**Supplementary File**

**Supplementary Figures**
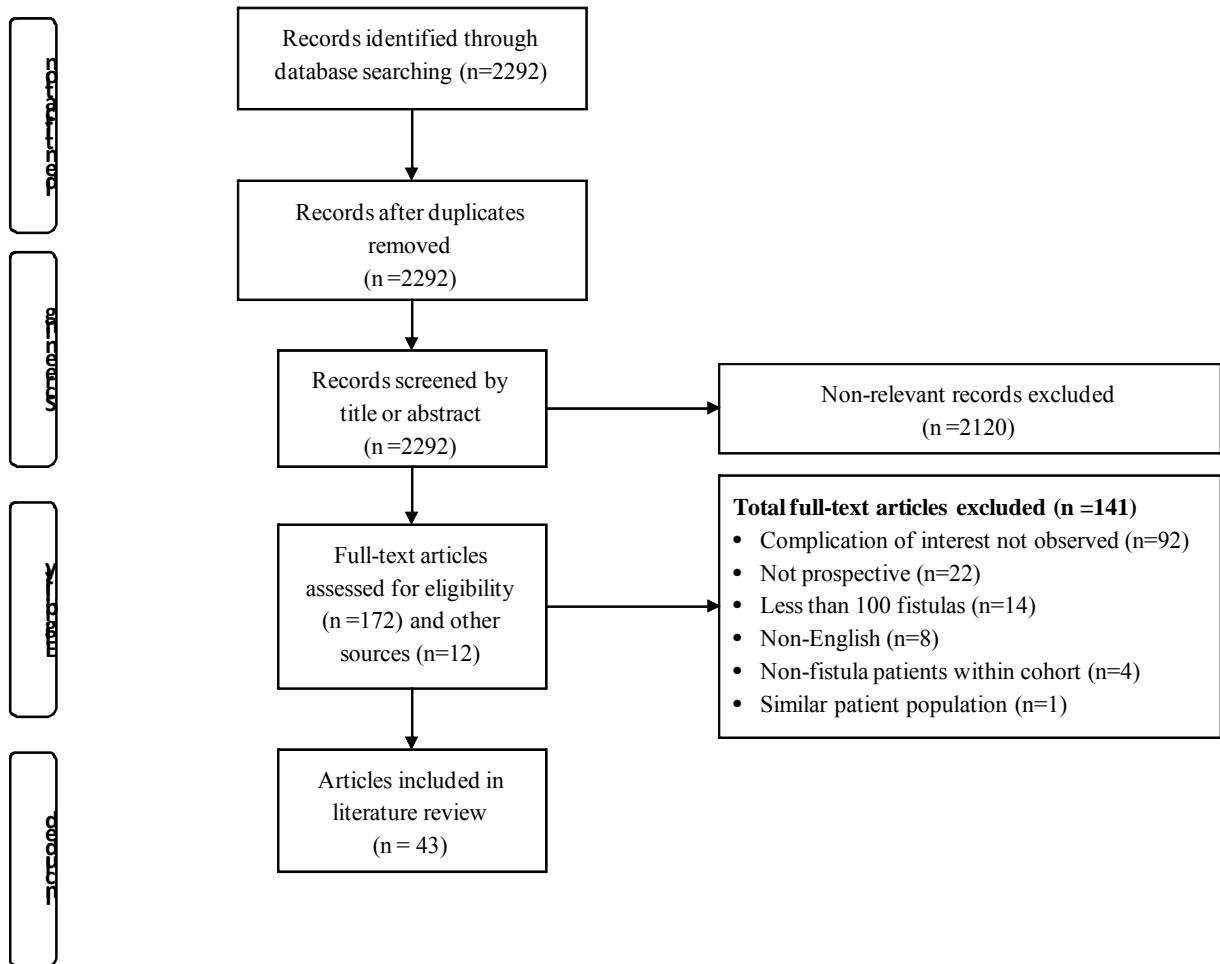
**Figure S1:** Flow diagram of study eligibility and inclusion.

| Author (year) | Group | No. Fistulas | No. Events | % Upper arm |
|---|---|---|---|---|
| van Loon et al.(2010) | Buttonhole | 75 | 2 | 51 |
| Koksoy et al.(2009) | Upper Arm | 50 | 4 | 100 |
| Korkut et al.(2010) | AVF-T | 350 | 32 | 100 |
| Renaud et al.(2012) | Non-Elderly | 191 | 4 | 41 |
| Paul et al.(2010) | Open AVF-T | 78 | 2 | 100 |
| Koksoy et al.(2009) | AVF-T | 50 | 3 | 100 |
| Tessitore et al.(2008) | Standard | 97 | 4 | 18 |
| Ayez et al.(2012) | Upper Arm | 173 | 4 | 100 |
| Tessitore et al.(2008) | Qa Surviellance | 62 | 1 | 21 |
| Lok et al.(2005) | Non-Elderly | 248 | 3 | 44 |
| Lok et al.(2005) | Elderly | 196 | 1 | 53 |
| Renaud et al.(2012) | Elderly | 89 | 0 | 39 |
| Paul et al.(2010) | Endoscopic AVF-T | 98 | 0 | 100 |

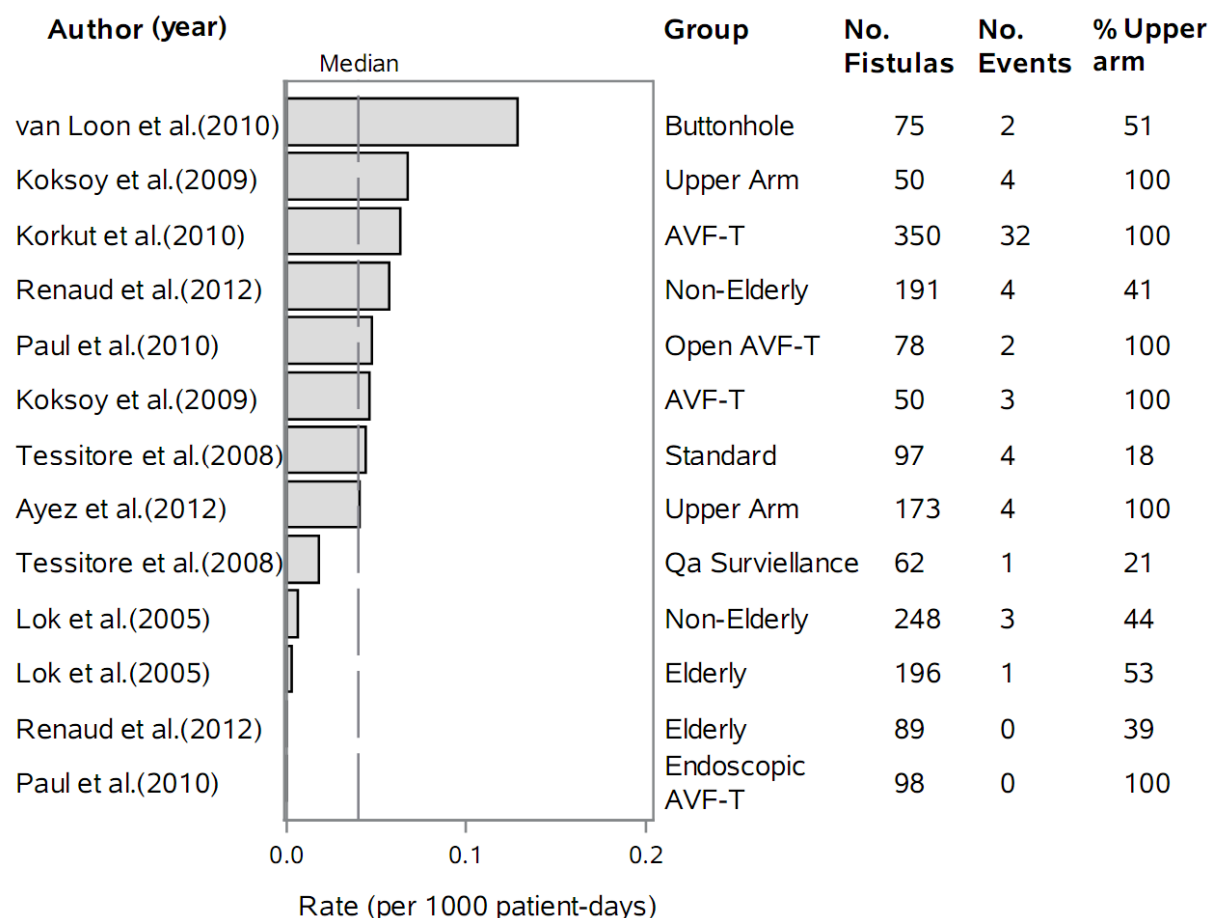Rate (per 1000 patient-days)

**Figure S2:** Studies reporting the incident rate for aneurysms per 1000 patient-days. Dashed line refers to the median event rate per 1000 patient-days. Please note, Van Loon et al. estimated an event rate of 3.01 Aneurysms per 1000 patient-days for patients cannulated using the rope ladder technique. We excluded this event rate because the figure became distorted when including this event rate.

