

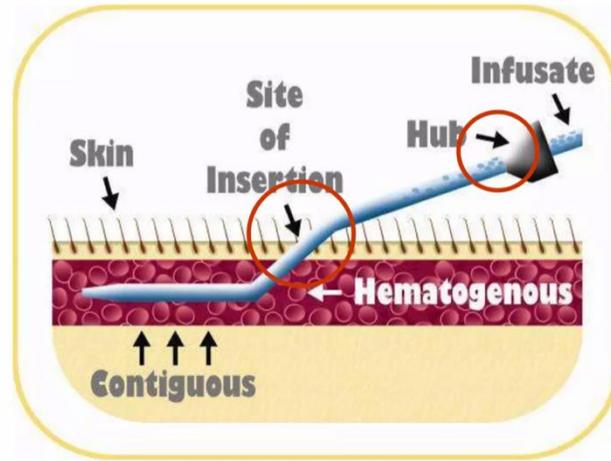
Infection prevention in vascular access

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Advances Practice Nurse



Introduction



Risk factors for central-line-associated bloodstream infection (CLABSI) in neonatal intensive care unit infants with central venous catheter (CVC)

Risk factors	Incidence (per 1000 lines)	HR (95% CI)	aHR (95% CI)
Catheter type			
UVC	43.48	1.00	1.00
PICC	86.13	0.54 (0.43–0.68)	0.51 (0.40–0.66)
Gestational age (weeks)			
22–25	189.15	1.00	1.00
26–27	119.12	0.64 (0.50–0.82)	0.63 (0.49–0.81)
28–31	51.31	0.30 (0.23–0.39)	0.28 (0.21–0.37)
32–36	25.34	0.19 (0.13–0.29)	0.15 (0.10–0.23)
≥37	22.35	0.20 (0.14–0.30)	0.14 (0.09–0.21)
Congenital abnormality			
No	66.58	1.00	1.00
Yes	69.28	0.82 (0.66–1.04)	1.45 (1.11–1.89)
Major surgery			
No	62.58	1.00	1.00
Yes	87.75	0.83 (0.66–1.05)	1.0 (0.77–1.29)
Age at insert (days)			
<7	64.52	1.00	1.00
7–13	79.37	0.79 (0.56–1.12)	0.80 (0.56–1.15)
14–20	110.43	0.96 (0.59–1.54)	0.92 (0.57–1.50)
21–27	35.71	0.30 (0.11–0.80)	0.28 (0.10–0.75)
≥28	72.99	0.66 (0.42–1.04)	0.53 (0.33–0.85)

Central-line associated bloodstream infection (CLABSI) outcomes per participating centre

	A	B	C	D	E	F	G	H	I
Neonates with a central-line, N	375	167	118	177	183	190	254	113	122
Total line-days, N	5705	1912	1958	2393	2387	1996	3917	1917	1720
CLABSI episodes, N	29	31	11	23	11	9	23	18	5
Neonates with CLABSI, N (%)	29 (7.7%)	31 (18.6%)	11 (9.3%)	23 (12.9%)	11 (6.0%)	9 (4.7%)	23 (9.0%)	18 (15.9%)	5 (4.0%)
<28 weeks GA	19 (66%)	16 (52%)	9 (82%)	14 (61%)	5 (45%)	6 (67%)	11 (48%)	11 (61%)	5 (100%)
<750 g BW	12 (41%)	3 (9.7%)	2 (18%)	9 (39%)	4 (36%)	5 (56%)	4 (17%)	8 (44%)	1 (20%)
Cumulative incidence rate	7.73	18.56	9.32	12.99	6.01	4.74	9.06	15.93	4.10
Incidence per 1000 line-days	5.08	16.14	5.62	9.61	4.61	4.51	5.87	9.39	2.91

2019–2020
160 infections /1699 (7,5%) central lines

- Jansen et al, 2024. CLABSI burden among Dutch NICU's. <https://doi.org/10.1016/j.jhin.2023.11.020>
- Hamza et al, 2022 A multidisciplinary intervention to reduce CLABSI in PICU and NICU <https://doi.org/10.1016/j.pedneo.2021.08.010>
- Bierlaire et al, 2021 How to minimize CLABSI in a NICU: a quality improvement intervention based on retrospective analysis and the adoption of an evidence-based bundle <https://doi.org/10.1007/s00431-020-03844-9>
- Sanderson et al, 2017. Dwell time and risk of CLABSI in neonates. DOI: [10.1016/j.jhin.2017.06.023](https://doi.org/10.1016/j.jhin.2017.06.023)



