**Practice Guidelines for Central Venous Access: Update 2020**

**Supplement 2: PRISMA Diagram and Literature Search Summary**

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) Diagram



|  |  |
| --- | --- |
| **N** | **Full-text Exclusion Reason (first listed)** |
| 43 | Review, letter, editorial, descriptive paper, guideline, or meta-analysis/SR with no original data |
| 1 | Non-English article with no adequate English abstract |
| 6 | Article or abstract not peer-reviewed |
| 276 | Subjects excluded from or not identified by evidence model (also animal studies or surveys, in vitro) |
| 230 | Interventions excluded from or not identified by evidence model (or no relevant intervention or wrong comparators) |
| 124 | Outcomes excluded from or not relevant to evidence model |
| 13 | Unable to interpret findings due to lack of clarity or research design flaws |
| 5 | Duplicate data or secondary analysis of data presented in original article |
| 31 | Other wrong study design |
| 729 | Total |

**Literature Search Strategy:** Terms and limits used to generate the search is detailed below. Limits as indicated in the search strategies.

**Resource utilization (1-5)**

*PubMed*

(((((bundle\*[tiab] OR program\*[tiab] OR protocol\*[tiab] OR checklist\*[tiab] OR multidisciplin\*[tiab] OR framework\*[tiab] OR ((education\*[tiab] OR qualit\*[tiab] OR improv\*[tiab] OR prevent\*[tiab]) AND (program\*[tiab] OR initiativ\*[tiab] OR collaborat\*[tiab])) OR (qualit\*[tiab] AND (manag\*[tiab] OR improv\*[tiab])))) OR (((hygien\*[tiab] OR hand washing OR decontaminat\*[tiab] OR disinfect\*[tiab] OR nursing)) AND ((prevent\*[tiab] OR control[tiab]))) OR pronovost [AU]) AND (((((central[tiab] OR cv[tiab] OR cvp[tiab] OR subclavian vein[tiab] OR umbilic\*[tiab]) AND (catheter\*[tiab] OR line[tiab] OR lines[tiab])) OR cvc[tiab] OR cvcs[tiab] OR cla bsi[tiab] OR clabsi[tiab] OR (catheter\*[tiab] AND (bloodstream infection\*[tiab] OR bsi[tiab]))))) AND (((intensive care[tiab] OR special care[tiab] OR critical\*[tiab] OR icu[tiab] OR nicu[tiab] OR picu[tiab] OR icus[tiab] OR nicus[tiab] OR picus[tiab]))) ) AND "english and humans"[Filter]) NOT (Editorial[ptyp] OR Letter[ptyp])

*Embase*

('education program'/exp OR 'education program' OR 'checklist'/exp OR checklist OR 'total quality management'/exp OR 'total quality management' OR bundle\*:abti OR program\*:abti OR protocol\*:abti OR checklist\*:abti OR multidisciplin\*:abti OR framework\*:abti OR (((education\* OR qualit\* OR improv\* OR prevent\*) NEAR/3 (program\* OR initiativ\* OR collaborat\*)):abti) OR ((qualit\* NEAR/3 (manag\* OR improv\*)):abti) OR (('hygiene'/exp OR 'hygiene' OR 'hand washing'/exp OR 'hand washing' OR 'disinfection'/exp OR disinfection OR 'skin decontamination'/exp OR 'skin decontamination' OR 'intensive care nursing'/exp OR 'intensive care nursing' OR hygien\*:abti OR 'hand washing':abti OR decontaminat\*:abti OR disinfect\*:abti OR nursing:abti) AND ('prevention and control'/exp OR 'prevention and control' OR 'prevention'/exp OR prevention OR 'control'/exp OR control OR prevent\*:abti OR control\*:abti))) AND ('central venous catheter'/exp OR 'central venous catheter' OR (((central OR cv OR cvp OR 'subclavian vein' OR umbilic\*) NEXT/3 (catheter\* OR line\*)):abti) OR 'cv cath':abti OR cvc:abti OR cvcs:abti OR 'cla bsi':abti OR clabsi:abti OR ((catheter\* NEAR/3 ('bloodstream infection' OR 'bloodstream infections' OR bsi)):abti)) AND (('intensive care'/exp OR 'intensive care' OR 'intensive care unit'/exp OR 'intensive care unit' OR 'critical illness'/exp OR 'critical illness' OR 'critically ill patient'/exp OR 'critically ill patient' OR 'intensive care':abti OR 'special care':abti OR critical\*:abti OR icu:abti OR nicu:abti OR picu:abti OR icus:abti OR nicus:abti OR picus:abti) AND [humans]/lim AND [english]/lim) AND (([article]/lim OR [article in press]/lim OR [conference paper]/lim OR [review]/lim OR [cochrane review]/lim OR [systematic review]/lim OR [meta analysis]/lim OR [controlled clinical trial]/lim OR [randomized controlled trial]/lim) AND [humans]/lim AND [english]/lim AND [embase]/lim)