AVF-T: transposed arteriovenous fistula; open AVF-T: AVF transposition of a deep vein through a long open incision; Endoscopic AVF-T: AVF transposition of a deep vein through endoscopic procedure; Buttonhole: All patients cannulated using a buttonhole technique; Upper Arm: cohort made up of all upper arm fistulas; Qa Surveillance: Access blood flow monitoring. Elderly: ≥65 years; Standard: no specific cohort followed.
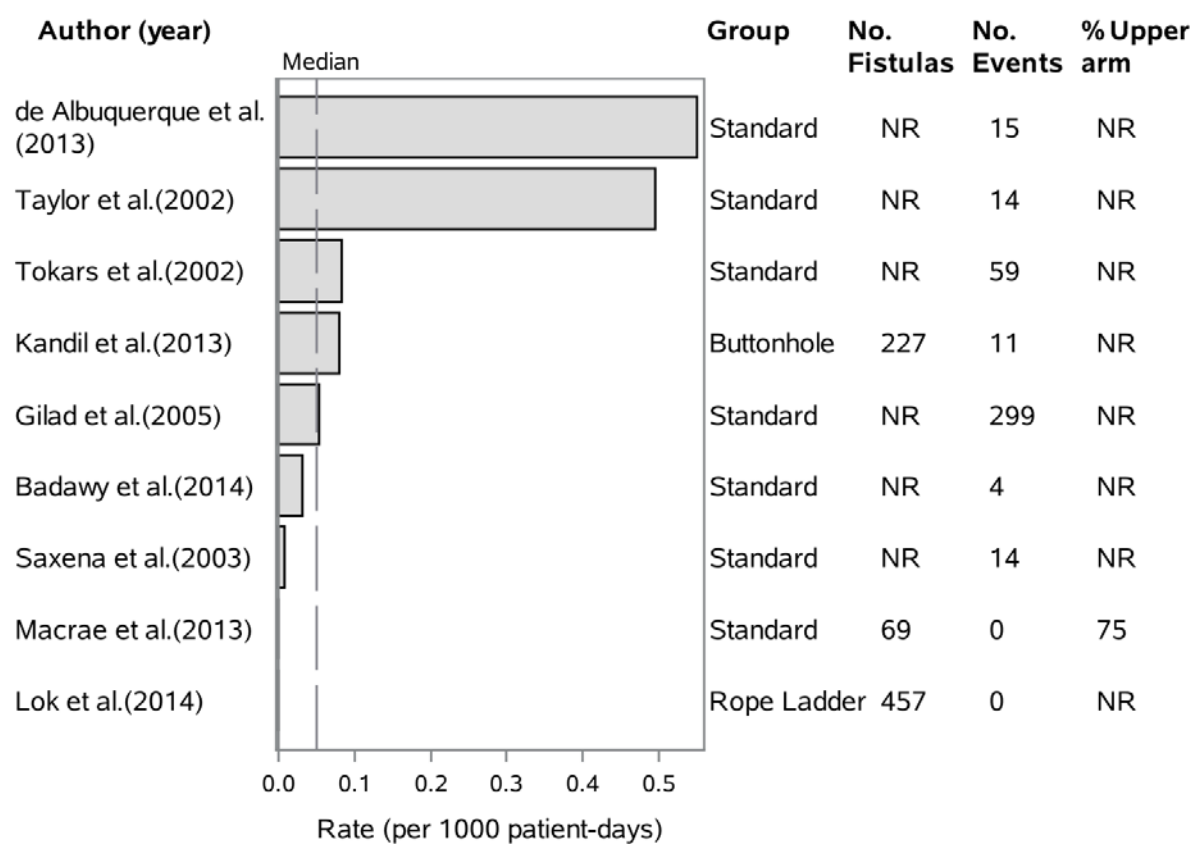
| Author (year) | Group | No. Fistulas | No. Events | % Upper arm |
|---|---|---|---|---|
| de Albuquerque et al. (2013) | Standard | NR | 15 | NR |
| Taylor et al.(2002) | Standard | NR | 14 | NR |
| Tokars et al.(2002) | Standard | NR | 59 | NR |
| Kandil et al.(2013) | Buttonhole | 227 | 11 | NR |
| Gilad et al.(2005) | Standard | NR | 299 | NR |
| Badawy et al.(2014) | Standard | NR | 4 | NR |
| Saxena et al.(2003) | Standard | NR | 14 | NR |
| Macrae et al.(2013) | Standard | 69 | 0 | 75 |
| Lok et al.(2014) | Rope Ladder | 457 | 0 | NR |

**Figure S3:** Studies reporting the incident rate for bloodstream infections per 1000 patient-days. Dashed line refers to the median event rate per 1000 patient-days.

Buttonhole: All patients cannulated using a buttonhole technique; Rope Ladder: All patients cannulated using a rope ladder technique; Standard: no specific cohort followed.
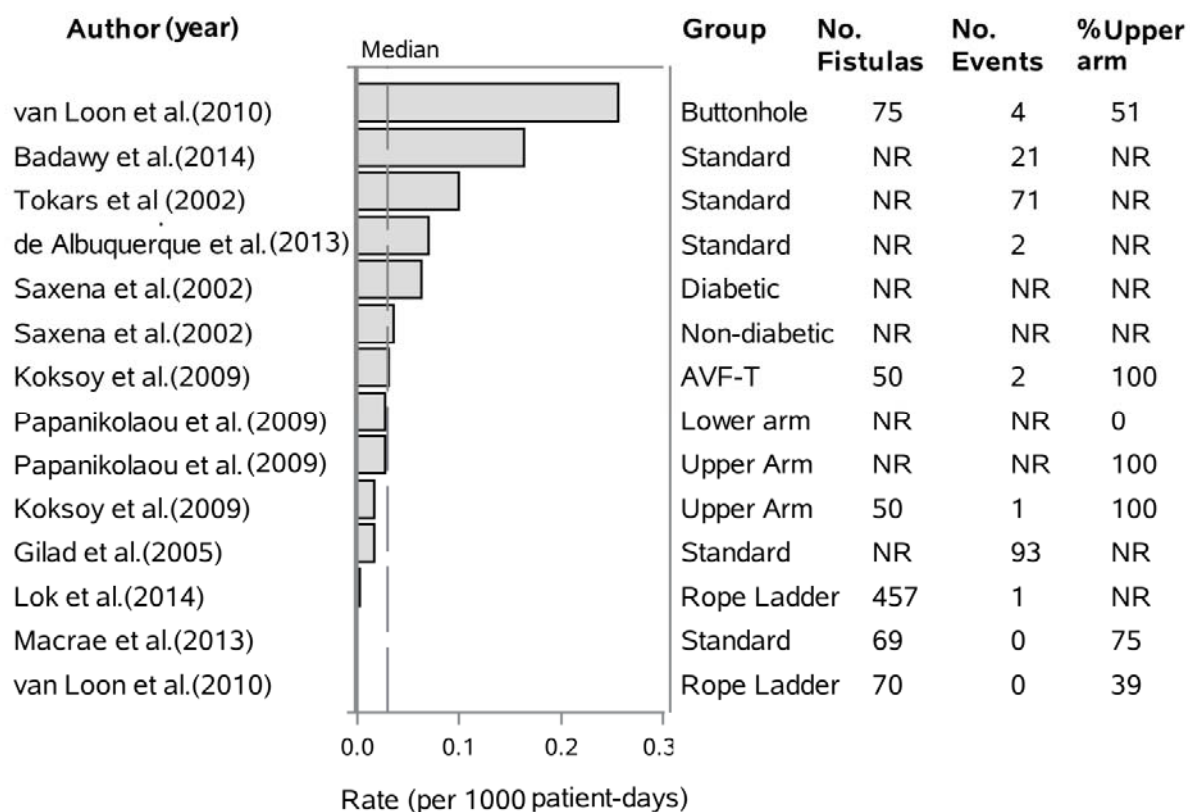
| Author (year) | Median | Group | No. Fistulas | No. Events | %Upper arm |
|---|---|---|---|---|---|
| van Loon et al.(2010) | | Buttonhole | 75 | 4 | 51 |
| Badawy et al.(2014) | | Standard | NR | 21 | NR |
| Tokars et al (2002) | | Standard | NR | 71 | NR |
| de Albuquerque et al.(2013) | | Standard | NR | 2 | NR |
| Saxena et al.(2002) | | Diabetic | NR | NR | NR |
| Saxena et al.(2002) | | Non-diabetic | NR | NR | NR |
| Koksoy et al.(2009) | | AVF-T | 50 | 2 | 100 |
| Papanikolaou et al.(2009) | | Lower arm | NR | NR | 0 |
| Papanikolaou et al.(2009) | | Upper Arm | NR | NR | 100 |
| Koksoy et al.(2009) | | Upper Arm | 50 | 1 | 100 |
| Gilad et al.(2005) | | Standard | NR | 93 | NR |
| Lok et al.(2014) | | Rope Ladder | 457 | 1 | NR |
| Macrae et al.(2013) | | Standard | 69 | 0 | 75 |
| van Loon et al.(2010) | | Rope Ladder | 70 | 0 | 39 |