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Introduction

Definition

Bloodstream infection	Definitions
Catheter-related bloodstream infection (CRBSI)	<p>Clinical signs and + bloodculture in the absence of an obvious source other than CVC with one of the following:</p> <ul style="list-style-type: none"> - + culture (>15 CFU (colony-forming units)) from a part of the catheter with the same organisms isolated peripherally - Blood culture with a pathogene ratio of $\geq 3:1$ (CVC vs peripheral) - Time difference of ≤ 2 hours leading to culture positive between CVC and peripheral cultures
Central-line associated bloodstream infection (CLABSI)	<p>Primary bloodstream infection in a patient who had a central line within the 48 hours period before development of infection or 48h after catheter removal</p> <p>Infection must not be related to an alternative cause</p>



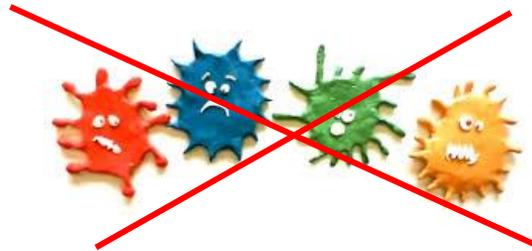
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- Bell et al, 2017. Prevention of CLABSI. doi:10.1016/j.idc.2017.05.007.
- Cho et al 2019 Central line-associated bloodstream infection in neonates <https://doi.org/10.3345/kjp.2018.07003>
- Catho et al, 2023. Risk of CABS I by cathetertype in a NICU: a large cohort study of more than 1100 intravascular cateters. <https://doi.org/10.1016/j.jhin.2023.06.011>



Introduction

Bundle



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Vascular Access workshop



Strategies for the preventions of VAD infections

Types of VADs and sites selection

Selection should be based upon the length of intended therapy and the clinical needs

- Peripherally catheter
- Venous umbilical catheters (VUC) are the universal early vascular access device
- Peripherally inserted central catheter (PICC) / Epicutaneo central catheter (ECC) are placed after a view days of UVC
- Tunneled catheter (Broviac)

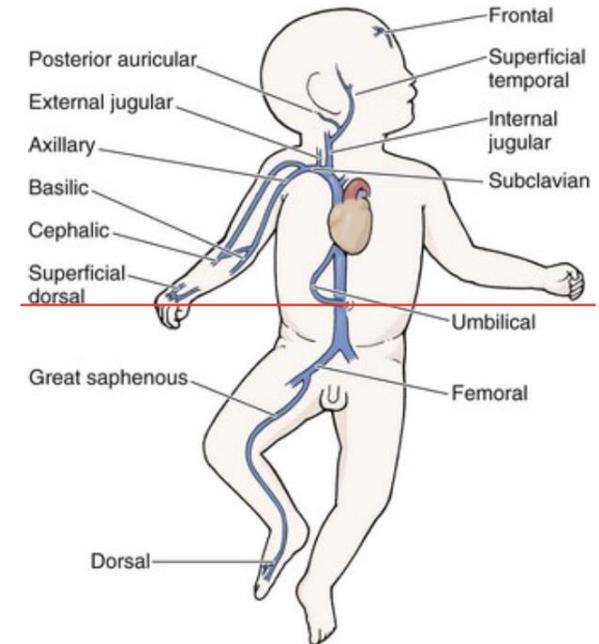


Table 2. Comparison of catheter characteristics and outcomes.

	UAC (n = 55; 13.75%)	UVC (n = 84; 21.0%)	Broviac (n = 22; 5.5%)	SDVC (n = 57; 14.25%)	PICC (n = 182; 45.5%)	Total (n = 400; 100%)	p value
Catheter tip position evaluated by radiograph	NA	84 (100.0)	21 (95.5)	57 (100.0)	179 (98.4)	341 (85.3)	.007 ^a
Central	NA	37 (44.0)	18 (85.7)	33 (57.9)	99 (55.3)	187 (54.8)	
Non-central	NA	47 (56.0)	3 (14.3)	24 (42.1)	80 (44.7)	154 (45.2)	
Type of complications, n (%)							
All	8 (14.5)	12 (14.3)	10 (45.5)	18 (31.6)	75 (41.2)	123 (30.8)	<.001 ^a
Mechanical	5 (9.1)	6 (7.1)	7 (31.8)	9 (15.8)	45 (24.7)	72 (18.0)	.816 ^a
Infiltration	0 (0)	0 (0)	2 (9.1)	1 (1.8)	28 (15.4)	31 (7.8)	.003 ^a
Infectious	3 (5.5)	6 (7.1)	3 (13.6)	9 (15.8)	30 (16.5)	51 (12.8)	.816 ^a
Length of catheter stay, median (min-max)	6 (2-28)	5 (2-18)	16 (4-94)	11 (2-37)	10 (2-46)	8 (2-94)	<.001 ^b
Parenteral nutrition, n (%)	0 (0.0)	66 (78.6)	20 (90.9)	50 (87.7)	179 (98.4)	315 (78.8)	<.001 ^a
Duration of parental nutrition, median (min-max)	NA	5 (0-18)	14 (0-82)	7 (0-37)	9 (0-46)	7 (0-82)	<.001 ^b
Rate of non-elective removals, n (%)	7 (13.0)	9 (11.7)	7 (46.7)	11 (19.6)	62 (39.5)	96 (26.7)	<.001 ^a
Length of catheter stay for non-elective removals (days), median (min-max)	7 (3-12)	5 (2-10)	15 (11-19)	7 (2-30)	5 (2-34)	6 (2-34)	.037 ^b

NA: not applicable; UAC: umbilical arterial catheters; UVC: umbilical venous catheters; SDVC: short duration venous catheters.

