**Appendix 1.** Study settings and designs of the included studies (n= 26) presented in alphabetical order.

| Reference | Ward or pharmacy based preparation or administration | Objective and Study design | Aseptically prepared medicines | Contamination/ results | Method of microbilogical analysis |
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| Original research/studies (n=19) | | | | | |
| Austin and Elia 2013 | Ward based preparation | To examine whether different aseptic techniques affect the contamination rates of intravenous doses prepared on hospital wards. A comparative study. | A growth medium infusate was used to make flushes to syringes | The pharmacy operator achieved lower contamination rates than nurses. | The airborne and surface environmental contamination was monitored during session. Prepared syringes were incubated and contaminats identified |
| Bertoglio et al 2013 | Ward based catheter flushing and locking | To compare the use of pre-filled syringe with manually filled syringes for flushing for reducing catheter-related bloodstream infections (CRBSI). A retrospective observational cohort study. | Saline syringes | The CRBSI rate was 2,7 % in the pre-filled syringe group and 6,3 % in the manually filled syringe group | Blood samples and bacterial identification |
| Buerke et al 2010 | Ward-based (CT unit) contrast agent administration via automatic injectors | To compare single- and multiple use of syringes in automatic injectors to evaluate microbiologic contamination and time benefit. A comparative study. | CT contrast agent and saline | No bacterial contamination of prefilled single use contras or saline syringes. Contamination of two saline syringes with multiple use of saline syringes | Surface and palm samples:replicate organism detection and counting agar plates and Contrast or saline sample: injection to tryptic soy broth and after incubation streaking to agar plates |
| Chemaly et al 2011 | Manufactured syringes | To evaluate contaminated pre-filled heparin and saline syringes clinical impact in patients. A multicenter case series study. | Pre-filled heparin and saline syringes | Patients got clinical symptoms | Blood culture and bacterial identification of automated methods |
| Crill et al 2010 | Pharmacy based delivery method | To evaluate microbial contamination associated with different methods of neonatal intravenous fat emulsion preparation and delivery. A comparative study. | Intravenous fat emulsion infusions | The number of contaminated samples did not significantly differ between these different methods | Each sample was inoculated into a blood culture bottle, incubated and then microorganism were identified |
| De Giorgi et al 2010 | Ward based preparation and administration | To analyze safety risks in injectable medications and to assess the potential impact and pharmacoeconomic | Gentamicin, morphine and dopamine | Thirty-one failure modes identified and the most critical failure mode was microbial contamination | |

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| | | aspects of safety tools. A prospective study. | | | |
| De Smet et al 2012 | Ward based administration and catheter flushing | To study if Burkholderia cepacia bloodstream infections may result from the use of Ringer lactate solution as multiple-dose vial for catheter flushing. A prospective surveillance study. A simulation and observation study. A comparative study. | Ringer lactate solution as multiple-dose vial for catheter flushing | Three patients died from burkholderia cepacia bloodstream infection. | Blood cultures are sampled when signs of Systemic Inflammatory Response are present.Blood is cultured and incubated and organisms identified. Also environmental sampling were taken. |
| Dias et al 2008 | Pharmacy based preparations | To management of patients with CVC infection due to contaminated infusate and to define the amount of patients to get the infection through this route. A descriptive study. | Heparin catheter-lock solution | 48 patient get this contaminated solution and 32 of these patients get infection due to *P.putida*, the same bacilli isolated from heparin solution | Blood culture and bacterial identification of automated methods |
| Dolan et al 2010 | | To provide practise guidance for health care facilities on essential safe injection, infusion, and vial practices that should be implemented in such settings. Good practices for safe infusion. | | List of aseptic techniques to environmental conditions, IV solutions, flushing, syringes, vials, blood clucose monitoring devices and HCW | |
| Gargiulo et al 2012 | Ward prepared and admistered infusions | To evaluate the possibility that anaesthetists are administering potentielly pathogenic micro-organisms to their patients. A prospective microbiological and observational study. | Sterile water for injection and sodium chloride powder | Organisms were isolated from 13 % of bags, 5 % of syringes and 35 % of needles | The samples were filtered and filter mambrane placed onto agar plate and then incubation ja identification. Also needles analysed in sterile tryptic soy broth. Environment contamination investigated by agar plates and organisms were identified. |
| Gershman et al 2008 | Pharmacy prepared syringes | To summarize the findings of those bloodstream infections after exposure to contaminated flush solutions. A comparative study. | Heparinized Saline Flush syringes | There were for example fever and chills among patients who get contamined flushing solutions | Cultures of blood samples, of sections and of syringes were performed at microbiology laboratories |
| Gorski 2010 | Home infusion therapy with central venous access device | To bring out techniques that prevent CVAD-infections. | | Infection related to CVADs in home care patient are preventable | |

