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Venous access devices: current perspectives

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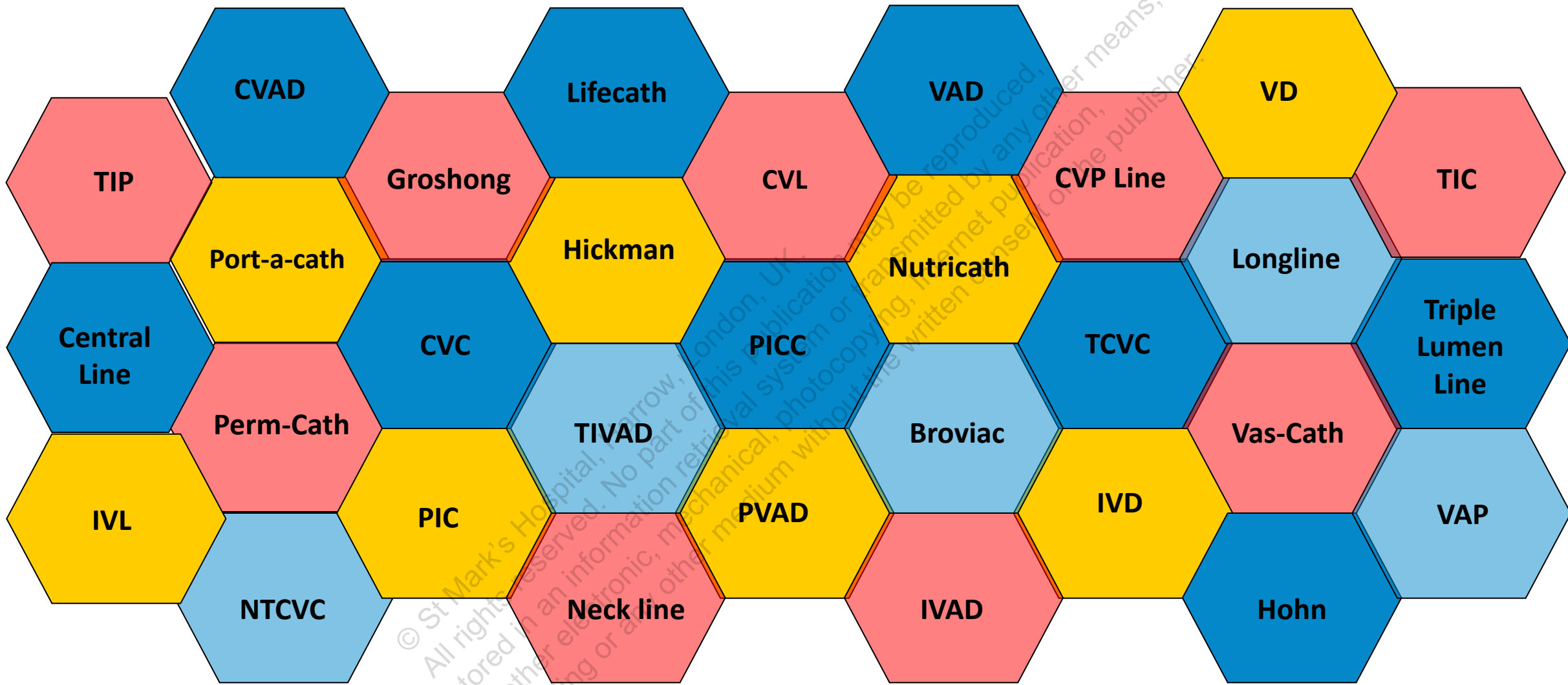
Overview

- Outline the different central venous access devices that may be used for parenteral nutrition
- Examine evidence base underpinning device selection
- Present emerging device technology

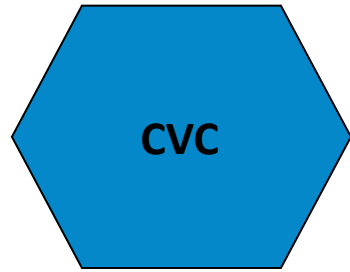
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Which type of device for PN?