^aPearson Chi-square test.

^bKruskal-Wallis rank test.

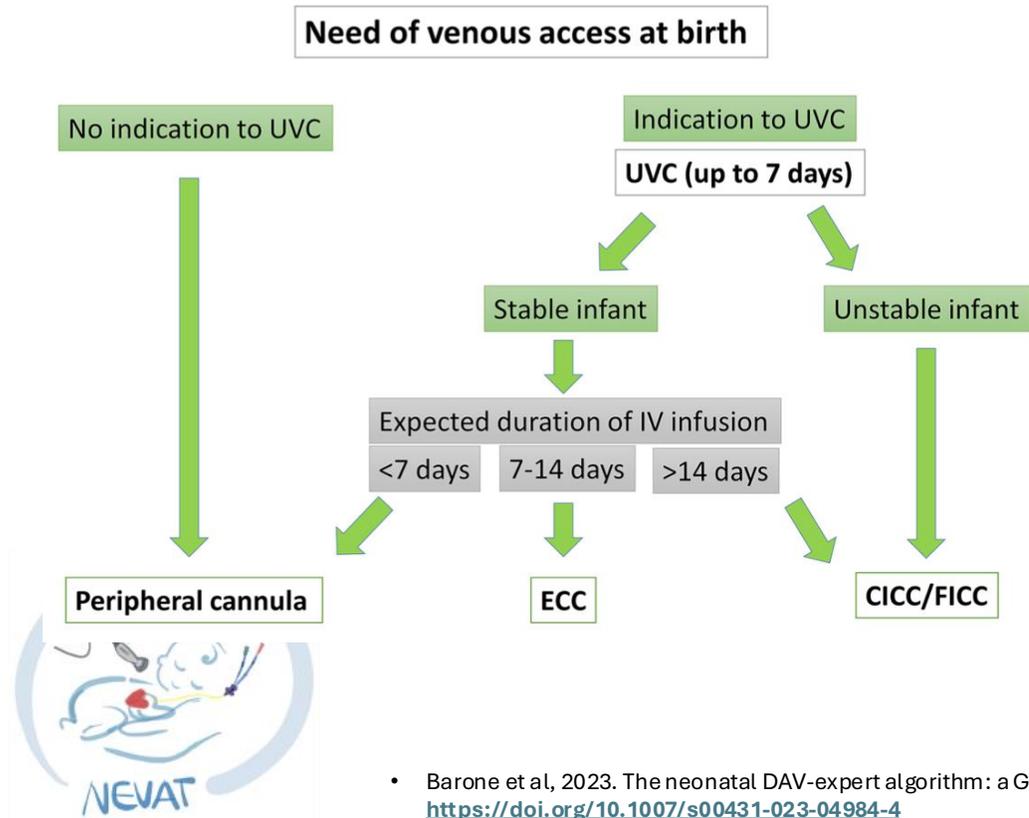
- Catho et al, 2023. Risk of CABS by cathetertype in a NICU: a large cohort study of more than 1100 intravascular catheters. <https://doi.org/10.1016/j.jhin.2023.06.011>
- Soares et al, 2017. Complications of central lines in neonates admitted to a level III NICU. <https://doi.org/10.1080/14767058.2017.1355902>



