, et.al., 2004 ²¹ Germany</p>	<p>2495 PIV catheters with injection port built into catheter hub in 1582 patients 27% with possible infection 104 events per 1000 catheter days Based on fever and other clinical signs and symptoms, no culture data reported</p>
<p>Dargin, 2010 ³³ USA</p> <p>Assessed survival and complications of peripheral catheters inserted with ultrasound guidance in emergency patients.</p>	<p>75 patients consecutively enrolled 6.35 cm (2.5 inch) 18 g peripheral catheter in deep basilic or brachial vein by ED resident or attending MD Chlorhexidine skin prep, sterile transparent membrane dressing over probe with sterile coupling gel Transparent membrane dressing for securement 47% failed within 24 hours due to infiltration Localized cellulitis, abscess, suppurative phlebitis or BSI tracked but none reported Avoidance of CVC was positive outcome</p> <p>Failure from infiltration could reflect lack of attention to adequate stabilization. Site selection could present challenges if PICC is needed later in hospitalization.</p>

<p>Easterlow, 2010²¹</p> <p>England</p> <p>Change initiative with peripheral catheters to reduce the high rates of MRSA bacteremia at a large hospital.</p>	<p>Baseline audit found significant problems with PIV management.</p> <p>Primary change was from a ported catheter with a 3-way tap (i.e., stopcock) to a closed catheter system with preattached extension set and needleless connector</p> <p>Intensive education on skin antisepsis, use of split septum needleless connector and disinfection, drug delivery, policy changes, and monthly audits.</p> <p>8-month period prior to product & other changes: 30 MRSA bacteremia cases 17 classified as HCAs 9 deemed catheter related</p> <p>8-month period after changes 14 MRSA bacteremia cases 11 classified as HCAs 4 definitely and 2 possibly related to catheter</p> <p>Significant changes in organizational culture, products, and practices at the same time make it impossible to isolate the impact of a single change.</p>
<p>Ritchie, 2007⁵³</p> <p>New Zealand</p> <p>Point prevalence study of all patients with IV device and urinary catheters to assess infectious complications with each device and report quality assurance information.</p>	<p>Infectious complications determined by presence of positive microbiological cultures in patients with a device on the survey day. Lab data assessed for positive blood cultures 4 days before and after survey date and catheter tips 7 days after the survey date.</p> <p>345 PIV in 305 of 830 patients</p> <ul style="list-style-type: none"> • 22/345 peripheral catheters with signs of infection (pain, swelling, erythema and/or purulent discharge) • 1 with exit site swab culture but device was still in situ • 6/44 (14%) in situ for longer than 72 h with signs of infection • 16/301 (5%) in peripheral catheters in situ for less than 72 h with signs of infection <p>All lab-confirmed infections were in CVCs.</p> <p>All inserters of all types of catheters targeted for more education as a result of this study.</p>
<p>Adhikari, 2010³⁴</p> <p>USA</p> <p>Retrospective data collection to compare infection rates in peripheral catheters inserted with ultrasound to those inserted with traditional methods; adults in a level 1 academic urban ED</p>	<p>Skin prep details not provided</p> <p>US probe covered with non-sterile glove and bacteriostatic lubricant gel used.</p> <p>402 with 1.88 or 2.5 inch 18 gauge catheter in antecubital fossa veins or basilic vein with US</p> <p>402 with mostly 18 g in antecubital fossa veins using traditional methods</p> <p>40 records eliminated but no details of the specific number from each group</p> <p>CDC definitions for skin and soft tissue infection used</p> <p>2 documented infections in the US group or 5.2 per 1000 devices</p> <p>3 in the traditional group of 7.8 per 1000 devices</p>