**Intravenous antibiotic prophylaxis (6)**

*PubMed*

(((((Catheterization, Central Venous[mh] OR venous OR infus\*) AND (Antibiotic Prophylaxis OR prophyl\*[TIAB] OR prevent\*[TIAB]) AND (Bacteremia OR Sepsis[MH] OR Staphylococcal Infections))) AND ("english and humans"[Filter])) NOT (((impreg\*[tiab] OR hemodialy\*[tiab] OR Catheterization, Peripheral[mh])) OR ((Editorial[ptyp] OR Letter[ptyp]))))

**Aseptic techniques (ie practitioner aseptic preparation and patient skin preparation) (7)**

*PubMed*

((((Catheterization, Central Venous[mh] OR central venous catheter\*[tw] OR central venous line\*[tw])) AND ((antisepsis[mh] OR antisepsis[tw] OR hand Hygiene OR handwash\*[tw] OR hand wash\*[tw] OR hand hygiene[tw] OR aseptic technique\*[tw] OR barrier precaution\*[tw] OR Anti-Infective Agents, Local[mh] OR Chlorhexidine[mh] OR Iodine[mh] OR Povidone[mh] OR Triclosan[mh] OR Hexachlorophene[mh] OR Cetrimonium Compounds[mh] OR Phenol[mh] OR Hydrogen Peroxide[mh] OR Alcohols[mh] OR Soaps[mh] OR (iodine\*[tw] OR povidone\*[tw] OR chlorhexidine[tw] OR betadine[tw] OR triclosan[tw] OR hexachlorophene[tw] OR chloroxylenol[tw] OR cetrimide[tw] OR benzalkonium[tw] OR benzylkonium[tw] OR octenidine[tw] OR phenol\*[tw] OR carbolic[tw] OR hydrogen peroxide[tw] OR alcohol[tw] OR alcohols[tw] OR antiseptic\*[tw] OR soap\*) OR skin disinfect\* OR ("Hand Disinfection"[mh] OR "Surgical Drapes"[mh] OR "Surgical Attire" [mh] OR "hair removal"[mh] OR sterile drapes [tiab]))) AND (("english and humans"[Filter]))) NOT ((Editorial[ptyp] OR Letter[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR hemodialy\*[tiab] OR Catheterization, Peripheral[mh])))

**Catheter coatings/impregnation (selection of catheter type) (8)**

*PubMed*

(((((Catheterization, Central Venous [mh]) OR (venous catheter OR vein catheter) OR Catheterization, Central Venous/adverse effects [mh] OR Catheterization/adverse effects\*)) AND (((impregn\* OR bond\* OR coat\*) OR (anti-microbial or antisep\* or antibiotic\*) OR Chlorhexidine OR Silver-Sulfadiazine OR Minocycline OR rifampin OR heparin OR (Rifampi\* OR Minocyclin\* OR Silver-Sulfadiazine OR Chlorhexidine OR Arrowgard OR Cook Spectrum OR Silver))) AND (("english AND humans"[Filter]))) NOT ((Editorial[ptyp] OR Letter[ptyp]) OR ((hemodialysis[mh] OR renal dialysis[mh] OR hemodialy\*[tiab])))) OR ((((Catheterization, Central Venous [mh]) OR (venous catheter OR vein catheter) OR Catheterization, Central Venous/adverse effects [mh] OR Catheterization/adverse effects\*)) AND (((impregn\* OR bond\* OR coat\*) OR (anti-microbial or antisep\* or antibiotic\*) OR Chlorhexidine OR Silver-Sulfadiazine OR Minocycline OR rifampin OR heparin OR (Rifampi\* OR Minocyclin\* OR Silver-Sulfadiazine OR Chlorhexidine OR Arrowgard OR Cook Spectrum OR Silver))) AND ((("english and humans"[Filter]) AND (letter[ptyp] AND case reports[ptyp]) NOT (letter[ptyp] NOT case reports[ptyp])) NOT (Editorial[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR PICC OR peripheral[tw] OR Cardiac catheterization[mh] OR tunneled)))