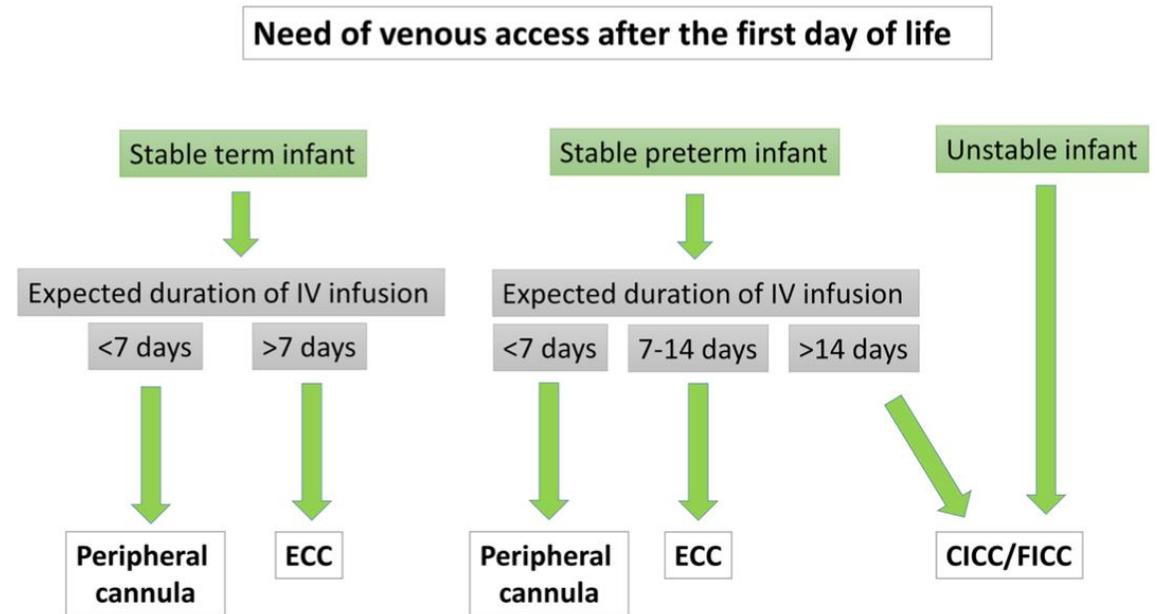
Strategies for the preventions of VAD infections

Types of VADs and sites selection

Algorithm for the choice of the vascular access device at birth



Algorithm for the choice of the vascular access device at birth after the first day of life



- Barone et al, 2023. The neonatal DAV-expert algorithm: a GAVeCeLT/ GAVePed consensus for the choice of the most appropriate venous access in newborns. <https://doi.org/10.1007/s00431-023-04984-4>



Strategies for the preventions of VAD infections

Handhygiene

Is identified by the WHO and National IPC guidelines as a key of HAI prevention strategy

- Antiseptic detergent
 - Chlorhexidine (2 – 4%)
- Waterless alcohol gel (>60%)



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<https://www.WHO.int/home>

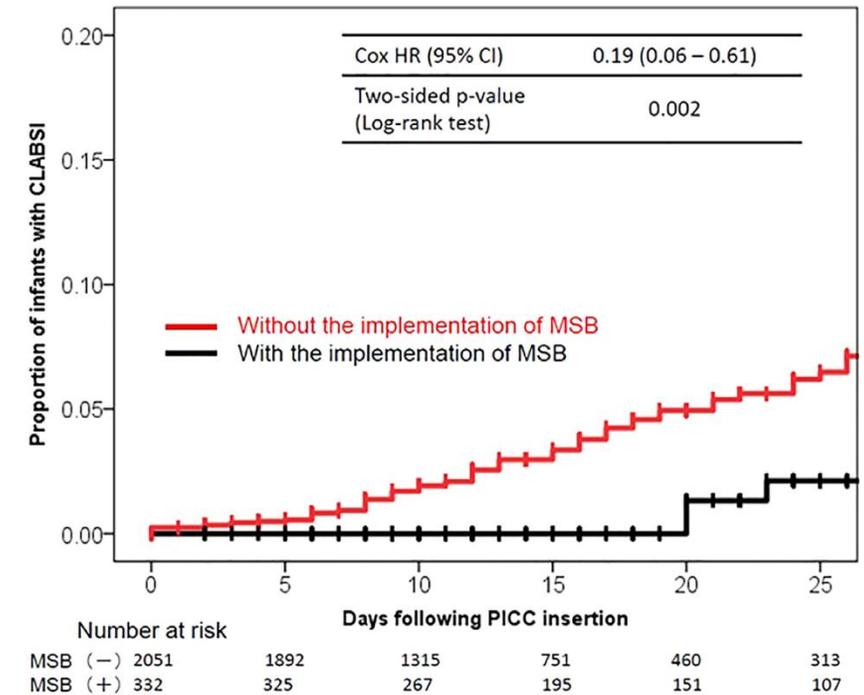
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Strategies for the preventions of VAD infections

Barrier precautions for insertion

- Non sterile/ sterile Gloves
- Long-sleeved sterile gowns
- Masks: covering nose tightly
- Caps: ! All hair must be under the cap
- Sterile full body drape



81% infection reduction by implementation of maximal sterile barrier



Strategies for the preventions of VAD infections

Use of Chlorhexidine/ alcohol to prepare skin

2% CHG-Aqueous solution and 2% CHG-IPA 70% can be used safely in preterm neonates strict procedure

Clarke et al, 2024. 2% CHG-A versus CHG-70% for skin disinfection prior to PCVC: the ARTIC RC feasibility trial. doi:10.1136/archdischild-2023-325871