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A central venous catheter, also known as a central line, is a long thin flexible tube inserted via a vein in the neck, chest, arm or groin, with the tip sitting in either the superior vena cava (SVC), or the inferior vena cava (IVC)

1. Tip position?

SVC

IVC

2. Centrally or peripherally inserted?

Central

CICC

Internal jugular

Subclavian

FICC

Femoral

Peripheral

PICC

Basilic

Cephalic

3. Direct or indirect puncture?

Direct

Non tunnelled

Indirect

Tunnelled

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Catheter selection considerations

- Meets any safety standards
 - Allergies
- Long or short term
- Intended therapies
- Who will be providing the device?
 - Choice of devices?
- Who will be inserting the device?
- Who will be caring for the device?
 - Patient involvement

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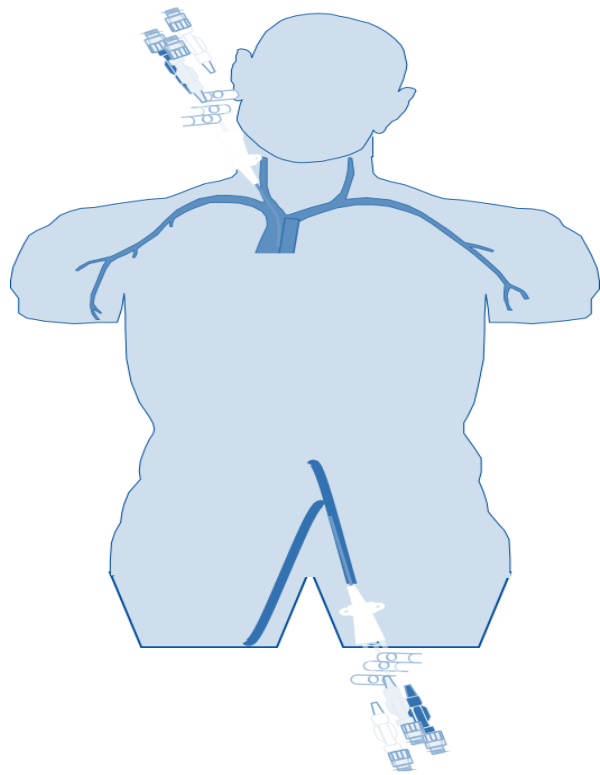


Vein preservation

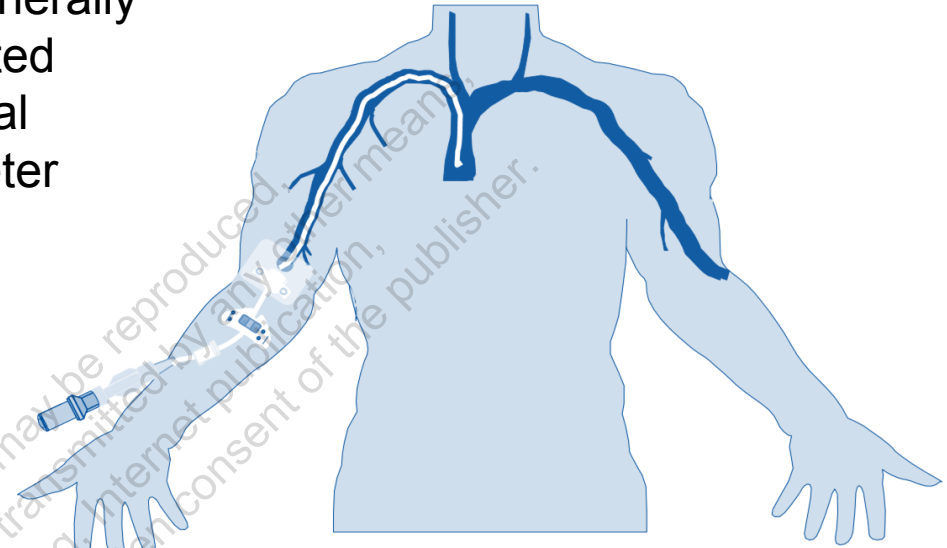
- Venous access devices damage veins
 - Peripheral & central
 - Damage not always immediate
 - PN is thrombogenic
 - Underlying medical condition may increase thrombosis risk
- Important, but overlooked, consideration in IF
 - Patient & healthcare professional education needed