Rate (per 1000 patient-days)

**Figure S4:** Studies reporting the incident rate for local access infections per 1000 patient-days. Dashed line refers to the median event rate per 1000 patient-days.

AVF-T: transposed arteriovenous fistula; Buttonhole: All patients cannulated using a buttonhole technique; Rope Ladder: All patients cannulated using a rope ladder technique; Diabetic: refers to diabetic nasal carriers of methicillin-resistant and methicillin-susceptible staphylococcus aureus (MRSA & MSSA); Non-diabetic: refers to non-diabetic nasal carriers of methicillin-resistant and methicillin-susceptible staphylococcus aureus (MRSA & MSSA); Upper Arm: cohort made up of all upper arm fistulas; Lower Arm: cohort made up of all lower arm fistulas; Standard: no specific cohort followed.

**Table S1.** PRISMA checklist

| Section/topic | # | Checklist item | Reported |
|---|---|---|---|
| **TITLE** | | | |
| Title | 1 | Identify the report as a systematic review, meta-analysis, or both. | Yes |
| **ABSTRACT** | | | |
| Structured summary | 2 | Provide a structured summary including, as applicable: background; objectives; data sources; study eligibility criteria, participants, and interventions; study appraisal and synthesis methods; results; limitations; conclusions and implications of key findings; systematic review registration number. | Yes |
| **INTRODUCTION** | | | |
| Rationale | 3 | Describe the rationale for the review in the context of what is already known. | Yes |
| Objectives | 4 | Provide an explicit statement of questions being addressed with reference to participants, interventions, comparisons, outcomes, and study design (PICOS). | Yes |
| **METHODS** | | | |
| Protocol and registration | 5 | Indicate if a review protocol exists, if and where it can be accessed (e.g., Web address), and, if available, provide registration information including registration number. | Yes |
| Eligibility criteria | 6 | Specify study characteristics (e.g., PICOS, length of follow-up) and report characteristics (e.g., years considered, language, publication status) used as criteria for eligibility, giving rationale. | Yes |
| Information sources | 7 | Describe all information sources (e.g., databases with dates of coverage, contact with study authors to identify additional studies) in the search and date last searched. | Yes |
| Search | 8 | Present full electronic search strategy for at least one database, including any limits used, such that it could be repeated. | Yes |
| Study selection | 9 | State the process for selecting studies (i.e., screening, eligibility, included in systematic review, and, if applicable, included in the meta-analysis). | Yes |
| Data collection process | 10 | Describe method of data extraction from reports (e.g., piloted forms, independently, in duplicate) and any processes for obtaining and confirming data from investigators. | Yes |

| Data items | 11 | List and define all variables for which data were sought (e.g., PICOS, funding sources) and any assumptions and simplifications made. | Yes |
|---|---|---|---|
| Risk of bias in individual studies | 12 | Describe methods used for assessing risk of bias of individual studies (including specification of whether this was done at the study or outcome level), and how this information is to be used in any data synthesis. | Yes |
| Summary measures | 13 | State the principal summary measures (e.g., risk ratio, difference in means). | Yes |
| Synthesis of results | 14 | Describe the methods of handling data and combining results of studies, if done, including measures of consistency (e.g., $I^2$) for each meta-analysis. | Yes |

| Risk of bias across studies | 15 | Specify any assessment of risk of bias that may affect the cumulative evidence (e.g., publication bias, selective reporting within studies). | Yes |
|---|---|---|---|
| Additional analyses | 16 | Describe methods of additional analyses (e.g., sensitivity or subgroup analyses, meta-regression), if done, indicating which were pre-specified. | N/A |
| **RESULTS** | | | |
| Study selection | 17 | Give numbers of studies screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally with a flow diagram. | Yes |
| Study characteristics | 18 | For each study, present characteristics for which data were extracted (e.g., study size, PICOS, follow-up period) and provide the citations. | Yes |
| Risk of bias within studies | 19 | Present data on risk of bias of each study and, if available, any outcome level assessment (see item 12). | Yes |
| Results of individual studies | 20 | For all outcomes considered (benefits or harms), present, for each study: (a) simple summary data for each intervention group (b) effect estimates and confidence intervals, ideally with a forest plot. | Yes |
| Synthesis of results | 21 | Present results of each meta-analysis done, including confidence intervals and measures of consistency. | N/A |
| Risk of bias across studies | 22 | Present results of any assessment of risk of bias across studies (see Item 15). | Yes |
| Additional analysis | 23 | Give results of additional analyses, if done (e.g., sensitivity or subgroup analyses, meta-regression [see Item 16]). | N/A |
| **DISCUSSION** | | | |
| Summary of evidence | 24 | Summarize the main findings including the strength of evidence for each main outcome; consider their relevance to key groups (e.g., healthcare providers, users, and policy makers). | Yes |

| Limitations | 25 | Discuss limitations at study and outcome level (e.g., risk of bias), and at review-level (e.g., incomplete retrieval of identified research, reporting bias). | Yes |
|---|---|---|---|
| Conclusions | 26 | Provide a general interpretation of the results in the context of other evidence, and implications for future research. | Yes |
| **FUNDING** | | | |
| Funding | 27 | Describe sources of funding for the systematic review and other support (e.g., supply of data); role of funders for the systematic review. | Yes |

**Table S2.** Distribution of components describing study quality of observational studies

| | |
|---|---|
| **Was the conception of study question formed prior to data collection?** | |
| No | 21 |
| Unclear | 3 |
| Yes | 15 |
| **Recruitment Type** | |
| Consecutive | 31 |
| Not reported | 5 |
| Random | 3 |
| **Was enrolment based on pre-specified eligibility criteria?** | |
| No | 13 |
| Yes | 26 |
| **Was the exposure defined as the access planned (access intended) as opposed to the access in place prior to the study (access achieved)?** | |
| No | 20 |
| Yes | 19 |
| **Is it reported whether participants were eligible to different forms of fistula access?** | |
| No | 25 |
| Unclear | 1 |
| Yes | 13 |
| **Was the proportion lost to follow-up less or equal to 10%?** | |
| Unclear | 27 |
| Yes | 12 |
| **Aneurysm: Was the outcome definition the same as published standardized definition?** [16,45] | |
| No | 1 |
| Unclear | 5 |

| | |
|---|---|
| Yes | 2 |
| Not Applicable | 31 |

**Infection: Was the outcome definition the same as published standardized definition**

| | |
|---|---|
| No | 2 |
| Unclear | 7 |
| Yes | 13 |
| Not Applicable | 17 |

**Ischemic Steal: Was the outcome definition the same as published standardized definition[44]**

| | |
|---|---|
| No | 1 |
| Unclear | 9 |
| Yes | 2 |
| Not Applicable | 27 |

**Venous Hypertension: Was the outcome definition the same as published standardized definition**

| | |
|---|---|
| Unclear | 1 |
| Not Applicable | 38 |

**Thrombosis: Was the outcome definition the same as published standardized definition[43,44]**

| | |
|---|---|
| No | 3 |
| Unclear | 11 |
| Yes | 1 |
| Not Applicable | 24 |

**Were at least age, sex, diabetes, heart disease, and peripheral vascular disease considered or reported?**

| | |
|---|---|
| No | 32 |
| Yes | 7 |

**Are reports of the study free of suggestion of selective outcome reporting?**

| | |
|---|---|
| No | 6 |
| Unclear | 3 |
| Yes | 30 |
| **Was the study apparently free of other problems that could put it at a risk of bias?** | |
| No | 17 |
| Unclear | 2 |
| Yes | 20 |