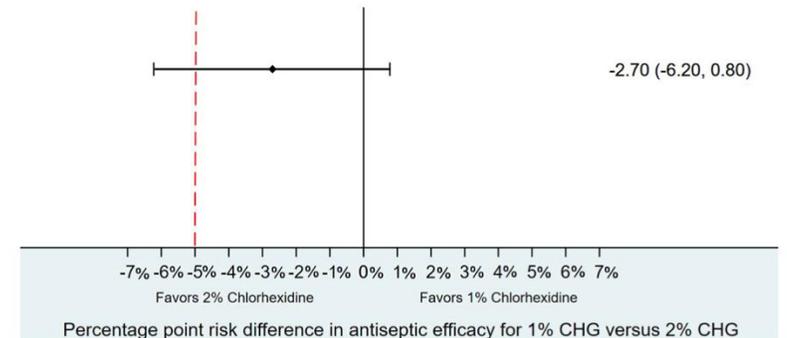
2% CHG-A might more effective than 1% CHG-A (-2,70%), but is not statistically significant

Sharma et al, 2021. Aqueous chlorhexidine 1% versus 2% for neonatal antiseptis: a randomised non-inferiority trial. doi:10.1136/archdischild-2020-321174

Laboratory Culture for infants with at least one positive culture result

	Before disinfection	After disinfection	Proximal catheter segment	Catheter tip segment
2%CHG-70%IPA (N=23/87)	11 (12,6%)	1 (1,15%)	2 (2,30%)	1 (1,15%)
2%CHG-A (N= 8/27)	4 (14,8%)	1 (3,7%)	1 (3,7%)	2 (7,4%)

S. Capitis – S. Haemolyticus – S. Epidermis – S. Warneri



In neonates with GA < 26 weeks

Chlorhexidine in aqueous solution



Chlorhexidine alcohol solution just at the point of insertion, dab and not rub, rinse with saline solution after disinfection



Strategies for the preventions of VAD infections

Ultrasound

- Reduce the number attempt
- Reduce infection rate

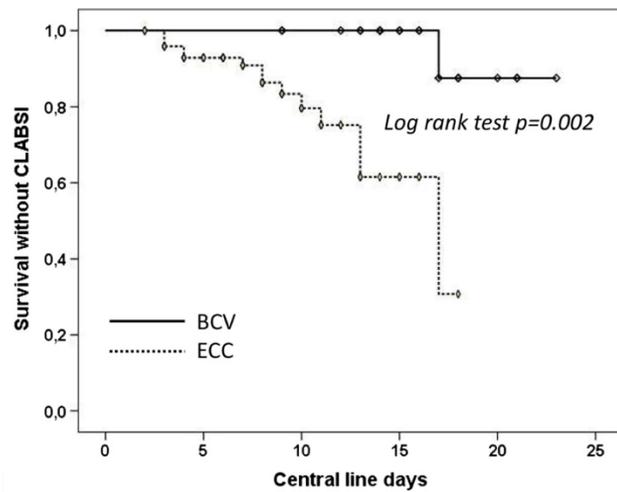


Table 1 Distribution of patients' profiles and catheter-related parameters and their association with the catheter types

Variables	Total n=1333	USG-CVC 69 (5.2%)	PICC 1264 (94.8%)	P value
Year				
2016	376 (28.2)	42 (60.9)	334 (26.4)	0.001
2017	507 (38)	27 (39.1)	480 (38)	
2018	450 (33.8)	0 (0)	450 (35.6)	
Side of the body				
Left	498 (41.1)	14 (22.6)	484 (42.1)	0.002
Right	715 (58.9)	48 (77.4)	667 (57.9)	
Site of insertion				
Upper extremities	360 (29.5)	37 (53.6)	323 (28)	0.001
Lower extremities	861 (70.5)	32 (46.4)	829 (72)	
Number of pricks				
First prick	839 (63.9)	43 (69.4)	796 (63.6)	0.001
Second prick	305 (23.2)	8 (12.9)	297 (23.7)	
Third prick	145 (11)	6 (9.7)	139 (11.1)	
Fourth prick	22 (1.7)	4 (6.5)	18 (1.4)	
Fifth prick	1 (0.1)	0 (0)	1 (0.1)	
Sixth prick	2 (0.2)	1 (1.6)	1 (0.1)	
Reason for insertion				
Difficult intravenous insertion	8 (0.6)	0 (0)	8 (0.6)	0.47
Hypoglycaemia	10 (0.8)	0 (0)	10 (0.8)	
Long-term intravenous fluid therapy	1286 (96.6)	68 (100)	1218 (96.4)	
Long-term intravenous medication therapy	27 (2)	0 (0)	27 (2.1)	
Catheter insertion success rate				
Successful	1198 (89.9)	61 (88.4)	1137 (90)	0.68
Not successful	135 (10.1)	8 (11.6)	127 (10)	
Reason for removal				
CLABSI	40 (3.4)	5 (8.2)	35 (3.1)	0.031
Leaking	26 (2)	10 (16.4)	26 (2.3)	
Accidental removal	8 (0.7)	1 (1.6)	7 (0.6)	0.40
Broken catheter	7 (0.6)	0 (0)	7 (0.6)	
Local redness and swelling	104 (8.7)	5 (8.2)	99 (8.8)	0.88
Occlusion	42 (3.5)	0 (0)	42 (3.7)	
Malposition	13 (1.1)	0 (0)	13 (1.1)	0.50
Elective	833 (69.9)	29 (47.5)	804 (71.1)	
Death	39 (3.3)	5 (8.2)	34 (3)	0.03
Phlebitis	70 (5.9)	6 (9.8)	64 (5.7)	