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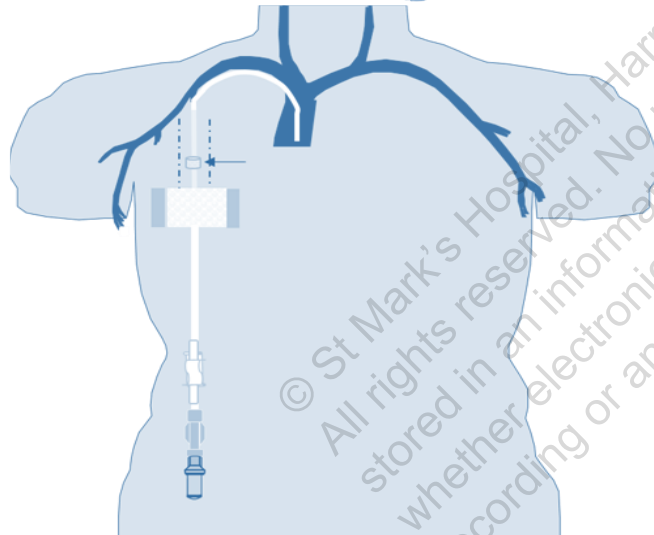
Non
tunnelled
multi
lumen



Peripherally
inserted
central
catheter



Tunnelled
cuffed
Hickman
type

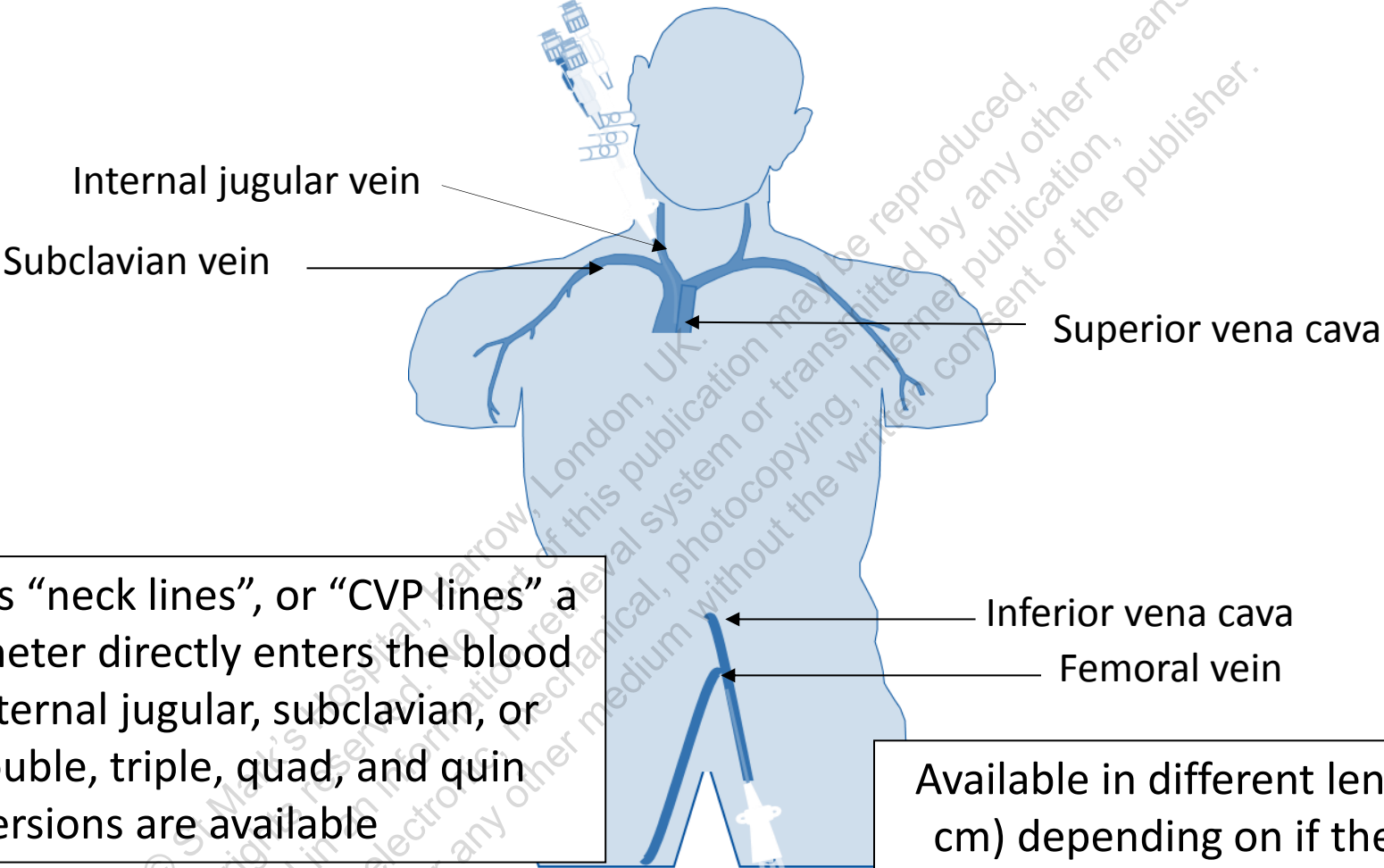


Totally
implanted
port "port
cath"