	<p>No statistical difference</p> <p>US found to be as safe as traditional methods of PIV insertion, with both having low infection rates</p>
<p>Campbell, 2005⁴⁴ Canada</p> <p>Retrospective audit of records from patients with peripheral catheter from May 1, 2002-June 30, 2003 in a teaching facility inpatient and ambulatory infusion center. Compared rates of complications based on flushing frequency</p>	<p>111 PIVs in 63 patient</p> <p>56 complications in 48 catheters. Suspicion of infection in 11 of 56 No further definition of signs, symptoms, cultures, etc Reports lower complications in those flushed less often than every 24 hours</p> <ul style="list-style-type: none"> • 9 received flushes every 8 hours; 7 (78%) with complications • 3 received flushes every 12 hours; 2 (66%) with complications • 99 received flushes every 24 hours; 39 (40%) with complications • p=0.021 <p>Small numbers do not suggest enough statistical power to draw any conclusions.</p>
<p>Boyd, 2010¹¹ Scotland</p> <p>To assess compliance with a new bundle for insertion and care of short peripheral catheters.</p>	<p>Need for intervention was documented by the finding of 10% of all <i>S aureus</i> bacteremias were associated with peripheral catheters from May-Oct 2007 (unpublished data), which was in line with the 11% estimate for all UK hospitals</p> <p>100 peripheral catheters analyzed over a 25 week period Quality indicators focused on daily review of need, dwell time, location, site condition, and removal. Details of care bundle not provided Data reported on gradual improvement with compliance with bundle but no data included on bacteremia rates after implementation of this bundle</p>
<p>Malach, 2005⁵⁴ Israel</p> <p>Series of 9 point prevalence studies on PIVs and phlebitis in adults and pediatrics</p>	<p>6 studies in 1996, 98, 99, 2000 and 2002 included all hospitalized patients except PICU, NICU, and adult ICU. 3 studies in 2003 included all adults and no pediatrics</p> <p>40% +/- 8% of hospitalized patients have peripheral catheter. 6.6% +/- 3.3% have catheter associated phlebitis Trend decreased over the years from 12.7% to 2.6%</p> <p>Studies in 2003 included culturing of all catheters with phlebitis.</p> <ul style="list-style-type: none"> • 25 catheters cultured • 10 (40%) showed bacterial growth <p>Compared to 45 control catheters cultured, 15 or 33% with bacterial growth No difference in organisms between groups, Staph epidermidis most frequent</p>

	<p>Authors concluded that local inflammation might be the first and necessary step for peripheral catheter infections.</p>
<p>Nahirya, 2008 ⁴¹ Uganda</p> <p>To assess the prevalence of infections from peripheral catheters in hospitalized pediatric patients</p>	<p>Data collected at time of removal of short peripheral catheters included appearance, duration of use, IV therapies given.</p> <p>After cleaning with 2% povidone iodine, the external junction at the catheter hub was disconnected and swab culture taken of internal catheter hub surfaces.</p> <p>After cleaning skin with 2% povidone iodine and catheter removal, 2 cm catheter segment was sent for culture. Blood culture obtained from a new puncture site</p> <p>391 catheters, all cultured 81 (20.72%) colonized catheter tip 44 (11.25%) colonized catheter hubs 19 (4.86%) with same organism at tip and hub</p> <p>16 (4.09%) catheter tips has same organism as blood 7 (1.79%) with same organisms at tip, hub and in blood</p> <p><i>S. aureus</i> was most prevalent organisms in all locations cultured, followed by <i>S. epidermidis</i></p> <p>No information was provided in the study about skin antisepsis, stabilization, dressing or the personnel performing these insertions.</p> <p>The authors discussed data on a combination of peripheral and CVC infections as if the etiology and pathophysiology were the same.</p>
<p>Geffers, 2010 ⁵⁵ Germany</p> <p>Reported on the relationship between central and peripheral catheters and the risk of BSI in very low birth weight infants from 22 NICUs</p>	<p>2126 infants with 261 (12.3%) developing BSI Incidence density = 3.3 per 1000 patient days Multivariate analysis showed hazard ratios of 6.2 for CVC and 6.0 for peripheral catheters.</p> <p>Days with only CVC not separated from days with both types of catheters.</p> <p>Data is not clear as to whether the risk with each catheter is equal in this population or if there is less adherence to aseptic technique with peripheral catheter insertion and care.</p> <p>There were significant differences between some NICUs, indicating the need for unit-based surveillance and education.</p> <p>This age group appears to have similar risk factors for BSI regardless of the type of catheter being used.</p>
<p>Humphreys, 2008 ²⁰</p> <p>UK – data from England, Wales, Northern Ireland, and Republic of Ireland</p> <p>A prevalence survey in 2006 of HCAs</p>	<p>HCAI rate was 7.6% or 5743/75,694 patients</p> <ul style="list-style-type: none"> • 9.4% (2719/28,987) had a peripheral IV catheter in place • 6% (1054/17,595) had a peripheral catheter within the past 7 days. <p>In those with primary BSI:</p> <ul style="list-style-type: none"> • 264/28987 (0.9%) with current peripheral catheter