**Table S3:** Distribution of components describing study quality of randomized controlled trials

| Was the allocation sequence adequately generated? | |
|---|---|
| Unclear | 1 |
| Yes | 3 |
| **Was allocation adequately concealed?** | |
| Unclear | 1 |
| Yes | 3 |
| **Was knowledge of the allocated interventions adequately prevented during the study?** | |
| No | 1 |
| Yes | 3 |
| **Were incomplete outcome data adequately addressed?** | |
| No | 1 |
| Yes | 3 |
| **Are reports of the study free of suggestion of selective outcome reporting?** | |
| No | 1 |
| Yes | 3 |
| **Was the study apparently free of other problems that could put it at a risk of bias?** | |
| No | 1 |
| Yes | 3 |
| **Did the outcome assessor NOT have knowledge of the allocated intervention?** | |
| No | 2 |
| Yes | 2 |
| **Was the Proportion lost to follow-up less or equal to 10%?** | |
| Unclear | 1 |

| | |
|---|---|
| Yes | 3 |
| **Aneurysm: Was the outcome definition the same as published standardized definition? [16,45]** | |
| Yes | 1 |
| Not Applicable | 3 |
| **Infection: Was the outcome definition the same as published standardized definition?** | |
| Yes | 1 |
| Not Applicable | 3 |
| **Steal: Was the outcome definition the same as published standardized definition? [44]** | |
| Not Applicable | 4 |
| **Venous hypertension: Was the outcome definition the same as published standardized definition?** | |
| Not Applicable | 4 |
| **Thrombosis: Was the outcome definition the same as published standardized definition?** | |
| Unclear | 2 |
| Yes | 1 |
| Not Applicable | 1 |

*The number of cohorts reported rather than the number of studies.

**Table S4:** Complication rates reported by study and unique cohort.

| Author (Year) | Group | Complication | No. Fistulas | No. Events | Reported Rate | Units | Rate (per 1000 patient-days) |
|---|---|---|---|---|---|---|---|
| Lok et al. (2005) | Non-Elderly (<65 years) | Aneurysm | 248 | 3 | 0.0002 | patient-month | 0.01 |
| Lok et al. (2005) | Elderly (≥65 years) | Aneurysm | 196 | 1 | 0.00 | patient-month | 0.00 |
| Tessitore et al. (2008) | Standard | Aneurysm | 97 | 4 | 0.02 | patient-year | 0.04 |
| Tessitore et al. (2008) | Qa Surveillance | Aneurysm | 62 | 1 | 0.01 | patient-year | 0.02 |
| Koksoy et al. (2009) | Upper Arm | Aneurysm | 50 | 4 | 0.02 | patient-year | 0.07 |
| Koksoy et al. (2009) | AVF-T | Aneurysm | 50 | 3 | 0.02 | patient-year | 0.05 |
| van Loon et al. (2010) | Buttonhole | Aneurysm | 75 | 2 | 0.05 | patient-year | 0.13 |
| van Loon et al. (2010) | Rope Ladder | Aneurysm | 70 | 47 | 1.1 | patient-year | 3.01 |
| Paul et al. (2010) | Open AVF-T | Aneurysm | 78 | 2 | 0.02 | patient-year | 0.05 |
| Paul et al. (2010) | Endovascular AVF-T | Aneurysm | 98 | 0 | 0.00 | patient-year | 0.00 |
| Korkut et al. (2010) | AVF-T | Aneurysm | 350 | 32 | 0.02 | patient-year | 0.06 |
| Renaud et al. (2012) | Non-Elderly (<65 years) | Aneurysm | 191 | 4 | 0.02 | patient-year | 0.06 |
| Renaud et al. (2012) | Elderly (≥65 years) | Aneurysm | 89 | 0 | 0.00 | patient-year | 0.00 |
| Ayez et al. (2012) | Upper Arm | Aneurysm | 173 | 4 | 0.04 | 1000 patient-days | 0.04 |
| Elseviers et al. (2003) | Standard | Bleeding | 1049 | 22 | 0.06 | 1000 patient-days | 0.06 |
| Koksoy et al. (2009) | AVF-T | Bleeding | 50 | 2 | 0.01 | patient-year | 0.03 |
| Koksoy et al. (2009) | Upper Arm | Bleeding | 50 | 1 | 0.01 | patient-year | 0.02 |
| Papanikolaou et al. (2009) | Upper Arm | Bleeding | . | . | 0.04 | patient-year | 0.11 |
| Papanikolaou et al. (2009) | Lower arm | Bleeding | . | . | 0.03 | patient-year | 0.08 |
| Korkut et al. (2010) | AVF-T | Bleeding | 350 | 17 | 0.01 | patient-year | 0.03 |
| Ayez et al. (2012) | Upper Arm | Bleeding | 173 | 8 | 0.08 | 1000 patient-days | 0.08 |
| McCarley et al. (2001) | DVPM | Catheter Insertion | 41 | . | 0.06 | patient-year | 0.16 |
| McCarley et al. (2001) | VABFM | Catheter Insertion | 43 | . | 0.07 | patient-year | 0.19 |
| McCarley et al. (2001) | NM | Catheter Insertion | 39 | . | 0.18 | patient-year | 0.49 |
| Tessitore et al. (2008) | Standard | Catheter Insertion | 97 | 22 | 0.10 | patient-year | 0.27 |
| Tessitore et al. (2008) | Qa Surveillance | Catheter Insertion | 62 | 4 | 0.03 | patient-year | 0.07 |
| Ravani et al. (2002) | Standard | Death | 197 | 78 | 0.23 | patient-year | 0.64 |
| Astor et al. (2005) | Standard | Death | 185 | 44 | 11.7 | 100 person-years | 0.32 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Jennings et al. (2006) | Standard | Death | 134 | 4 | 0.03 | patient-year | 0.09 |
| Tessitore et al. (2008) | Qa Surveillance | Death | 62 | 21 | 0.14 | patient-year | 0.37 |
| Tessitore et al. (2008) | Standard | Death | 97 | 24 | 0.1 | patient-year | 0.26 |
| Koksoy et al. (2009) | Upper Arm | Death | 50 | 22 | 0.14 | patient-year | 0.37 |
| Koksoy et al. (2009) | AVF-T | Death | 50 | 10 | 0.06 | patient-year | 0.15 |
| Paul et al. (2010) | Open AVF-T | Death | 78 | 14 | 0.12 | patient-year | 0.33 |
| Paul et al. (2010) | Endovascular AVF-T | Death | 98 | 18 | 0.16 | patient-year | 0.44 |
| Ng et al. (DOPPS) (2011) | Standard | Death | 476 | 27 | 13 | 100 patient-years | 0.36 |
| Renaud et al. (2012) | Elderly (≥65 years) | Death | 89 | 10 | 0.1 | patient-year | 0.28 |
| Renaud et al. (2012) | Non-Elderly (<65 years) | Death | 191 | 13 | 0.07 | patient-year | 0.19 |
| Ayez et al. (2012) | Upper Arm | Death | 173 | 55 | 0.56 | 1000 patient-days | 0.56 |
| Tessitore et al. (2008) | Standard | Difficulty Cannulation | 97 | 4 | 0.02 | patient-year | 0.04 |
| Tessitore et al. (2008) | Qa Surveillance | Difficulty Cannulation | 62 | 4 | 0.03 | patient-year | 0.07 |
| Olsha et al. (2014) | Elderly (≥80 years) | Hematoma | 128 | 2 | 0.01 | patient-year | 0.03 |
| Lok et al. (2005) | Non-elderly (<65 years) | High cardiac output | 248 | 2 | 0.006 | patient-year | 0.017 |
| Lok et al. (2005) | Elderly (≥65 years) | High cardiac output | 196 | 0 | 0 | patient-year | 0 |
| McCarley et al. (2001) | NM | Hospitalization (All-Cause) | 39 | . | 0.72 | patient-year | 1.97 |
| McCarley et al. (2001) | DVPM | Hospitalization (All-Cause) | 41 | . | 0.47 | patient-year | 1.29 |
| McCarley et al. (2001) | VABFM | Hospitalization (All-Cause) | 43 | . | 0.10 | patient-year | 0.27 |
| Ng et al. (DOPPS) (2011) | Standard | Hospitalization (All-Cause) | 476 | . | 104 | 100 patient-years | 2.85 |
| Badawy et al. (2014) | Standard | Hospitalization (All-Cause) | . | 121 | 2.83 | 100 patient-months | 0.94 |
| Ng et al. (DOPPS) (2011) | Standard | Hospitalization (Infection-Related) | 476 | . | 12.6 | 100 patient-years | 0.34 |
| Lok et al. (2003) | Duplex US Monitoring | Hospitalization (VA-Related) | 189 | . | 6 | 1000 access-days | 6.00 |
| Lok et al. (2003) | Transonic Surveillance | Hospitalization (VA-Related) | 241 | . | 4 | 1000 access-days | 4.00 |
| Jennings et al. (2006) | Standard | Hospitalization (VA-Related) | 134 | 0 | 0.00 | patient-year | 0.00 |
| Ng et al. (DOPPS) (2011) | Standard | Hospitalization (VA-Related) | 476 | . | 23.8 | 100 patient-years | 0.65 |
| Tokars et al. (2002) | Standard | Infection-Bacteremia | . | 59 | 0.25 | 100 patient-months | 0.08 |