**Selection of catheter insertion site (for prevention of infectious complications) (9)**

*PubMed*

(((Catheterization, Central Venous[mh]) AND ((access OR route OR site) OR ((jugular AND subclavian) OR (jugular AND femoral) OR (subclavian AND femoral) OR (femoral AND nonfemoral))) AND ((catheter-related infections[mh] OR bacteremia OR blood stream infection OR venous thrombosis[mh] OR (thrombosis OR occlusion) OR safety OR catheter-associated infections OR catheter-related bloodstream infections OR Bacterial Infections[mh] OR catheter-related bloodstream infection OR catheter infection OR central venous catheter related infection OR complications OR catheter-related sepsis OR sepsis[mh])) AND (("english and humans"[Filter]))) NOT ((Editorial[ptyp] OR Letter[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR peripheral\*[TI] OR PICC))) OR (((access OR route OR site) OR ((jugular AND subclavian) OR (jugular AND femoral) OR (subclavian AND femoral) OR (femoral AND nonfemoral))) AND (Catheterization, Central Venous[mh]) AND ((("english and humans"[Filter]) AND (letter[ptyp] AND case reports[ptyp]) NOT (letter[ptyp] NOT case reports[ptyp])) NOT (Editorial[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR PICC OR peripheral[tw] OR Cardiac catheterization[mh] OR tunneled)))

**Catheter fixation and insertion site dressings (10-11)**

*PubMed*

((("english and humans"[Filter]) NOT (Editorial[ptyp] OR Letter[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR peripheral\*[TI] OR PICC)) AND ((Surgical Stapling[mh] OR Sutures[mh] OR stapl\* OR suture\* OR securement OR tape) AND Catheterization, Central Venous[mh])) OR (((Catheterization, Central Venous[mh] OR central venous catheter\*[tw] OR central venous line\*[tw] OR central-vein catheter)) AND ((occlusive dressings[mh] OR bandages, hydrocolloid[mh] OR silver[mh] OR silver sulfadiazine[mh] OR polyurethanes[mh] OR iodine[mh] OR chlorhexidine[mh] OR dermabond OR biopatch OR antibiotic\*[tw] OR anti-bacterial agents[mh] OR transparent OR bandages[mh] OR dressing[tiab] OR tegaderm OR Occlusive Dressings[mh])) AND (((occlusive\* OR hydrocolloid\* OR silver\* OR polyurethane\* OR permeable OR nonpermeable OR non-permeable OR transparent OR chlorhexidine OR iodine\* OR gauze OR tape) OR (dressing\* OR sponge\*))) AND (("english and humans"[Filter]) NOT (Editorial[ptyp] OR Letter[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR peripheral\*[TI] OR PICC)))

**Catheter maintenance (12)**

*PubMed*

(((Catheterization, Central Venous[mh] OR central venous catheter\*[tw] OR central venous line\*[tw] OR central-vein catheter[tw] OR triple-lumen catheter\*[tw] OR subclavian catheter\*[tw] OR internal jugular catheter\*[tw] OR femoral catheter\*[tw])) AND ((equipment[tw] OR changes[tw] OR guidewire[tw] OR scheduled[tw] OR maintenance[tw] OR inspection[tw] OR changing catheters[tw] OR new site[tw] OR wiping[tw] OR stopcock[tw] OR duration[tw] OR exchange\*[tw] OR removal[tw])) AND (("english and humans"[Filter]) NOT (Editorial[ptyp] OR Letter[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR peripheral\*[TI] OR PICC OR review[ptyp] OR "totally implantable venous access devices"[tw] OR TIVAD\*[tw] OR fung\*[ti] OR candid\*[ti] OR Malassezia[ti] OR antifungal[ti] OR Rhodotorula[tw] OR Acinetobacter[tw] OR Antifungal Agents[mh])))

**Aseptic techniques using an existing central line for injection or aspiration (e.g., wiping port with alcohol, not using stopcocks) (13)**