	<ul style="list-style-type: none"> • 48/17,595 (0.3%) had peripheral catheter within the past 7 days. • 192/3866 (5%) with current CVC • 36/1586 (2.3%) had CVC in the past 7 days <p>Primary BSI appears to occur about 5 times more frequently with CVC than with peripheral catheter.</p>
<p>Pujol, 2007 ⁵⁶ Spain</p> <p>Assessed clinical outcome data on peripheral catheter BSI in non-ICU patients over 18 months</p>	<p>Data collected from Oct 2001 to March 2003 on all vascular catheter-related BSI.</p> <ul style="list-style-type: none"> • 150 cases in 147 patient or 0.37/1000 patient days • 77 (51%) were associated with peripheral catheters (0.19 cases/1000 patient days) • 73 (49%) were associated with CVCs (0.18 cases/1000 patient days) <p>55 (65%) from short peripheral catheters 27 (35%) from midline catheters</p> <p>Peripheral catheters had a greater rate of <i>S. aureus</i> infections than those from CVCs MRSA infections about the same with both types of catheters. Short peripheral catheters produced BSI within 3.9 days of insertion. Short peripheral catheters inserted in ED were infected within 3.7 days vs 5.7 days if inserted on nursing units.</p> <p>Patients with <i>S. aureus</i> infection had more complications than those infected with other organisms (metastatic infections from arthritic joints, empyema, and peritonitis in patient with cirrhosis.</p> <p>PIV catheter infection about same frequency as CVC-BSIs. Catheter placement included aseptic technique by nurses, chlorhexidine ointment over site with sterile gauze or sterile adhesive bandage. Dressings were changed when necessary and at least every 48 hours and catheters were allowed to remain in place until a complication developed.</p> <p>CVCs were inserted in the operating room or bedside using maximal barrier precautions.</p> <p>No details about hand hygiene, skin antisepsis, or catheter securement were provided.</p>
<p>Aygum, 2006 ⁵⁷ Turkey</p> <p>Prospective study to culture all peripheral catheters removed from Nov 2001 to April 2002</p>	<p>147 peripheral catheters removed from 131 patients. Semi-quantitative and quantitative cultures of catheters obtained. Gram stain performed of extraluminal surfaces. 14 or 9.5% had significant growth of coagulase-negative <i>Staphylococcus</i>, <i>Acinetobacter baumannii</i>, <i>Pseudomonas aeruginosa</i>, MRSA, <i>Klebsiella pneumoniae</i>, <i>Enterococcus</i>, and polymicrobial growth. Clinical signs of local inflammation were absent. One patient developed sepsis.</p>

<p>Hirschmann, 2001 ⁵⁸</p> <p>Austria</p> <p>Prospective multi-center study to compare the impact of hand hygiene on frequency of peripheral catheter complications.</p>	<p>1132 peripheral catheters analyzed 379 single complications (24%) Redness, pain, swelling seen but none with purulence.</p> <p>Complications seen when</p> <ul style="list-style-type: none"> • No hand hygiene or gloves = 30.3% • Hand washing with regular soap = 32.7% • Use of alcoholic hand gel = 18% • Wearing gloves = 21% <p>Demonstrates the need for greater education on use of proper hand hygiene and use of gloves for insertion procedures.</p>
<p>Trinh, 2011 ¹⁴</p> <p>USA</p> <p>Retrospective analysis of adults patients with <i>S. aureus</i> bacteremia from July 2005 to March 2008, correlated with clinical documentation of the PVC site condition</p>	<p>Blood and catheter tip cultures correlated to clinical findings by a physician or IV nurse. 544 cases of <i>S. aureus</i> bacteremia 18 definite and 6 probable cases related to peripheral catheter 12% of all <i>S. aureus</i> bacteremias Catheter insertion in the ED in 67% of identified cases 46% in right antecubital fossa, 21% in left antecubital fossa</p> <p>Calculated rate = 0.06 bacteremias per 1000 catheter days</p> <p>Adult discharge data from U.S. hospitals used to calculate an estimate of 10,028 <i>S. aureus</i> bacteremias from peripheral catheters annually.</p>
<p>1 Cohort Study, INS ranking IV</p>	
<p>Hirai, 2009 ⁵⁹</p> <p>Japan</p> <p>Retrospective analysis of 41 gastrectomy patients receiving TPN compared with 41 receiving PPN</p>	<p>No details included about the specific types of catheters used, however the authors did state that TPN was infused through a CVC inserted preoperatively.</p> <p>Metabolic data included along with infectious events</p> <p>TPN group with 8 postop infections, 2 were catheter sepsis</p> <p>PPN group with 5 postop infections, 1 with catheter sepsis No details on diagnosis of catheter sepsis, signs and symptoms or catheter manipulation</p>
<p>3 Case Controlled Studies, INS ranking IV</p>	
<p>Liopsis, 2003 ⁴²</p> <p>Canada</p> <p>Two groups of extremely low birth weight infants comparing outcomes from peripheral central venous catheters (PCVC) to short peripheral catheters</p>	<p>Both groups had 44 patients each and were matched for birth weight, gestational age, gender, and severity of illness.</p> <p>3 infectious episodes for a total of 1138 catheter days in the PCVC group; 9 suspected infections; 3 infants died from infection</p> <p>12 infectious episodes for a total of 1114 days in the peripheral catheter group; 14 suspected infections; 6 infants died from infection. (p-0.03)</p>