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Non-tunnelled multilumen



Often referred to as “neck lines”, or “CVP lines” a non-tunnelled catheter directly enters the blood stream via the internal jugular, subclavian, or femoral vein. Double, triple, quad, and quin lumen versions are available

Available in different lengths (16 & 20 cm) depending on if the left or right side being used

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Peripherally inserted central catheter

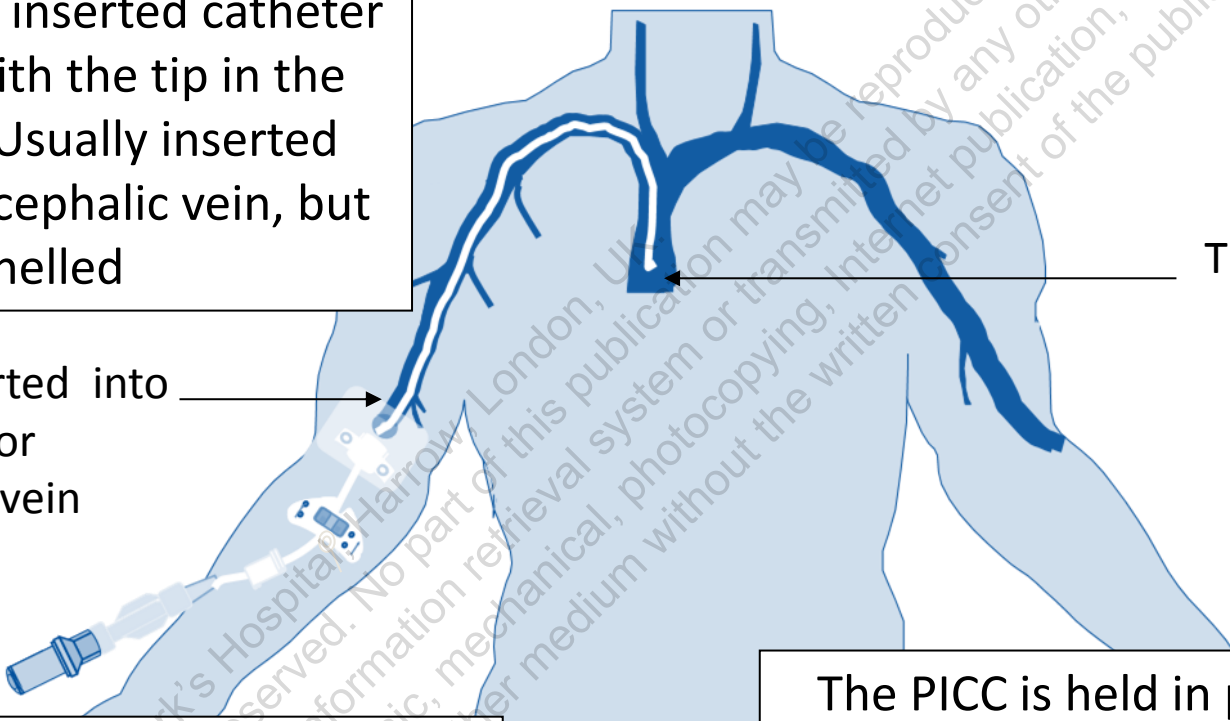
A PICC is a peripherally inserted catheter between 40-60 cm with the tip in the superior vena cava. Usually inserted directly into basilic or cephalic vein, but can be tunneled