*PubMed*

(((Catheterization, Central Venous[mh] OR central venous catheter\*[tw] OR central venous line\*[tw] OR central-vein catheter[tw] OR triple-lumen catheter\*[tw] OR subclavian catheter\*[tw] OR internal jugular catheter\*[tw] OR femoral catheter\*[tw] OR catheter[tw]) AND (needleless[tw] OR needle-free[tw] OR wiping[tw])) AND (("english and humans"[Filter]) NOT (Editorial[ptyp] OR Letter[ptyp])))

**Selection of catheter insertion site for prevention of trauma or mechanical injury (14)**

*PubMed*

(((Catheterization, Central Venous[mh] OR (("subclavian vein" OR "Jugular Veins" OR "Femoral veins") AND catheter\*))) AND (((access OR route OR site) OR ((jugular AND subclavian) OR (jugular AND femoral) OR (subclavian AND femoral) OR (femoral AND nonfemoral) OR subclavian OR femoral OR jugular))) AND ((venous thrombosis[mh] OR (thrombosis OR occlusion) OR safe\* OR complication\*[tw] OR thrombos\* OR occlu\* OR block\* OR stenos\* OR thrombosis[mh] OR carotid artery puncture OR carotid puncture OR arterial puncture)) AND (("english and humans"[Filter]) NOT (Editorial[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR peripheral\*[TI] OR PICC))) OR ((Catheterization, Central Venous[mh] OR (("subclavian vein" OR "Jugular Veins" OR "Femoral veins") AND catheter\*)) AND (((access OR route OR site) OR ((jugular AND subclavian) OR (jugular AND femoral) OR (subclavian AND femoral) OR (femoral AND nonfemoral) OR subclavian OR femoral OR jugular))) AND ((venous thrombosis[mh] OR (thrombosis OR occlusion) OR safe\* OR complication\*[tw] OR thrombos\* OR occlu\* OR block\* OR stenos\* OR thrombosis[mh] OR carotid artery puncture OR carotid puncture OR arterial puncture)) AND (((("english and humans"[Filter]) AND (letter[ptyp] AND case reports[ptyp]) NOT (letter[ptyp] NOT case reports[ptyp])) NOT (Editorial[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR PICC OR peripheral[tw] OR Cardiac catheterization[mh] OR tunneled))))

**Patient positioning (15)**

*PubMed*

((((Catheterization, Central Venous[mh] OR "subclavian vein" OR "Jugular Veins" OR "Femoral veins") AND (head-down tilt[mh] OR posture[mh] OR positioning, patient[mh] OR trendelenburg[tw])) AND (("english and humans"[Filter]))) NOT ((Editorial[ptyp] OR Letter[ptyp] OR hemodialysis[mh] OR renal dialysis[mh]))) OR (((Catheterization, Central Venous[mh] OR "subclavian vein" OR "Jugular Veins" OR "Femoral veins")) AND ((head-down tilt[mh] OR posture[mh] OR positioning, patient[mh] OR trendelenburg[tw])) AND ((("english and humans"[Filter]) AND (letter[ptyp] AND case reports[ptyp]) NOT (letter[ptyp] NOT case reports[ptyp])) NOT (Editorial[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR PICC OR peripheral[tw] OR Cardiac catheterization[mh] OR tunneled)))