	<p>Infections defined as a positive blood culture at least 2 days after insertion and within 24 hours of catheter removal and the absence of other indwelling catheter.</p> <p>Per-Q-Cath used for the PCVC group. “Angiocatheters”, butterfly needles or scalp needles used for the peripheral catheter group.</p>
<p>Nasser, 2004⁶⁰ Lebanon</p> <p>Infectious outbreak investigation using matched case-control and a retrospective cohort.</p>	<p>411 cases of <i>Burkholderia cepacia</i> BSI (formerly known as <i>Pseudomonas cepacia</i>) in 361 patients over 7 years; all cases involved intravenous catheters and fever associated with their insertion.</p> <p>Most catheters involved were short peripheral catheters with CVC used rarely. Having 2 peripheral catheters was identified as a risk factor for BSI. Phlebitis seen in 20 of the 50 case-patients and only 2 of the 100 control patients.</p> <p>Skin antisepsis included povidone-iodine from purchased squirt bottles; applied to a piece of sterile cotton and rubbed in circular manner onto site. This was followed by 70% alcohol to remove the povidone-iodine. Alcohol was purchased as 90% ethanol and diluted by pharmacy to be 70%, then distributed to nursing units in 4-liter plastic containers, then poured into plastic squirt bottles and applied to cotton balls.</p> <p>Culture of the inside of water tap grew <i>B. cepacia</i>, which was found to be the same genotype as those in 2 patients.</p> <p>Pharmacy changed to dilute alcohol with only sterile water and individually wrapped swabs were supplied to nursing units for catheter insertion procedure. 6 prepackaged swabs issued to each patient upon admission. The need for additional swabs caused nurses to revert to using the solution from the bottles prepared by pharmacy with the contaminated tap water when sterile water was not available.</p> <p>Medical record review for 50 patients showed</p> <ul style="list-style-type: none"> • Fever in 98% • IV phlebitis in 44% • Recurrent bacteremia in 20% <p><i>B. cepacia</i> is usually killed by alcohol. This organism is known for its ability to attach and cling to any surface and form a biofilm. Authors suggest that the organism may have been residing in a biofilm on the inner surface of the plastic bottles.</p>
<p>Lee, 2010⁶¹ Taiwan</p>	<p>Insertion sites cleaned with 75% alcohol followed by 10% povidone iodine and allowed to dry for 2 minutes.</p>

<p>To investigate soft tissue infections associated with short peripheral venous catheters in hospitalized patients at 2 hospitals.</p>	<p>Dressings were non-transparent sterile elastic bandages. Injection sites were cleaned with 75% alcohol before use and catheters and sets were changed within 72 hours. January 2006 through December 2008 - 46 patients with 46 cases of soft tissue infection related to peripheral venous catheters.</p> <ul style="list-style-type: none"> • 8 cases with purulent drainage or cellulitis at insertion site; 1 of these with BSI from same pathogen as what was found at the site • 6 with abscesses requiring surgical debridement • 6 with bacteremia and local inflammation • 26 with local inflammation for more than 3 days after catheter removal. <p>Identified risks were</p> <ul style="list-style-type: none"> • Continuous infusion for more than 24 hours • Sites in the lower extremities • Use of infusion pumps • Neurological or neurosurgical conditions <p>Greater risk from continuous infusion rather than intermittent infusions seems at odds with other reports.</p> <p>Chlorhexidine not available in Taiwan at the time of this study.</p>
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1 Correlational Study, INS ranking IV