Catheter inserted into basilic or cephalic vein

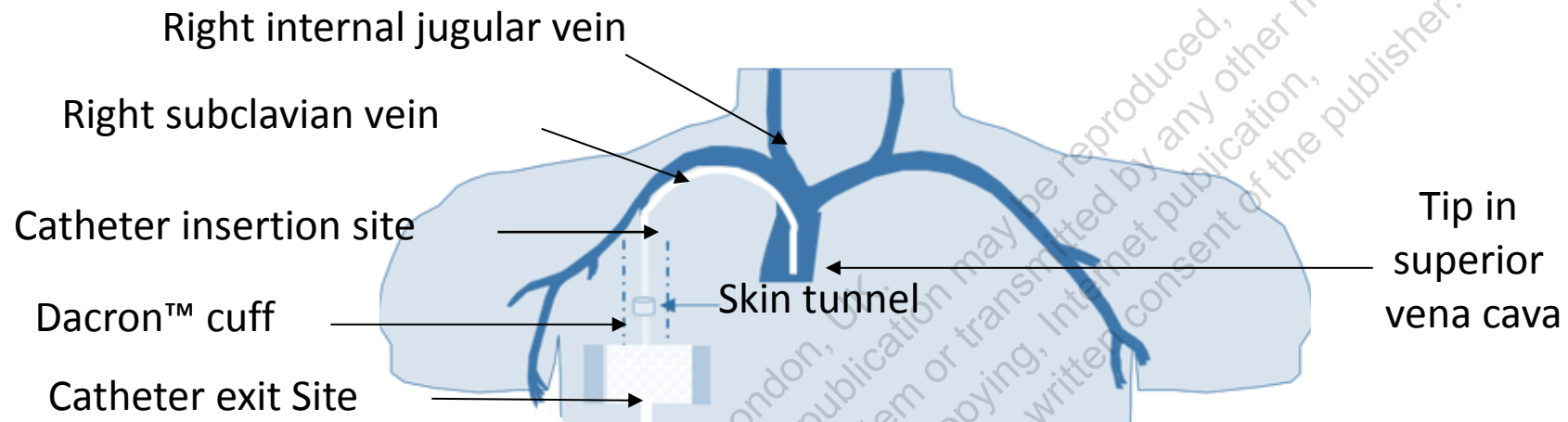
Tip in superior vena cava

Silicone or polyurethane
Single, double and triple lumen available

The PICC is held in place by anchoring the integral catheter fixation device with either sutures or a specific securement device, ie Statlock™



Tunnelled cuffed "Hickman" type



Single, double and triple lumens available

The catheter is tunnelled under the skin and enters the superior vena cava from either the subclavian, or internal jugular vein. It is held in place within the skin tunnel by means of a small cuff of felt-like material (Dacron) which the body forms scar tissue around



Totally implanted port "Port-a-cath™"

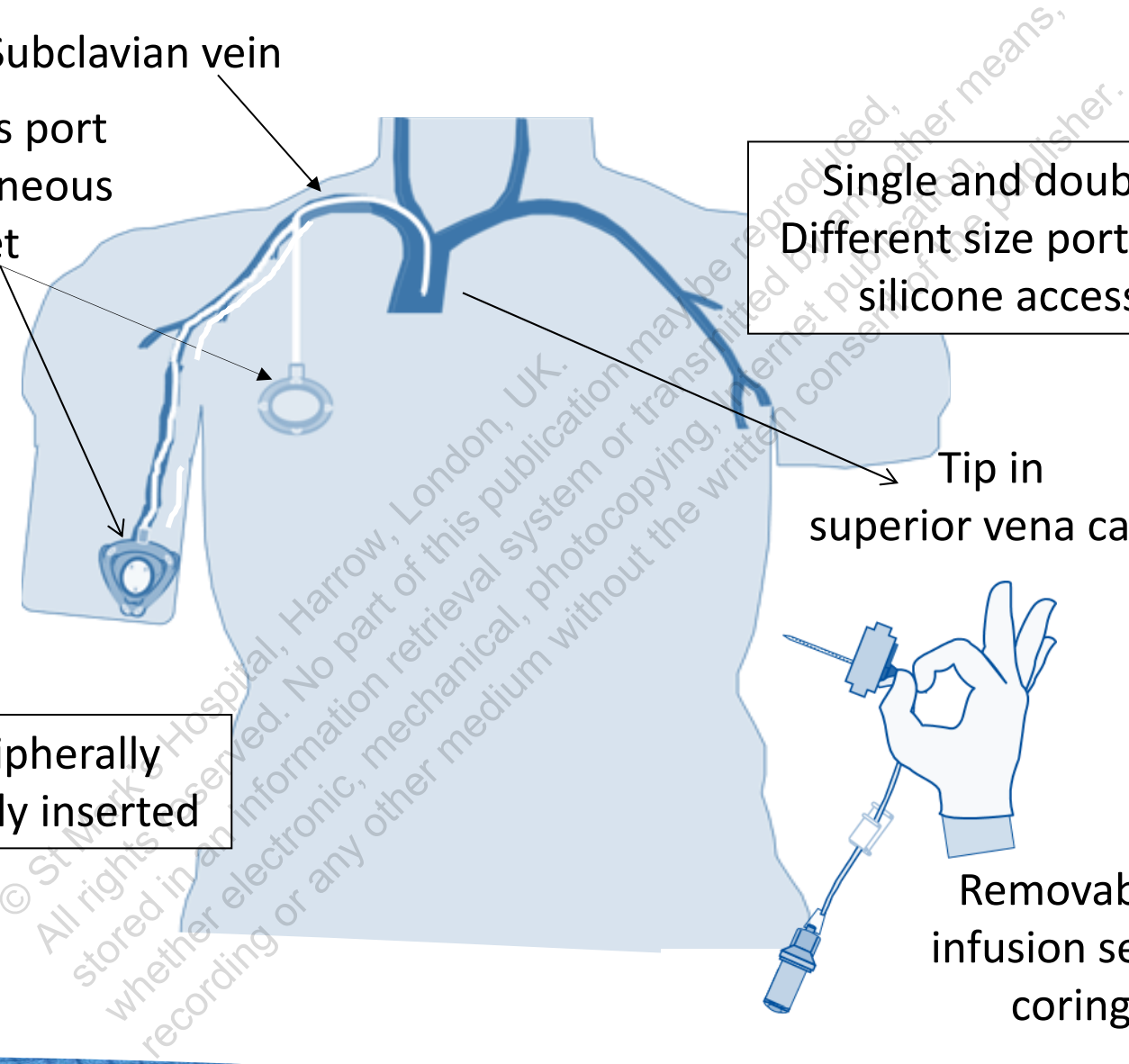
Right Subclavian vein
Vascular access port
within subcutaneous
skin pocket