| Taylor et al. (2002) | Standard | Infection-Bacteremia | . | 14 | 0.21 | 1000 dialysis sessions | 0.50 |
|---|---|---|---|---|---|---|---|
| Gilad et al. (2005) | Standard | Infection-Bacteremia | . | 299 | 0.16 | 100 patient-months | 0.05 |
| Saxena et al. (2003) | Standard | Infection-Bacteremia | . | 14 | 0.02 | 100 patient-months | 0.01 |
| Macrae et al. (2013) | Standard | Infection-Bacteremia | 69 | 0 | 0.00 | patient-year | 0.00 |
| de Albuquerque et al. (2013) | Standard | Infection-Bacteremia | . | 15 | 0.55 | 1000 access-days | 0.55 |
| Kandil et al. (2013) | Buttonhole | Infection-Bacteremia | 227 | 11 | 2.94 | 100 treatment years | 0.08 |
| Badawy et al. (2014) | Standard | Infection-Bacteremia | . | 4 | 0.09 | 100 patient-months | 0.03 |
| Lok et al. (2014) | Rope Ladder | Infection-Bacteremia | 457 | 0 | 0.00 | 1000 patient-days | 0.00 |
| Tokars et al. (2002) | Standard | Infection-Local | . | 71 | 0.30 | 100 patient-months | 0.10 |
| Saxena et al. (2002) | Diabetic Nasel Carriers of MRSA/MSSA | Infection-Local | . | . | 0.02 | patient-year | 0.06 |
| Saxena et al. (2002) | Non-diabetic Nasel Carriers of MRSA/MSSA | Infection-Local | . | . | 0.01 | patient-year | 0.04 |
| Gilad et al. (2005) | Standard | Infection-Local | . | 93 | 0.05 | 100 patient-months | 0.02 |
| Koksoy et al. (2009) | Upper Arm | Infection-Local | 50 | 1 | 0.01 | patient-year | 0.02 |
| Koksoy et al. (2009) | AVF-T | Infection-Local | 50 | 2 | 0.01 | patient-year | 0.03 |
| Papanikolaou et al. (2009) | Lower arm | Infection-Local | . | . | 0.01 | patient-year | 0.03 |
| Papanikolaou et al. (2009) | Upper Arm | Infection-Local | . | . | 0.01 | patient-year | 0.03 |
| van Loon et al. (2010) | Buttonhole | Infection-Local | 75 | 4 | 0.09 | patient-year | 0.26 |
| van Loon et al. (2010) | Rope Ladder | Infection-Local | 70 | 0 | 0.00 | patient-year | 0.00 |
| Macrae et al. (2013) | Standard | Infection-Local | 69 | 0 | 0.00 | patient-year | 0.00 |
| de Albuquerque et al. (2013) | Standard | Infection-Local | . | 2 | 0.07 | 1000 access-days | 0.07 |
| Badawy et al. (2014) | Standard | Infection-Local | . | 21 | 0.49 | 100 patient-months | 0.16 |
| Lok et al. (2014) | Rope Ladder | Infection-Local | 457 | 2 | 0.00 | 1000 patient-days | 0.00 |
| Bonforte et al. (2004) | Lower arm | Ischemic steal syndrome | 112 | 2 | 0.00 | patient-month | 0.02 |
| Lok et al. (2005) | Elderly (≥65 years) | Ischemic steal syndrome | 196 | 3 | 0.00 | patient-month | 0.01 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lok et al. (2005) | Non-Elderly (<65 years) | Ischemic steal syndrome | 248 | 1 | 0.00 | patient-month | 0.00 |
| Jennings et al. (2006) | Standard | Ischemic steal syndrome | 134 | 2 | 0.02 | patient-year | 0.05 |
| Huijbregts et al. (2008) | Standard | Ischemic steal syndrome | 285 | 2 | 0.01 | patient-year | 0.03 |
| Papanikolaou et al. (2009) | Lower arm | Ischemic steal syndrome | . | . | 0.01 | patient-year | 0.03 |
| Papanikolaou et al. (2009) | Upper Arm | Ischemic steal syndrome | . | . | 0.10 | patient-year | 0.27 |
| Paul et al. (2010) | Open AVF-T | Ischemic steal syndrome | 78 | 2 | 0.02 | patient-year | 0.05 |
| Paul et al. (2010) | Endovascular AVF-T | Ischemic steal syndrome | 98 | 0 | 0.00 | patient-year | 0.00 |
| Korkut et al. (2010) | AVF-T | Ischemic steal syndrome | 350 | 25 | 0.02 | patient-year | 0.05 |
| Jennings et al. (2011) | Elderly (≥65 years) | Ischemic steal syndrome | 461 | 15 | 0.06 | 1000 patient-days | 0.06 |
| Renaud et al. (2012) | Non-Elderly (<65 years) | Ischemic steal syndrome | 191 | 3 | 0.02 | patient-year | 0.04 |
| Renaud et al. (2012) | Elderly (≥65 years) | Ischemic steal syndrome | 89 | 2 | 0.02 | patient-year | 0.06 |
| Ayez et al. (2012) | Upper Arm | Ischemic steal syndrome | 173 | 12 | 0.12 | 1000 patient-days | 0.12 |
| Olsha et al. (2014) | Elderly (≥80 years) | Ischemic steal syndrome | 128 | 11 | 0.06 | patient-year | 0.18 |
| McCarley et al. (2001) | NM | Radiological Intervention | 39 | . | 0.00 | patient-year | 0.00 |
| McCarley et al. (2001) | VABFM | Radiological Intervention | 43 | . | 0.21 | patient-year | 0.58 |
| McCarley et al. (2001) | DVPM | Radiological Intervention | 41 | . | 0.09 | patient-year | 0.25 |
| Dixon et al. (2002) | Lower arm | Radiological Intervention | 88 | 26 | 1.44 | patient-year | 3.95 |
| Dixon et al. (2002) | Upper Arm | Radiological Intervention | 117 | 76 | 2.71 | patient-year | 7.42 |
| Lok et al. (2003) | Transonic Surveillance | Radiological Intervention | 241 | . | 0.65 | 1000 access-days | 0.65 |
| Lok et al. (2003) | Transonic Surveillance | Radiological Intervention | 241 | . | 0.10 | 1000 access-days | 0.10 |
| Lok et al. (2003) | Duplex US Monitoring | Radiological Intervention | 189 | . | 0.73 | 1000 access-days | 0.73 |
| Lok et al. (2003) | Duplex US Monitoring | Radiological Intervention | 189 | . | 0.21 | 1000 access-days | 0.21 |
| Lok et al. (2005) | Elderly (≥65 years) | Radiological Intervention | 196 | . | 0.31 | access-year | 0.85 |
| Lok et al. (2005) | Elderly (≥65 years) | Radiological Intervention | 92 | . | 0.30 | access-year | 0.82 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Lok et al. (2005) | Elderly (≥65 years) | Radiological Intervention | 92 | . | 0.02 | access-year | 0.05 |
| Lok et al. (2005) | Elderly (≥65 years) | Radiological Intervention | 93 | . | 0.32 | access-year | 0.88 |
| Lok et al. (2005) | Non-Elderly (<65 years) | Radiological Intervention | 93 | . | 0.26 | access-year | 0.71 |
| Lok et al. (2005) | Non-Elderly (<65 years) | Radiological Intervention | 248 | . | 0.29 | access-year | 0.79 |
| Lok et al. (2005) | Non-Elderly (<65 years) | Radiological Intervention | 93 | . | 0.09 | access-year | 0.25 |
| Lok et al. (2005) | Non-Elderly (<65 years) | Radiological Intervention | 248 | . | 0.10 | access-year | 0.27 |
| Lok et al. (2005) | Elderly (≥65 years) | Radiological Intervention | 93 | . | 0.03 | access-year | 0.08 |
| Lok et al. (2005) | Non-Elderly (<65 years) | Radiological Intervention | 139 | . | 0.09 | access-year | 0.25 |
| Lok et al. (2005) | Non-Elderly (<65 years) | Radiological Intervention | 139 | . | 0.30 | access-year | 0.82 |
| Lok et al. (2005) | Elderly (≥65 years) | Radiological Intervention | 196 | . | 0.02 | access-year | 0.05 |
| Shahin et al. (2005) | Qa Surviellance | Radiological Intervention | 76 | . | 0.58 | patient-year | 1.59 |
| Shahin et al. (2005) | Standard | Radiological Intervention | 146 | . | 0.10 | patient-year | 0.27 |
| Jennings et al. (2006) | Standard | Radiological Intervention | 134 | 11 | 0.09 | patient-year | 0.25 |
| Polkinghorne et al. (2006) | Standard | Radiological Intervention | 68 | 1 | 0.01 | patient-year | 0.03 |
| Polkinghorne et al. (2006) | Qa Surveillance | Radiological Intervention | 69 | 5 | 0.05 | patient-year | 0.14 |
| Huijbregts et al. (2008) | Standard | Radiological Intervention | 285 | 49 | 0.24 | patient-year | 0.66 |
| Tessitore et al. (2008) | Qa Surveillance | Radiological Intervention | 62 | 33 | 0.21 | patient-year | 0.58 |
| Tessitore et al. (2008) | Standard | Radiological Intervention | 97 | 22 | 0.09 | patient-year | 0.24 |
| Pflederer et al. (2008) | AVF-T | Radiological Intervention | 161 | . | 0.31 | patient-year | 0.85 |
| Pflederer et al. (2008) | Standard | Radiological Intervention | 321 | . | 0.54 | patient-year | 1.48 |
| Koksoy et al. (2009) | Upper Arm | Radiological Intervention | 50 | 7 | 0.04 | patient-year | 0.12 |
| Koksoy et al. (2009) | AVF-T | Radiological Intervention | 50 | 4 | 0.02 | patient-year | 0.06 |
| van Loon et al. (2010) | Buttonhole | Radiological Intervention | 75 | 3 | 0.07 | patient-year | 0.19 |
| van Loon et al. (2010) | Rope Ladder | Radiological Intervention | 70 | 38 | 0.89 | patient-year | 2.44 |