<p>Gallant & Schultz, 2006³² USA</p> <p>To assess phlebitis rates at 96 hours of dwell and beyond; to assess the phlebitis rates based on bacterial, mechanical and chemical factors in a 14 bed cardiac surgery critical unit and 42 bed cardiothoracic step-down unit</p>	<p>Skin prep with alcohol; transparent dressing used. Catheters removed if Visual Infusion Phlebitis Scale was 2 or greater, patient complaining of pain or discomfort or therapy was complete. Sites assessed at same time each day. Blood culture obtained with signs/symptoms of bacteremia. Catheters dwelling less than or equal to 96 hours compared with those dwelling for greater than 96 hours. 851 sites in 506 patients. Reasons for removal known in 789 catheters. No statistical difference in phlebitis rates between groups.</p> <p>Significant increase in phlebitis with subsequent catheter when patient's 1st catheter developed phlebitis. Data obtained from 471 patients where the number of catheters and reasons for removal were known.</p> <ul style="list-style-type: none"> • 226 patients had 1 catheter with phlebitis rate of 2.7% • 245 had 2 or more catheters with phlebitis rate of 13.4% • Total number of patients with phlebitis in at least 1 PIV site - 35; 29 or 83% occurred in a restarted catheter. <p>1 blood culture with negative results, no infections found. This study caused the hospital to change their policy to restart peripheral catheters when clinically indicated based their Visual Infusion Phlebitis scale.</p>
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9 Randomized Controlled Trials, INS ranking III

<p>Barria, 2007 ⁶² Chile</p> <p>Comparison of outcomes with a 2 F silicone PICC vs 24 gauge polyurethane catheters or 27 gauge winged needle</p>	<p>37 patients in each group Primary outcome was suspected or proven sepsis and phlebitis</p> <p>Suspected sepsis</p> <ul style="list-style-type: none"> • 14 with PICC (37.8%) • 8 with PIV (21.6%) p= 0.127 <p>Confirmed sepsis</p> <ul style="list-style-type: none"> • 1 with PICC (2.8%) • 2 with PIV (5.1%) p=0.530 <p>None caused by catheter as shown by tip culture</p> <p>Phlebitis</p> <ul style="list-style-type: none"> • 6 in PICC group, 10.8% (0.4 per 1000 catheter hours) • 23 in PIV group 40.5% (1.8 per 1000 catheter hours) p=0.007 <p>Comparable groups due to randomization. Small size of each group could have showed lack of power to detect differences between groups.</p>
<p>Wilson, 2007 ⁴³ USA</p> <p>Comparison of outcomes with 2 Fr PICCs and peripheral catheters in preterm neonates less than or equal to 1250 g birth weight or 30 weeks gestation.</p>	<p>2 Fr silicone PICCs in 46 patients</p> <ul style="list-style-type: none"> • Sterile insertion • Skin prep with povidone-iodine • No prophylactic antibiotics • All tubing changes with sterile technique <p>Peripheral catheters</p> <ul style="list-style-type: none"> • Size not reported • Clean technique used for tubing changes • No details of skin prep <p>Reported outcomes were the number of infants with at least one episode of systemic infection or died between randomization and study end point.</p> <ul style="list-style-type: none"> • 17 / 46 (37%) in PICC group • 14 / 40 (28%) in peripheral catheter group <p>Reported data on infecting organisms very similar between both groups Authors concluded that PICCs decrease frequency of painful punctures without significantly increasing occurrence of systemic infection or the length of stay</p>
<p>Webster, 2008 ⁶³ Australia</p> <p>Comparison of routine 72-hour replacement of peripheral catheters with replacement only when clinically indicated in an adult population.</p>	<p>No controls over inserters or how peripheral catheters were inserted other than current hospital policy.</p> <p>Intervention group</p> <ul style="list-style-type: none"> • 379 catheters replaced when clinically indicated • 59.8 Catheter failures per 1000 device days • Phlebitis 16 (4%) • Local infection 2 (1%) • Suspected BSI 1 (0.3%)