Single and double ports available
Different size ports with different size
silicone access discs available

Tip in
superior vena cava

Ports can be peripherally
inserted or centrally inserted

Removable winged
infusion set with non-
coring needle





Types of CVC : the evidence base

- Lower infection with tunnelled catheters
 - Totally implanted ports lowest rates
 - Increased risk factor in HPN
 - The extent to which PICC affect risk & incidence of infection to be determined
- PICC associated with more thrombosis
- Studies not always in PN patients
 - Only consider infection as outcome measure

Size matters

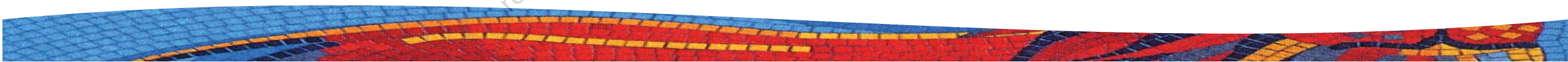
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Catheter vessel ratio

- The external diameter of the catheter should not exceed $\frac{1}{3}$ of the internal diameter of the vein
- 4 Fr device = 4 mm vein or larger
- 6 Fr device = 6 mm vein or larger
- 9 Fr device = 9 mm vein or larger
- Cephalic vein = 6 mm
- Basilic vein = 8 mm

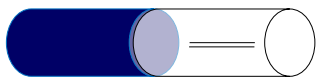
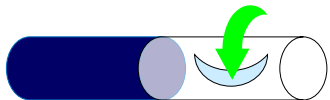
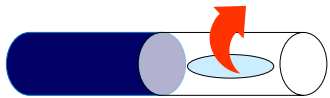
What about special characteristics?

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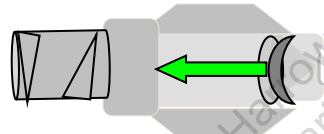
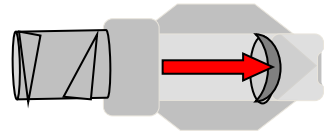


Valved CVC

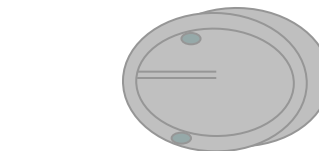
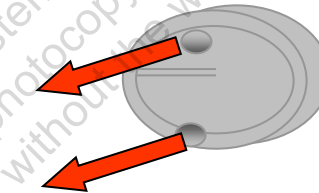
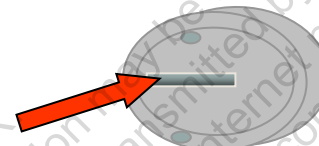
Groshong™ valve