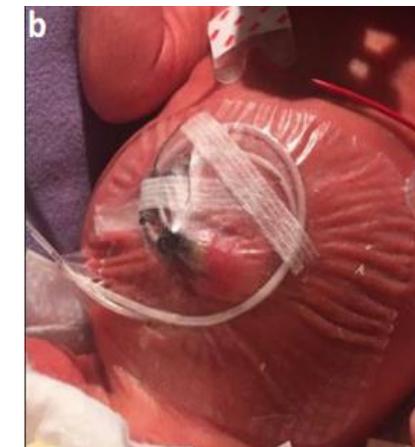
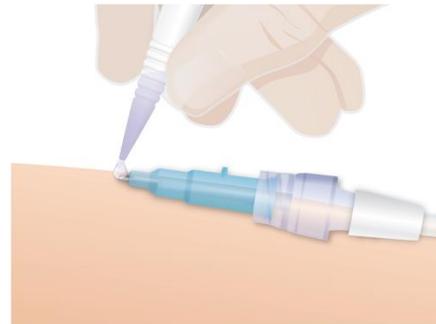


Strategies for the preventions of VAD infections

Catheter securement

- Improve stabilization
- Avoid CVC in and out movement
- Use the griplock → avoid accidental dislocation
- Use transparent dressing → point of insertion always visible
- Use cyanoacrylate glue at the insertionpoint → stabilization, hemostasis and anti infective properties

(reduce dislodgement with 90%)



- D'Andrea et al, 2021. Use of cyanoacrylate glue for the suturless securment of ECC in neonates. DOI:10.1177/11297298211008103

Strategies for the preventions of VAD infections

Line maintenance

DAILY REVIEW

Daily monitoring
Avoid routine replacements of central lines
Removed lines ASAP



CVC Dressing changes



Disinfection of access ports



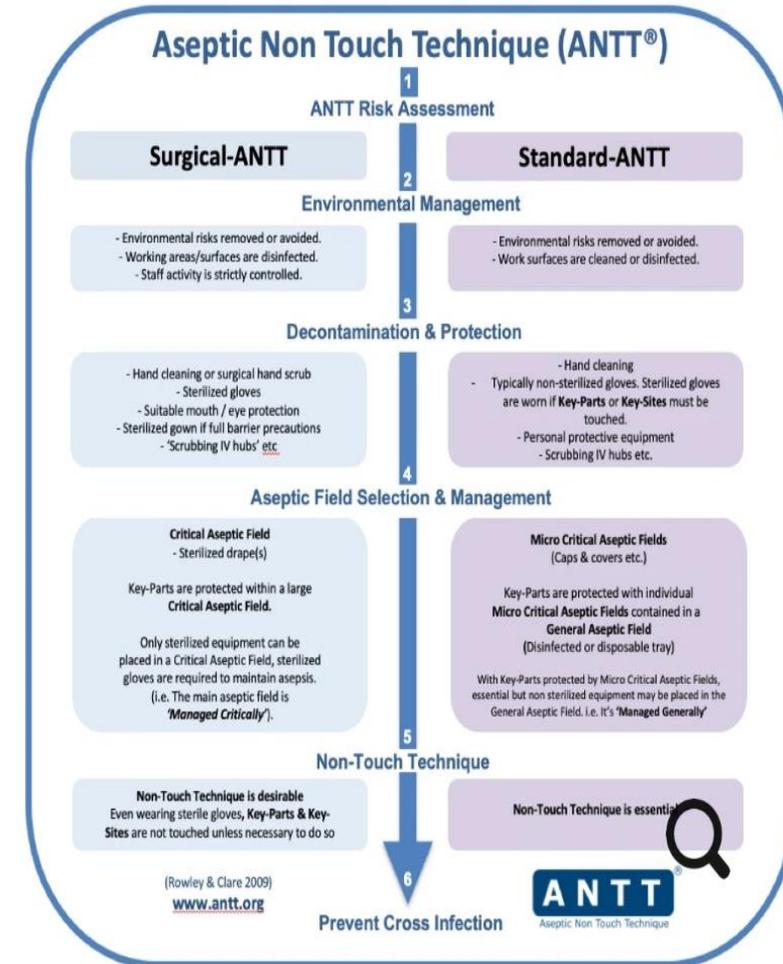
Limit number of times it is accessed
Standard line set-up and aseptic technique change