	<p>Control group</p> <ul style="list-style-type: none"> • 376 with routine replacement at 3 days dwell time • 60.9 Catheter failures per 1000 device days • Phlebitis 12 (3%) • Local infection 0 • Suspected BSI 1 (0.3%) <p>Not enough power in study to properly evaluated secondary outcomes of complications (e.g., phlebitis and infection)</p>
<p>Van Donk, 2009 ⁶⁴ Australia</p> <p>Compare routine replacement (72-96 h) of peripheral catheters to replacement when clinically indicated in home care patients with catheters inserted by MD and RNs not part of an IV Team</p>	<p>Clinically indicated group</p> <ul style="list-style-type: none"> • 105 patients • 155 catheters • 16,765 IV-hours • 61 with phlebitis and/or occlusions <p>Routine replacement group</p> <ul style="list-style-type: none"> • 95 patients • 161 catheters • 12,192 IV-hours • 39 with phlebitis and/or occlusion <p>No purulence or bacteremia in either group No statistical difference between groups No reports of cultures of any type. Statement about no bacteremia assumed to be based on clinical signs and symptoms only</p>
<p>Machado, 2008 ²⁴ Brazil</p> <p>Compared use of only adhesive tape over puncture site to use of sterile gauze dressing and sterile TSM dressing in children mostly of preschool age with Teflon catheters</p>	<p>Skin antisepsis with 70% alcohol</p> <p>Control group with only tape</p> <ul style="list-style-type: none"> • 50 catheters in 37 children • Phlebitis in 5 catheters (10%) <p>Sterile gauze group</p> <ul style="list-style-type: none"> • 50 catheters in 40 children • Phlebitis in 1 catheter (2%) <p>Sterile TSM group</p> <ul style="list-style-type: none"> • 32 children but did not report number of catheters • Phlebitis in 1 catheter (2%) <p>No statistical significant differences, p = 0.091 High infiltration rates in all groups – 98.8% No infection data reported</p> <p>5-fold greater rate of phlebitis with only tape over site Risk of colonization and possible infection from use of tape alone is unknown</p> <p>High rate of infiltration suggests reliance only on dressing type for securement.</p>
<p>Lee, 2009 ²⁵</p>	<p>3165 patients with 6538 peripheral catheters</p>

<p>Taiwan</p> <p>Comparison of peripheral catheters in adults indwelling for 48 to 72 hours versus those dwelling for 72 to 96 hours; in medical & surgical units.</p>	<p>All skin antiseptics with 75% alcohol, 10% povidone iodine, with 2 min drying time before insertion. Semi-quantitative culture of all catheters at removal.</p> <p>48-72 hr group – 3308 PIVs 72-96 hr group - 3230 PIVs</p> <p>Phlebitis more common in 48-72 hr group than 72 – 96 hr group (4.4% vs 0.5%, p < .001) 160/162 catheters (98.8%) with phlebitis showed no microbiological evidence of infection No purulent exit site infection No CRBSI No data on other 2 catheters</p> <p>Insertion of 1st catheter by ED/unit nurse and continuous infusion equaled greater risk of local catheter infection. 1st PIV insertion</p> <ul style="list-style-type: none"> • By ED/unit nurse – 3.7% • By IV therapist – 2.1% • OR = 1.6, (1.003 to 2.5) p=.048 <p>Language in study indicates phlebitis is equal to local infection. 98.8% of catheters with phlebitis did not exhibit microbiological evidence of infection, suggesting microorganisms did not cause local inflammation.</p>
<p>Rickard, 2010 ⁶⁵ Australia</p> <p>Comparison of routine rotation of peripheral catheters every 3 days to removal only when clinically indicated in adults in hospital without an IV Team</p>	<p>362 patients total</p> <p>Clinically indicated group</p> <ul style="list-style-type: none"> • 185 patients, 280 devices • 26,885 device hours <p>Routine change group</p> <ul style="list-style-type: none"> • 177 patients, 323 devices • 23,288 device hours <p>No statistical differences for phlebitis, infiltration, occlusion or accidental removal. Cultures obtained only when clinically indicated No cases of local infection or BSI in either group</p>
<p>Periard, 2008 ⁶⁶ Switzerland</p> <p>Compared use of PICCs to peripheral catheters in an adult hospitalized population.</p>	<p>5 F silicone single lumen PICCs in 31 patients 18 g polyurethane peripheral catheters in 29 patients</p> <p>Infections assessed by appropriate cultures when clinically indicated.</p> <ul style="list-style-type: none"> • 1 local infection with tip colonization in a PICC • No local infection in peripheral catheter group • No BSI in either group <p>DVT with PICCs in 6 patients; 1 patient with peripheral catheter</p> <p>Superficial vein thrombosis with PICCs in 9 patients (29%);</p>