PaSV™ valve



Bard Solo™ valve



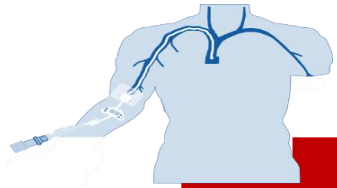
Positive pressure

Negative pressure

Neutral pressure

Groshong and PASV are available on PICC, Power CVC, Tunnelled Cuffed CVC and Ports.
Solo valve only available on PICC

Valved CVC: the evidence base



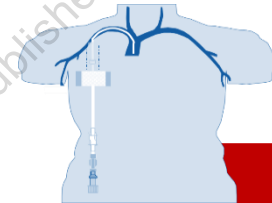
PICC

- PASV less occlusions than Groshong, n=100 p=0.06¹
- Solo vs PASV vs unvalved, n=180, no difference²



Port

- PASV easier to aspirate than non valved, n=54, p=0.004³
- PASV easier to aspirate vs non valved, n=73, p=0.02⁴



Tunnelled

- More catheter malfunction valved vs non valved p<0.05⁵
- n=356 increased ball valve effect → risk of thrombosis p<0.01⁶
- n=35 no difference in infective or mechanical comps⁷

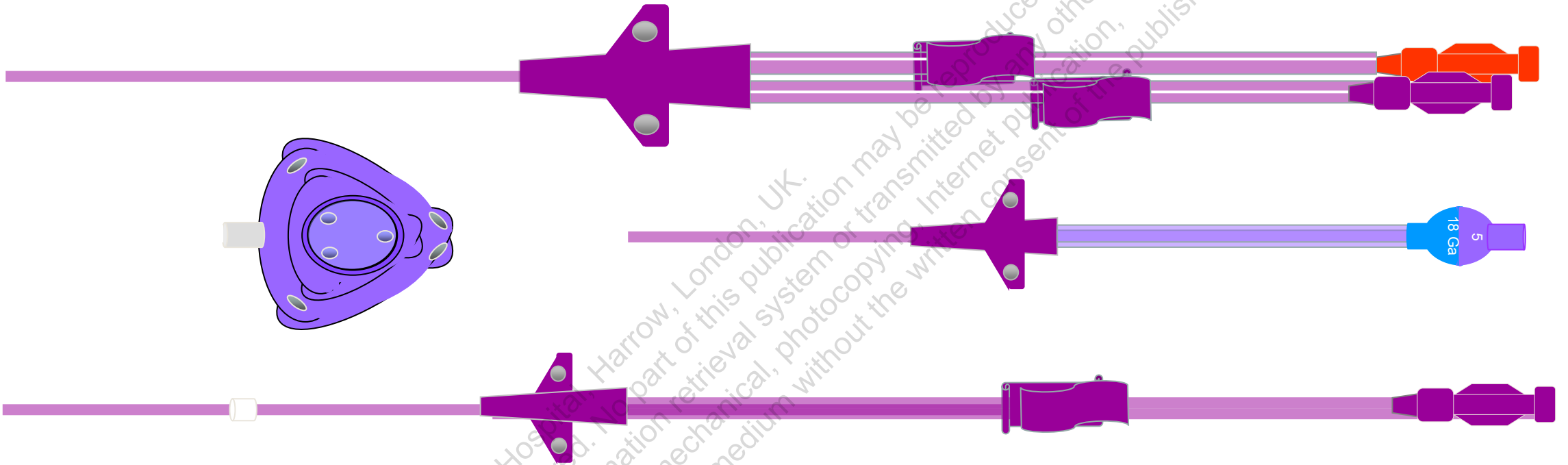
¹Hoffer et al, *JIVR* 2001; **12**(10): 1173-1177 ²Pittiruti et al, *Journal of Vascular Access* 2014; **15**(6): 519-523

³Lamont et al, *PMCID* 2003, **16**(4): 384-387 ⁴Carlo et al, *Am J Surg* 2004;**188**(6):722-727

⁵Pasquale et al, *Surg, Gyne & Obs* 1992; **174**(5): 408-410 ⁶Tolar & Gould, *Supportive Care in Cancer* 1996; **4**(1) 34-38