| Paul et al. (2010) | Open AVF-T | Radiological Intervention | 78 | 70 | 0.61 | patient-year | 1.66 |
|---|---|---|---|---|---|---|---|
| Renaud et al. (2012) | Elderly (≥65 years) | Radiological Intervention | 89 | 32 | 0.33 | patient-year | 0.91 |
| Renaud et al. (2012) | Non-Elderly (<65 years) | Radiological Intervention | 191 | 59 | 0.31 | patient-year | 0.85 |
| Ayez et al. (2012) | Upper Arm | Radiological Intervention | 173 | 58 | 0.59 | 1000 patient-days | 0.59 |
| Lin et al. (2013) | Standard | Radiological Intervention | 62 | . | 0.29 | patient-year | 0.79 |
| Lin et al. (2013) | Infrared | Radiological Intervention | 60 | . | 0.11 | patient-year | 0.30 |
| Macrae et al. (2013) | Buttonhole | Radiological Intervention | 70 | 135 | 0.90 | patient-year | 2.47 |
| Macrae et al. (2013) | Standard | Radiological Intervention | 69 | 82 | 0.72 | patient-year | 1.97 |
| Agarwal et al. (2014) | AVF-T (2-Stage) | Radiological Intervention | 83 | . | 2.15 | patient-year | 5.89 |
| Agarwal et al. (2014) | AVF-T (1-Stage) | Radiological Intervention | 61 | . | 1.84 | patient-year | 5.04 |
| Olsha et al. (2014) | Elderly (≥80 years) | Radiological Intervention | 128 | 198 | 0.9 | patient-year | 2.47 |
| Lok et al. (2005) | Elderly (≥65 years) | Surgical Revisions | 196 | . | 0.28 | access-year | 0.77 |
| Lok et al. (2005) | Elderly (≥65 years) | Surgical Revisions | 92 | . | 0.61 | access-year | 1.67 |
| Lok et al. (2005) | Non-Elderly (<65 years) | Surgical Revisions | 93 | . | 0.04 | access-year | 0.11 |
| Lok et al. (2005) | Non-Elderly (<65 years) | Surgical Revisions | 248 | . | 0.06 | access-year | 0.16 |
| Lok et al. (2005) | Non-Elderly (<65 years) | Surgical Revisions | 139 | . | 0.03 | access-year | 0.08 |
| Lok et al. (2005) | Elderly (≥65 years) | Surgical Revisions | 93 | . | 0.00 | access-year | 0.01 |
| Jennings et al. (2006) | Standard | Surgical Revisions | 134 | 4 | 0.03 | patient-year | 0.09 |
| Polkinghorne et al. (2006) | Qa Surveillance | Surgical Revisions | 69 | 7 | 0.07 | patient-year | 0.19 |
| Polkinghorne et al. (2006) | Standard | Surgical Revisions | 68 | 5 | 0.05 | patient-year | 0.15 |
| Huijbregts et al. (2008) | Standard | Surgical Revisions | 285 | 40 | 0.20 | patient-year | 0.55 |
| Tessitore et al. (2008) | Qa Surveillance | Surgical Revisions | 62 | 14 | 0.09 | patient-year | 0.25 |
| Tessitore et al. (2008) | Standard | Surgical Revisions | 97 | 6 | 0.02 | patient-year | 0.07 |
| Koksoy et al. (2009) | Upper Arm | Surgical Revisions | 50 | 1 | 0.01 | patient-year | 0.02 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Koksoy et al. (2009) | AVF-T | Surgical Revisions | 50 | 0 | 0.00 | patient-year | 0.00 |
| van Loon et al. (2010) | Buttonhole | Surgical Revisions | 75 | 3 | 0.07 | patient-year | 0.19 |
| van Loon et al. (2010) | Rope Ladder | Surgical Revisions | 70 | 3 | 0.07 | patient-year | 0.19 |
| Paul et al. (2010) | Open AVF-T | Surgical Revisions | 78 | 8 | 0.07 | patient-year | 0.19 |
| Paul et al. (2010) | Endovascular AVF-T | Surgical Revisions | 98 | 6 | 0.05 | patient-year | 0.15 |
| Renaud et al. (2012) | Elderly (≥65 years) | Surgical Revisions | 89 | 8 | 0.08 | patient-year | 0.23 |
| Renaud et al. (2012) | Non-Elderly (<65 years) | Surgical Revisions | 191 | 21 | 0.11 | patient-year | 0.30 |
| Ayez et al. (2012) | Upper Arm | Surgical Revisions | 173 | 30 | 0.3 | 1000 patient-days | 0.30 |
| Lin et al. (2013) | Standard | Surgical Revisions | 62 | . | 0.26 | patient-year | 0.71 |
| Lin et al. (2013) | Infrared | Surgical Revisions | 60 | . | 0.08 | patient-year | 0.22 |
| Macrae et al. (2013) | Buttonhole | Surgical Revisions | 70 | . | 0.09 | patient-year | 0.25 |
| Macrae et al. (2013) | Standard | Surgical Revisions | 69 | . | 0.11 | patient-year | 0.30 |
| McCarley et al. (2001) | DVPM | Thrombosis | 41 | . | 0.15 | patient-year | 0.41 |
| McCarley et al. (2001) | VABFM | Thrombosis | 43 | . | 0.07 | patient-year | 0.19 |
| McCarley et al. (2001) | NM | Thrombosis | 39 | . | 0.14 | patient-year | 0.38 |
| Lok et al. (2003) | Transonic Surveillance | Thrombosis | 241 | . | 0.33 | 1000 access-days | 0.33 |
| Lok et al. (2003) | Duplex US Monitoring | Thrombosis | 189 | . | 0.44 | 1000 access-days | 0.44 |
| Elseviers et al. (2003) | Standard | Thrombosis | 1049 | 55 | 0.15 | 1000 patient-days | 0.15 |
| Bonforte et al. (2004) | Lower arm | Thrombosis | 112 | 12 | 0.00 | patient-month | 0.14 |
| Mallamaci et al. (2005) | Standard | Thrombosis | 205 | 78 | 0.39 | 1000 patient-days | 0.39 |
| Lok et al. (2005) | Elderly (≥65 years) | Thrombosis | 196 | 25 | 0.00 | patient-month | 0.07 |
| Lok et al. (2005) | Non-Elderly (<65 years) | Thrombosis | 248 | 34 | 0.00 | patient-month | 0.07 |
| Shahin et al. (2005) | Qa Surveillance | Thrombosis | 76 | . | 0.21 | patient-year | 0.57 |
| Shahin et al. (2005) | Standard | Thrombosis | 146 | . | 0.26 | patient-year | 0.71 |
| Jennings et al. (2006) | Standard | Thrombosis | 134 | 19 | 0.16 | patient-year | 0.43 |
| Roozbeh et al. (2006) | Standard | Thrombosis | 171 | 31 | 0.09 | patient-year | 0.26 |
| Polkinghorne et al. (2006) | Qa Surveillance | Thrombosis | 69 | 6 | 0.06 | patient-year | 0.17 |
| Polkinghorne et al. (2006) | Standard | Thrombosis | 68 | 4 | 0.04 | patient-year | 0.12 |