	<p>in 13 or 44.8% with PIV, p=0.20 Study size was too small to draw conclusions about infection rates.</p>
<p>Small, 2008⁶⁷ England</p> <p>Comparison of organisms on peripheral catheter tips when skin prep was done with 2% chlorhexidine in alcohol versus 70% alcohol alone.</p>	<p>2% CHG/IPA group</p> <ul style="list-style-type: none"> • Applied with a back and forth scrubbing motion • 91 patients • 2.3 days mean dwell time • 18 (19.8%) had organisms present on tip <p>70% IPA alone</p> <ul style="list-style-type: none"> • Applied in a circular motion • 79 patients • 2.2 days mean dwell time • 39 (49.4%) had organisms present on tip
<p>4 Systematic Literature Reviews, INS ranking II</p>	
<p>Tagalakis, 2002⁸ Canada</p> <p>Review of literature on peripheral vein infusion thrombophlebitis using randomized controlled trials, case-controlled studies and cohort studies from 1966 to 2001, English language; data for CVCs, steel needles and PICCs excluded.</p>	<p>Suppurative thrombophlebitis, which may occur if the vein thrombus becomes infected, occurs following 0.2% to 2% of peripheral vein catheter insertions and is the most serious local complication of peripheral vein infusion thrombophlebitis.</p> <p>94 patients with 102 episodes of sepsis due to percutaneously inserted catheter</p> <ul style="list-style-type: none"> • 44 or 43% occurred with peripheral venous catheters <ul style="list-style-type: none"> ○ 16/44 with peripheral vein infusion thrombophlebitis, cellulitis or superficial abscess ○ 7 with suppurative thrombophlebitis <p>5% to 25% of peripheral catheters are colonized by skin organisms at time of removal as tested by semiquantitative cultures. Colonized catheters were up to 6 times more likely to be associated with peripheral vein infusion thrombophlebitis.</p> <p>There are still unanswered questions about the sequence of events – colonization leading to thrombophlebitis or inflammation leading to infection.</p>
<p>Maki, 2006¹⁷ USA</p> <p>Assessed risk of BSI in adults with different types of intravascular devices. Studies were English language, prospective from Jan 1, 1966 thru July 1, 2005</p>	<p>Criteria for studies included:</p> <ul style="list-style-type: none"> • Exact type of device was described • All BSI data collected prospectively • Criteria for determining IVD-BSI clearly described • At minimum, study criteria was consistent with CDC and NNIS • Duration of device implementation in population <p>Studies on plastic peripheral catheters</p> <ul style="list-style-type: none"> • No. – 110 • No. of catheters- 10,910 • No. of device days – 28,720 • No. of BSI – 13 • Pooled mean rate per 100 devices = 0.1 (0.1-0.2, 95%