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| | | Recommendations for best practise in home infusion therapy. | | | |
| Isanhart et al 2008 | Media-fill test in an academic laboratory setting | To evaluate aseptic skills of pharmacy student near the beginning and end of course. A comparative study. | A low- and a medium-risk media fill test to prepare syringes | The overall contamination rate at the baseline was 4,2 % versus 0 % at the final assesment. | Prepared syringes were sealed and incubated and then evaluated for presence of microbial contamination (solution turbidity) |
| Kerenyi et al 2011 | Ward prepared infusions | To examine contamination rates of syringes with different drugs used to administer intravenous medications. A comparative study. | The investigated medications were cordarone, furosemide, noradrenaline, adrenaline, bupivacaine+sufentanil, metoprolol, insulin, propofol, potassium chloride and morphin | The overall contamination rate was 16 % and insulin had higher contamination rates | Culturing to different agar plates, incubation and identification and also determined antibiotic sensitivities |
| Rangel-Frausto et al 2010 | Ward based adminstration | To compare closed and open infusion container for prevention of bloodstream infections. An open label, prospective cohort, active healthcare – associated infection surveillance. | Baxter Viaflex and commercially available open infusion containers | The CLAB rate was significantly higher during the open versus the closed container period. | Blood culturing and microorganimis identification with standard laboratory methods |
| Sigward et al 2012 | Pharmacy based preparation | To assess aseptic technique of pharmacy operators. A comparative study. | Simulated media-fill test (vials, syringes, minibags) | The overall operator failure rate in aseptic simulation test was 40 % and 2,3 % of the 300 preparations were contaminated | Filters incubated at agar plate and micro-organisms were identified with Vitek-2 identificatin system |
| Stucki et al 2009 | Pharmacy and ward prepared media-fill testing | To evaluate the direct influence of environmental cleanliness and risk manipulations on prepared syringes. A comparative study. | Syringes filled with tryptic soy broth and air | None prepared in cleanroom contained microorganisms, 6 % were contaminated in the operating room and 16 % were contaminated in the ward. These results correlate with the airborne particulate. | Air particulate contamination determined with a discrete particle counter |
| Yoshida et al 2008 | Both pharmacy and ward prepared infusions | To evaluate the risk factors for catheter-related bloodstream infection with CV catheters. A comparative study. | Different preparations, no meaning to results | Positive cultues showed an overall incidence of 2.26 per 1000 device-days. Higher odds ratio of positive cultures showed ICU and CV catheter placement for more than 30 days | Blood samples and bacterial identification |
| Younger et al 2008 | Ward based setting up and priming an intravenous | Step-by-step guide for the equipment required, correct | | | |

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| | infusion | preparation of patient and the procedure in setting up intaravenous infusion. Article is also concerned about infection risk in intravenous infusion. Nursing standards. | | | |
| Letters, editorials and commentaries (n=7) | | | | | |
| Agalloco et al 2009 | Pharmacy based preparation (cleanroom hand filling) | Commentary on hand filling in cleanrooms which is soon history and we have to use new technologies to guarantee the quality | | | |
| Chemaly et al 2009 | Pre-filled syringes | The letter to emphasize infection control teams role in identifying contaminated sources | Heparin an d saline pre-filled syringes | | |
| Cozanitis and Mäkelä 2008 | Ward based administration | Letter to point out that using the same syringe for a number of could harm patients | Propofol | Infection from contaminated syringes has been reported overwhelmingly | |
| Gorski 2013 | Ward and home based infusion preparation and administration | Editorial to address infection prevention, peripheral intravenous catheter use and alternative site infusions | | Infusion nurses across the globe will continue to face challenges as new technology emerges | |
| Kuehn 2012 | Commentary of unsafe injection practises on medical wards | The purpose is to campaign against unsafe injection practises and to increase the knowledge of risks to patients because of unsafe practices | | | |
| McCrea 2013 | Single-use vials | Column to explore the federal policies regarding safe injection practices and the focus on compliance | | | |
| Nakataki et al 2013 | **Infusion set needles** | **Brief report to examine the incidence of beacterial contamination in infusion set needles** | **Electrolytes or parenteral nutrition** | **Bacterial contamination was detected in 5,7 % of the samples** | **Needle was plated in culture medium and then inoculated medium was added to agar plates, incubated and then identified** |