| Huijbregts et al. (2008) | Standard | Thrombosis | 285 | 29 | 0.14 | patient-year | 0.38 |
|---|---|---|---|---|---|---|---|
| Tessitore et al. (2008) | Qa Surveillance | Thrombosis | 62 | 5 | 0.03 | patient-year | 0.09 |
| Tessitore et al. (2008) | Standard | Thrombosis | 97 | 20 | 0.08 | patient-year | 0.22 |
| Korkut et al. (2010) | AVF-T | Thrombosis | 350 | 186 | 0.13 | patient-year | 0.37 |
| Ayez et al. (2012) | Upper Arm | Thrombosis | 173 | 25 | 0.25 | 1000 patient-days | 0.25 |
| Lin et al. (2013) | Standard | Thrombosis | 62 | 11 | 0.18 | patient-year | 0.49 |
| Lin et al. (2013) | Standard | Thrombosis | 62 | 8 | 0.52 | patient-year | 1.43 |
| Lin et al. (2013) | Infrared | Thrombosis | 60 | 3 | 0.05 | patient-year | 0.14 |
| Lin et al. (2013) | Infrared | Thrombosis | 60 | 1 | 0.07 | patient-year | 0.19 |
| Macrae et al. (2013) | Buttonhole | Thrombosis | 70 | 6 | 0.04 | patient-year | 0.11 |
| Macrae et al. (2013) | Standard | Thrombosis | 69 | 7 | 0.05 | patient-year | 0.14 |
| Elseviers et al. (2003) | Standard | Total Complications | 1049 | 163 | 0.43 | 1000 patient-days | 0.43 |
| Lok et al. (2005) | Elderly (≥65 years) | Total Complications | 196 | 57 | 0.00 | patient-month | 0.15 |
| Lok et al. (2005) | Non-Elderly (<65 years) | Total Complications | 248 | 61 | 0.00 | patient-month | 0.13 |
| Papanikolaou et al. (2009) | Lower arm | Total Complications | . | . | 0.25 | patient-year | 0.68 |
| Papanikolaou et al. (2009) | Upper Arm | Total Complications | . | . | 0.57 | patient-year | 1.56 |
| Ayez et al. (2012) | Upper Arm | Total Complications | 173 | 110 | 1.12 | 1000 patient-days | 1.12 |
| Tokars et al. (2001) | Standard | Total Infections | . | 13 | 0.02 | patient-month | 0.60 |
| Stevenson et al. (2002) | Standard | Total Infections | . | 3 | 0.17 | 1000 dialysis sessions | 0.39 |
| Tokars et al. (2002) | Standard | Total Infections | . | 130 | 0.56 | 100 patient-months | 0.19 |
| Elseviers et al. (2003) | Standard | Total Infections | 1049 | 22 | 0.06 | 1000 patient-days | 0.06 |
| Jennings et al. (2006) | Standard | Total Infections | 134 | 0 | 0.00 | patient-year | 0.00 |
| Huijbregts et al. (2008) | Standard | Total Infections | 285 | 8 | 0.04 | patient-year | 0.11 |
| Qasaimeh et al. (2008) | Standard | Total Infections | 104 | 24 | 0.36 | patient-year | 0.99 |
| Pflederer et al. (2008) | AVF-T | Total Infections | 161 | . | 0.07 | patient-year | 0.19 |
| Pflederer et al. (2008) | Standard | Total Infections | 321 | . | 0.05 | patient-year | 0.14 |
| Labriola et al. (2011) | Standard | Total Infections | . | 57 | 0.31 | 1000 access-days | 0.31 |
| Renaud et al. (2012) | Elderly (≥65 years) | Total Infections | 89 | 0 | 0.00 | patient-year | 0.00 |
| Renaud et al. (2012) | Non-Elderly (<65 years) | Total Infections | 191 | 4 | 0.02 | patient-year | 0.06 |
| Ravani et al. (DOPPS) (2013) | Standard | Total Infections | 3352 | . | 3.00 | 1000 access-days | 3.00 |
| Ravani et al. (DOPPS) (2013) | Standard | Total Infections | 3352 | . | 1.7 | 1000 access-days | 1.70 |
| Ravani et al. (DOPPS) (2013) | Standard | Total Infections | 3352 | . | 0.9 | 1000 access-days | 0.90 |

| Macrae et al. (2013) | Standard | Total Infections | 69 | 0 | 0.00 | patient-year | 0.00 |
|---|---|---|---|---|---|---|---|
| Kandil et al. (2013) | Buttonhole | Total Infections | 227 | 26 | 4.01 | 100 treatment years | 0.11 |
| Lok et al. (2014) | Rope Ladder | Total Infections | 457 | 2 | 0.00 | 1000 patient-days | 0.00 |
| Korkut et al. (2010) | AVF-T | Venous hypertension | 350 | 16 | 0.01 | patient-year | 0.03 |

**Table S5:** Median complication rate (min, max) by patient subgroup

| Subgroup | Aneurysm | Infections | | Steal | Thrombosis |
|---|---|---|---|---|---|
| | | **All Types** | **Local Access** | | |
| Elderly* | 0.001 (0, 0.003) | NS | NS | 0.06 (0.008 ,0.18) | NS |
| Non-Elderly* | 0.03 (0.01, 0.06) | NS | NS | 0.02 (0.002 ,0.04) | NS |
| Lower Arm | NS | NS | NS | 0.03 (0.02 ,0.03) | NS |
| Upper Arm | 0.047 (0, 0.07) | 0.03 (0.02, 0.03) | 0.03 (0.02, 0.03) | 0.05 (0 ,0.27) | 0.31 (0.25, 0.37) |
| Buttonhole | NS | 0.17 (0.08, 0.26) | NS | NS | NS |
| Rope Ladder | NS | 0.001 (0, 0.002) | 0.001 (0, 0.002) | NS | NS |
| Any Surveillance | NS | NS | NS | NS | 0.33 (0.09, 0.58) |

*As defined in the study ; NS = Not Sufficient data (less than two groups)
Note: Subgroups are not mutually exclusive

**Item S1 – Study Protocol**

UNIVERSITY *of York*
Centre for Reviews and Dissemination

## PROSPERO International prospective register of systematic reviews

### Complication rates of the arteriovenous fistula: a systematic review
*Ahmed A. Al-Jaishi, Matthew J. Oliver, Aiden R. Liu, Amit X. Garg, Joyce C. Zhang, Sonia M. Thomas, Louise M. Moist*

**Citation**

Ahmed A. Al-Jaishi, Matthew J. Oliver, Aiden R. Liu, Amit X. Garg, Joyce C. Zhang, Sonia M. Thomas, Louise M. Moist. Complication rates of the arteriovenous fistula: a systematic review. PROSPERO 2014:CRD42014010444 Available from http://www.crd.york.ac.uk/PROSPERO_REBRANDING/display_record.asp?ID=CRD42014010444

**Review question(s)**

For adult patients (=18 years) on chronic hemodialysis, what is the complication rate of aneurysms, infections, ischemic steal syndrome, thrombosis, and venous hypertension among published literature between January 2000 and December 2013?

**Searches**

We designed and implemented a systematic literature search to identify all relevant published reports in Medline (PubMed) from January 1st 2000 to December 12th 2013. Our search strategy has been validated and has a sensitivity of 96.4% and specificity of 95.1% for capturing dialysis related published studies. We also used related articles feature in PubMed. Two investigators screened all English Language titles and abstracts obtained through the search syntax to identify potentially relevant articles. We retrieved the full-text of these articles to further assess their suitability for inclusion in this review. Bibliographies of selected articles were searched manually to identify any additional relevant studies.