	<p>CI)</p> <ul style="list-style-type: none"> • Pooled mean per 1000 device days = 0.5 (0.2 to 0.7, 95% CI) <p>Peripheral catheters = lowest rates of all devices by % of devices</p> <p>By device days – peripheral steel needles have highest rate at 8.6/1000 device days, based on 1 study of 148 devices, 350 device days and 3 BSIs</p> <p>By device days, peripheral plastic catheters have one of the lowest BSI rates with only peripheral and central venous ports being lower.</p> <p>Discussion section focused mainly on CVC risks but this is one quote is applicable:</p> <p>“The primary purpose of our review is to point out that <i>all</i> types of IVDs pose significant but often differing risk of IVD-related BSI.”</p>
<p>Zingg & Pittet, 2009⁵ Switzerland</p> <p>To determine if complications arising from peripheral venous catheters are under-evaluated and whether the peer-reviewed literature appropriately reflects the wide use of this device, whether potential harmful complications are well addressed, and the type of prevention and intervention measures proposed.</p>	<p>150 million peripheral catheters used annually in USA, extrapolated catheter days reach 450 million, 15 times higher than cumulative dwell time for CVCs.</p> <p>No Europe-wide epidemiology data on peripheral catheter use.</p> <p>2006 Swedish data reported annual use of 5 million peripheral catheters</p> <p>4-28% of peripheral catheters not used for treatment 20% of catheter days are unnecessary Rate of unnecessary catheters reaches almost 50% in ED</p> <p>Thrombophlebitis rates from 2% to 80%</p> <p>Peripheral catheter-BSI far more serious than thrombophlebitis</p> <p>Most likely mechanism is colonization of vascular catheter tract followed by biofilm formation. Colonization occurs during insertion and manipulation.</p> <p>Lack of published studies is surprising</p> <p>Incidence density estimated at 0.2 to 0.7 per 1000 device days and 0.08% of catheter use.</p> <p>Rates are low but absolute numbers may approach the same as CVC-BSI</p> <p>Peripheral catheter-BSI mentioned in studies as a secondary outcome, but studies without sufficient power to make such comments</p> <p>Colonization estimated between 5% to 25% of PIV at removal, surprising that more BSI not seen. Speculation of authors about the reasons:</p> <ul style="list-style-type: none"> • Short dwell time of PIV

	<ul style="list-style-type: none"> • Infrequent manipulations • Lack of appropriate surveillance <p>Local peripheral catheter infection rate of 2.3% from skin organisms that migrate into cutaneous tract</p> <p>Most frequently used but abused invasive device in hospitals</p> <p>Adequately powered studies seriously needed to address peripheral catheter-BSI, device and environment-associated risk factors and successful interventions</p>
<p>Webster, 2010⁶⁸ Australia</p> <p>Assessed the effect of removing peripheral catheters when clinically indicated compared with removing and re-siting routinely; randomized controlled trials only</p>	<p>6 RCTs 3455 participants 1 trial in England 5 in Australia 4 published 2 unpublished</p> <p>Catheter related bacteremia:</p> <ul style="list-style-type: none"> • Low risk population = 1/1000 device days in both groups • High risk population = 7/1000 device days in routine removal group; 4/1000 removal when clinically indicated <p>Phlebitis</p> <ul style="list-style-type: none"> • Low risk population <ul style="list-style-type: none"> ○ 25/1000 device days in routine removal groups ○ 31 per 1000 device days in clinically indicated groups • High risk population <ul style="list-style-type: none"> ○ 350 per 1000 device days in routine removal groups ○ 400 per 1000 device days in clinically indicated groups <p>Changing when clinically indicated reduced device-related bacteremia by 43% (not statistically significant) and increases phlebitis by 24% (not statistically significant)</p> <p>Local infection not statistically different between groups</p> <p>Clinically indicated group with 13% non-statistically significant increase in infiltration</p> <p>No indication that phlebitis was precursor to bacteremia</p>
1 Meta-Analysis, INS ranking I	
<p>Niel-Weise, 2010⁶⁹ Netherlands</p>	<p>RCTs or quasi-randomized trials with a definition of phlebitis and sufficient data to calculate the risk of phlebitis.</p>

<p>Assess the effect of inline filters on infusion-related phlebitis associated with PIV catheters</p>	<p>11 studies of 1633 PIV catheters, 826 with filters</p> <p>Inline filters reduce risk of phlebitis (RR 0.66) but the benefit is uncertain due to methodological shortcomings in the studies and marked unexplained statistical heterogeneity.</p> <p>Filters not recommended based on this analysis. Introduction included: “Fortunately peripheral catheters have rarely been associated with bloodstream infection or deep vein thrombosis.”</p>
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BSI = bloodstream infection
 CHG = chlorhexidine gluconate
 CVC = central venous catheter
 ED = emergency department
 HCAI = healthcare acquired infection
 IPA = isopropyl alcohol
 IVD = intravenous device
 MRSA = methicillin resistant Staphylococcus aureus
 NICU = neonatal intensive care unit
 NNIS – National Nosocomial Infection Surveillance System, currently known as the National Healthcare Safety Network
 PICC = peripherally inserted central catheter
 PIV = peripheral intravenous
 PPN = peripheral parenteral nutrition
 PVC = peripheral venous catheter
 SOP = standards of practice
 TB = tuberculosis
 TPN = total parenteral nutrition
 TSM = transparent membrane dressing
 UK = United Kingdom
 VA = Veterans Affairs