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- Hess et al, 2023. Assessment of UVC dwell-time of 8-14 days vs 1-7 days in VLBWI: a pilot single-center RCT. <https://doi.org/10.1016/j.earlhumdev.2023.105752>
- Bierlaire et al, 2021. how to minimize CLABSI in a NICU: a quality improvement intervention based on retrospective analysis and the adaption of an evidence-based bundle. <https://doi.org/10.1007/s00431-020-03844-9>
- Helder et al, 2019. Effect of the use of an antiseptic barrier cap on the rates of CLABSI in neonatal and pediatric ICU. <https://doi.org/10.1016/j.jaic.2019.11.026>

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Strategies for the preventions of VAD infections

Dwell time

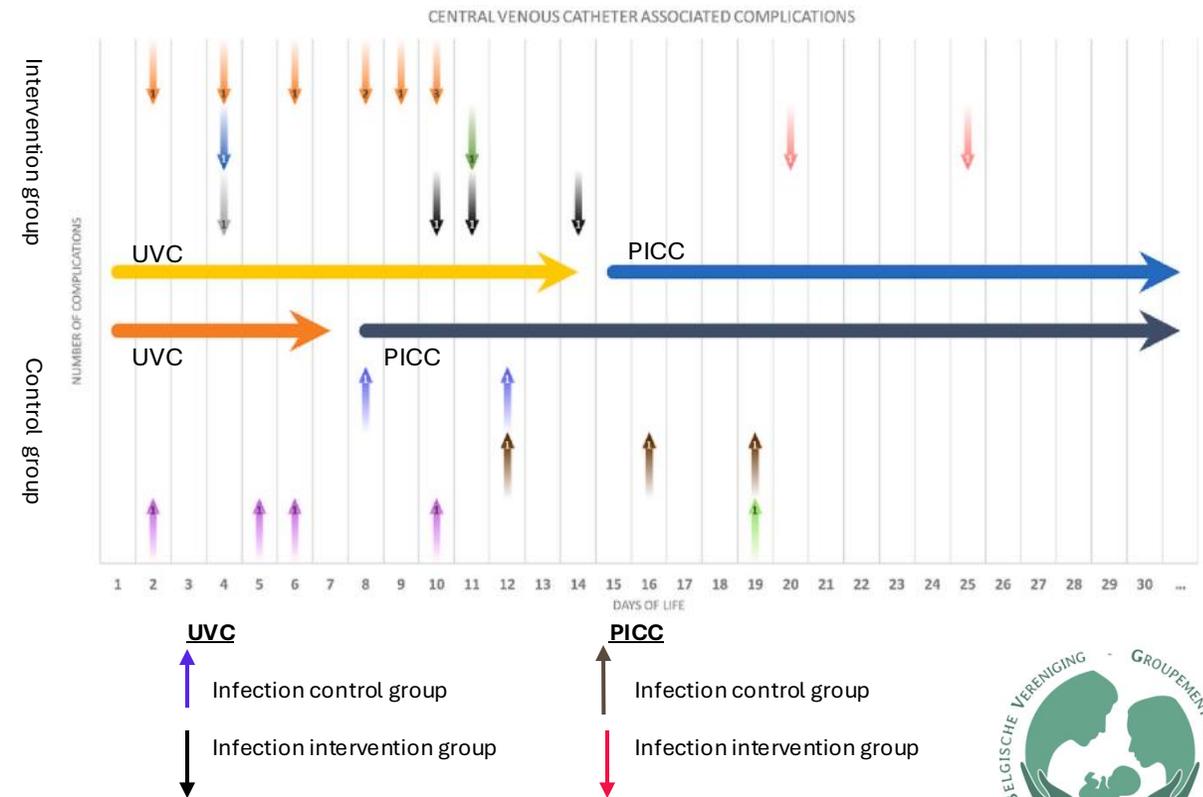
63 neonates, 168 CVC (2020–2022) 63 VUC, 21 AUC, 84 PICCs and 86 PVC

Parameter	Control group	Intervention group	
UVC-associated infections	2 (6.5 %)	3 (9.4 %)	1.0*
Number of infections per 1000 UVC days	8.6	9.0	
PICC-associated infections	4 (12.9 %)	1 (3.1 %)	0.2*
Number of infections per 1000 PICC days	7.3	3.9	

Table 2 The complications of PCVCs between two groups.