**Types of study to be included**

We will include any study that collected data prospectively (observational cohort studies or randomized control trials) and followed patients for at least 3 months.

**Condition or domain being studied**

Currently, over 23,000 Canadians and 2 million people worldwide with kidney failure survive by receiving chronic hemodialysis. Hemodialysis cannot occur without a reliable connection between the dialysis machine and the patient's circulation – this connection is their "vascular access" (VA) and represents the patient's "lifeline".

The VA can take one of three forms: i) a native arteriovenous fistula (fistula); ii) a synthetic arteriovenous graft (AV-graft); or iii) a central venous catheter (catheter). When the VA fails or has complications such as clotting or infection, a patient's life is put at risk. For this reason, the VA is also referred to as the "Achilles's heel" of hemodialysis. The ideal VA is one that facilitates adequate long-term dialysis with few complications and is not costly to create and maintain.

The three VA types are described below:

i) A fistula is surgically created by connecting an artery to a vein; the high blood flow from the artery to the vein distends and toughens the vein to the degree of maturation. After fistula maturation, the VA is ready for the repeated needle insertions (cannulations) needed for hemodialysis. Advanced planning is required for fistula creation and use due to variable wait times for surgical assessment, creation, and its maturation (typically 2-6 months after creation);

ii) An AV-graft (Figure 1-bottom) is a synthetic polytetrafluoroethylene Gortex) tube that is surgically connected between an artery and a vein; this AV-graft can then be cannulated for hemodialysis. Unlike the fistula, the AV-graft does not need to mature but usually requires 2-3 weeks before use to allow the swelling and discomfort to subside.

iii) A central venous catheter is a plastic tube inserted into the internal jugular (most common), subclavian, or femoral vein; it may be subcutaneously tunnelled and can be used immediately.

## Participants/ population

We will include any study that collected data prospectively (observational cohort studies or randomized control trials) and followed patients for at least 3 months. We will only deem a study eligible if it described =100 vascular accesses in patients with chronic kidney disease (CKD) and being treated with chronic hemodialysis. We chose a minimum sample size of 100 vascular access (i.e. fistula) because some of our outcomes of interest are rare events (e.g. ischemic steal syndrome has an event rate >0 to 5%) and would require a larger sample size to obtain a representative (and less spurious) estimate of event rates.

We include full-text articles in any language published after December 31st, 1999. Studies must have reported information on one or more of the following:

a) aneurysms

b) infections/sepsis/bacteremia

c) ischemic steal syndrome

d) AV access thrombosis or catheter dysfunction

e) venous hypertension

f) overall complications

g) radiological interventions

h) surgical revisions.

We will exclude studies of peritoneal dialysis and pediatric patients (<18 years).

## Intervention(s), exposure(s)

No intervention will be studied. We are aim to summarize the rates of fistula complications for all studies published between January 2000 and December 2013.

## Comparator(s)/ control

None

## Context

See above

## Outcome(s)

Primary outcomes

Studies must have reported information on one or more of the following primary or secondary outcomes:

Primary Outcomes and definitions:

a) Aneurysm: Diffuse and progressive degeneration of the vascular access site. Patient has signs of bleeding, infection, or ulceration.

b) Infections: Definite or probable local vascular access infections, vascular access-related sepsis, bacteremia or a composite of these infections.

c) Ischemic steal syndrome: One or more clinical manifestations of pain, ischemic neuropathy, ulceration, and gangrene felt to be related to a fistula diverting blood from the distal circulation resulting in a zone of arterial insufficiency in the tissues distal to the fistula.

d) Thrombosis: Absence of bruit or thrill, using auscultation and palpation, throughout systole and diastole at least 8

cm proximal to the arteriovenous anastomosis.

e) Venous hypertension: High pressure in veins due to damage to venous system.

None

**Secondary outcomes**
Secondary Outcomes:

a) Bleeding

b) Catheter Insertion

c) Death

d) Difficulty Cannulation

e) Hematoma

f) Hospitalization (All-Cause)

g) Hospitalization (Infection-Related)

h) Hospitalization (VA-Related)

i) Infection- Bacteremia

j) Infection- Local

k) Radiological Intervention

l) Surgical Revisions

m) Total Complications

n) Total Infections

None

## Data extraction, (selection and coding)
Two authors will abstract data from all selected studies. Any disagreements will be resolved by consensus with a third author.

## Risk of bias (quality) assessment
We will assess risk of bias among included studies, exploring participation, patient selection, attrition, exposure and outcome measurements, confounding, and selective reporting using a previously validated methods [1,2]. The results from study quality will not be considered at the analysis stage and planned synthesis.

[1] Busse J, Guyatt G. Instrument for assessing risk of bias in cohort studies. Available at: http://www.evidencepartners.com/resources/.

[2] Higgins JPT, Green S, eds. Cochrane Handbook for Systematic Reviews of Interventions Version 5.1.0 [updated March 2011]. The Cochrane Collaboration; 2011. Available at: Available from www.cochrane-handbook.org.

## Strategy for data synthesis
Data Analysis: depending on the quality of the data and our ability to pool information across studies, we will analyze our results in one of two ways: 1) Summarize results of systematic review using descriptive statistics; or 2) pool our

results using meta-analytic methods.

1. Summarizing results using descriptive statistics: If the data quality is poor and outcomes of interest are highly heterogeneous, we will not be able to pool the results using meta-analytic techniques. The heterogeneity of the data may be attribute to differences in sampled populations, outcome definitions, prevalence of co-morbid conditions, and variable sample selection criteria. Hence, it may not be appropriate to calculate a summary statistic based on the weighted average. In which case, we will report the median and range for the event rate (per 1000 access-days) for the outcome of interest. When incidence rates are not reported in a selected study, we will calculate the overall follow-up time (denominator) by multiplying the mean follow-up time by the number of patients. We will use the overall follow-up time to calculate the event rate per 1000 patient-days. It is important to note that in using this method we assume that the hazard rate of developing a particular outcome is constant across individuals and over time.

OR

2. Pooling results using meta-analytic methods: If the data permits pooling of results, we will calculate the 95% confidence interval (CI) for the study estimate of interest using the Wilson Score method. The Wilson Score interval has been shown to provide excellent coverage and has better performance than the standard Wald interval.

We will pool the rates of the complication of interest using a random effects meta-analysis and a linear mixed model. This method assumes that the observed rates follow a Normal distribution. We will account for correlation between subgroup estimates from the same study, as well as estimates from different articles but from the same dialysis facility.

We will use the I-squared statistic to measure the proportion of total variation in study estimates that is due to heterogeneity rather than sampling error. When reported, we will calculate the pooled estimate for pre-specified subgroups including site of vascular access (e.g. lower vs. upper arm fistula), age (elderly vs. non-elderly as defined in the selected study), as well as study location (North America vs. Europe).

We will perform the analyses using SAS 9.3 (SAS Institute Inc., Cary, NC, USA) PROC MIXED procedure. This method will allow us to specify covariates in the random effects univariable meta-regression. We will explore heterogeneity between risk estimates according to the mean patient age, proportions of men, diabetic patients, and patients with peripheral vascular disease, number of fistulas, recruitment start date, and publication year.

In sensitivity analyses, we will exclude all studies that are published after 2000 but recruited patients prior to 2000 and studies that asked study question after data collection (i.e. retrospective design). In order to justify our analyses, we will require at least three independent estimates per subgroup. We will use a two-sided p-value and consider a p-value <0.10 to be statistically significant.

## Analysis of subgroups or subsets
In subgroup analyses, we will examine the effect of fistula location (lower vs. upper arm), age (elderly vs. non-elderly), and location of study (North America vs. Europe) on our primary outcomes.

## Dissemination plans
We plan to submit our final result to an academic Nephrology Journal

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**Details of any existing review of the same topic by the same authors**
None to our knowledge

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http://www.crd.york.ac.uk/PROSPEROFILES/10444_PROTOCOL_20140527.pdf

**Stage of review**
Ongoing

**Date of registration in PROSPERO**
07 July 2014

**Date of publication of this revision**
08 July 2014

| Stage of review at time of this submission | Started | Completed |
|---|---|---|
| Preliminary searches | Yes | Yes |
| Piloting of the study selection process | Yes | Yes |
| Formal screening of search results against eligibility criteria | Yes | Yes |
| Data extraction | Yes | Yes |
| Risk of bias (quality) assessment | Yes | Yes |

| Data analysis | | Yes | Yes |
|---|---|---|---|