**Needle insertion and catheter placement (16)**

*PubMed*

(((Catheterization, Central Venous[mh] OR central venous catheter\*[tw] OR central venous line\*[tw] OR central-vein catheter OR (catheterization OR catheters, indwelling[mh] AND (venous OR subclavian OR jugular OR femoral)))) AND ((hemorrhage[mh] OR (Aneurysm, False[mh] OR pseudoaneurysm) OR dissection[tw] OR stroke OR airway obstruction OR insertion attempt\* OR puncture attempt\*[tw] OR dysrhythmia OR arterial puncture[tw] OR subclavian artery injury OR complicat\* OR tamponade OR Intracranial Embolism and Thrombosis[mh])) AND ((gauge[tw] OR length[tw] OR single-lumen[tw] OR double-lumen[tw] OR triple-lumen[tw] OR lumens[tw] large-bore[tw] OR large-caliber OR Catheterization, Central Venous/methods\* OR placement technique\*[tw] OR insertion technique\*[tw])) AND (("english and humans"[Filter]) NOT (Editorial[ptyp] OR Letter[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR peripheral\*[TI] OR PICC OR Cardiac catheterization[mh] OR tunneled))) OR (((Catheterization, Central Venous[mh] OR central venous catheter\*[tw] OR central venous line\*[tw] OR central-vein catheter OR (catheterization OR catheters, indwelling[mh] AND (venous OR subclavian OR jugular OR femoral)))) AND ((hemorrhage[mh] OR (Aneurysm, False[mh] OR pseudoaneurysm) OR dissection[tw] OR stroke OR airway obstruction OR insertion attempt\* OR puncture attempt\*[tw] OR dysrhythmia OR arterial puncture[tw] OR subclavian artery injury OR complicat\* OR tamponade OR Intracranial Embolism and Thrombosis[mh])) AND ((gauge[tw] OR length[tw] OR single-lumen[tw] OR double-lumen[tw] OR triple-lumen[tw] OR lumens[tw] large-bore[tw] OR large-caliber OR Catheterization, Central Venous/methods\* OR placement technique\*[tw] OR insertion technique\*[tw])) AND ((("english and humans"[Filter]) AND (letter[ptyp] AND case reports[ptyp]) NOT (letter[ptyp] NOT case reports[ptyp])) NOT (Editorial[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR PICC OR peripheral[tw] OR Cardiac catheterization[mh] OR tunneled)))

**Guiding and verifying needle, wire and catheter placement (17)**

*PubMed* (use API directly for similar articles)

(((Similar articles for PubMed (Select 28422778) OR #Similar articles for PubMed (Select 28443388)) OR ((("Catheterization, Central Venous"[majr] OR ((catheterization[mh] OR venipuncture[tw]) AND (femoral vein[mh] OR jugular veins[mh] OR subclavian vein[mh]))) AND (Ultrasonography[mh] OR ultrasonics[mh] OR manometry[mh] OR electrocardiography[mh] OR Fluoroscopy[mh] OR Radiography, Thoracic[mh] OR "pressure waveform"[tw] OR analysis, blood gas/therapeutic use[mh]))) ) AND (("english and humans"[Filter]) NOT (Editorial[ptyp] OR Letter[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR PICC OR Cardiac catheterization[mh] OR tunneled)))

((Similar articles for PubMed (Select 28422778) OR Similar articles for PubMed (Select 28443388) OR ((("Catheterization, Central Venous"[majr] OR (catheterization[mh] AND (femoral vein[mh] OR jugular veins[mh] OR subclavian vein[mh]))) AND (Ultrasonography[mh] OR ultrasonics[mh] OR manometry[mh] OR electrocardiography[mh] OR Fluoroscopy[mh] OR Radiography, Thoracic[mh] OR "pressure waveform"[tw] OR analysis, blood gas/therapeutic use[mh])))) AND ((("english and humans"[Filter]) AND (letter[ptyp] AND case reports[ptyp]) NOT (letter[ptyp] NOT case reports[ptyp])) NOT (Editorial[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR PICC OR peripheral[tw] OR Cardiac catheterization[mh] OR tunneled)))

**Not removing vs removing central venous catheter on evidence of arterial puncture (18)**

*PubMed*

((("Catheterization, Central Venous/adverse effects"[majr] OR (catheterization[mh] AND (femoral vein[mh] OR jugular veins[mh] OR subclavian vein[mh])))) AND ((Carotid Artery Injuries[mh] OR injur\*[tw] OR complication\*) AND manage\*[tw]) AND (("english and humans"[Filter]) NOT (Editorial[ptyp] OR Letter[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR PICC OR peripheral[tw] OR Cardiac catheterization[mh] OR tunneled))) OR ((("Catheterization, Central Venous/adverse effects"[majr] OR (catheterization[mh] AND (femoral vein[mh] OR jugular veins[mh] OR subclavian vein[mh])))) AND ((Carotid Artery Injuries[mh] OR injur\*[tw] OR complication\*) AND manage\*[tw]) AND ((("english and humans"[Filter]) AND (letter[ptyp] AND case reports[ptyp]) NOT (letter[ptyp] NOT case reports[ptyp])) NOT (Editorial[ptyp] OR hemodialysis[mh] OR renal dialysis[mh] OR PICC OR peripheral[tw] OR Cardiac catheterization[mh] OR tunneled)))