Complications (‰)	ND (n = 99)	RD (n = 98)	P value
	n (‰)	n (‰)	
Blood stream infection	4 (2.0)	0 (0.0)	0.048
Leakage	2 (1.0)	4 (2.5)	0.26
Occlusion	12 (5.7)	11 (5.6)	0.81
Phlebitis	1 (0.5)	4 (2.0)	0.18

ND: Non-regular dressing group, RD: Regular dressing group;
P values < 0.05 were statistically significant.



- Su et al, 2021. The appropriate frequency of frssing for PCVC in preventing CLABSI in NICU: A RCT. <https://doi.org/10.1016/j.pedneo.2021.02.001>
- Hess et al, 2023. Assessment of UVC dwell-time of 8-14 days vs 1-7 days in VLBWI: a pilot single-center RCT. <https://doi.org/10.1016/j.earlhumdev.2023.105752>
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Strategies for the preventions of VAD infections

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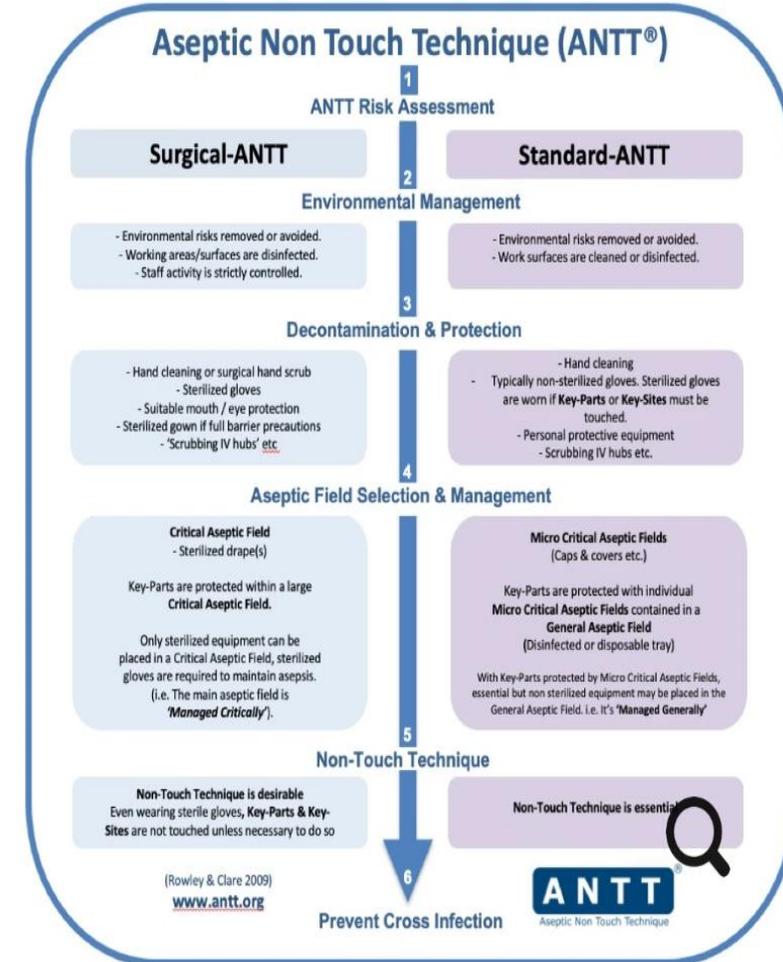
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Summary

Insertion bundle	Maintenance bundle
Establish a <u>central catheter kit</u> or cart with all the items required for the procedure	Perform <u>hand hygiene</u> with an alcohol-based product or disinfectant containing soap before or after accessing the catheter, or before or after changing the dressing.
Perform <u>hand hygiene</u> with an alcohol-based product or disinfectant- containing soap before and after palpating insertion sites and before and after inserting the central catheter	<u>Daily access the catheter insertion sites</u> to identify signs of infection and dressing integrity
Use <u>maximal barrier precautions</u> (sterile gown, sterile gloves, surgical mask, hat, and large sterile drape)	At least, if the dressing is damp, soiled or loosened, <u>change the dressing aseptically and disinfect the skin</u> around the insertion site with a suitable disinfectant (e.g., 2% chlorhexidine, 70% alcohol).
<u>Disinfect the skin</u> with a proper antiseptic (e.g., 2% chlorhexidine, 70% alcohol) before catheter insertion	Develop and use <u>standardized intravenous tubing setup and changes</u>
Use <u>US procedure</u> for the placement of for the catheter placement	<u>Maintain aseptic technique and scrub the hub</u> using appropriate disinfectant when replacing intravenous tubing and when accessing the catheter or use <u>disinfection caps</u>
Use either a <u>sterile transparent semipermeable dressing</u> or sterile gauze to cover the insertion site	<u>Daily review</u> catheter necessity to immediately eliminate when it is no longer essential



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<https://neonat.org/>

Thank You...



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