Haire et al, *Bone Marrow Transplant* 1991; **7**(1): 16-26

Power devices



- Designed to withstand power injection of CT contrast
- Available in midlines, non tunnelled, PICC, valved catheters, tunnelled cuffed, & ports

Power devices: the evidence base

- No increase in complications¹
- Additional use in critical care ²
- Safe in paediatrics³
- Increased risk of wrong route administration⁴
- Increased risk of infection & thrombosis⁵
- Tip malposition common (63%)⁶

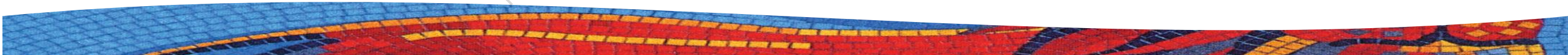
¹ Annetta et al, *Critical Care* 2012; **16**(Suppl 1):209 ²Pittiruti et al, *Critical Care Med* 2012; **16**(2): 425

³Rigsby et al, *AJR* 2007, **188**(3): 726-732 ⁴ www.ismp.org/newsletters/acutecare/articles/20090604-1.asp

⁵Baxi et al, *Infect Contr Hosp Epidemiol* 2013; **34**(8): 16-26 ⁶Lozano et al, *J Comp Assisted Tomography* 2012; **36**(4): 427-430

There's more to device selection
than the CVC...

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Needlefree connectors

- Replaceable 2 way valve added to catheter hub
- Introduced to reduce the incidence of needlestick injuries
- Individual specifications of devices vary
- The extent to which they may, or may not, influence infection & or occlusion yet to be determined

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O'Grady et al, *CDC Guidelines for the Prevention of Intravascular Catheter-Related Infections*, 2011

Loveday et al, *epic3: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections*

in NHS Hospitals in England, 2014



Practice considerations

Factors affecting infection

Connection surface

Dead space

Fluid pathway

Factors affecting occlusion

Amount of fluid displacement

Dead space

Emerging technology

- Anti thrombogenic
 - Endexo™ technology (Bioflo™)
 - Entire catheter surface
 - Resistant to platelets & thrombus
- In vitro testing showed Bioflo™ PICC had 87% less thrombus on surface, based on platelet count, than commonly used devices
- Plans to incorporate into ports but not tunnelled CVC

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AV fistula: a viable alternative?

- Predates use of tunnelled CVC¹
 - Associated with stenosis
 - Attributed to hypertonicity of PN
 - Used in pts with recurrent device related complications
- Dutch case series, n=127²
 - CRBSI lower than long term CVC
 - Occlusion higher
- 1 patient 31 yrs on HPN³
 - 3 fistula, latest for 25 yrs

¹Al-Amin et al, *J Vasc Access* 2013; **14**(2): 99-103

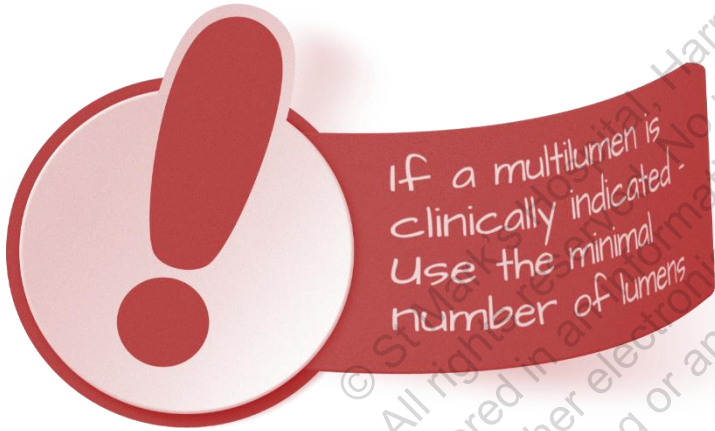
²Versleijen et al, *Gastroenterology* 2009; **136**(5): 1577-1584

³Versleijen et al, *Eur J Clin Nut* 2008; **62**:1254

Are multi-lumen devices associated with more catheter related sepsis?

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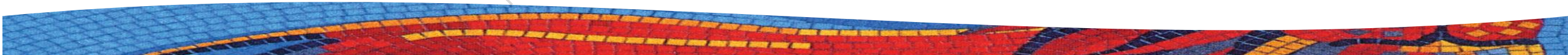
Multilumen vs single lumen



- The number of lumens is an independent risk factor for infection
 - Each lumen increases the risk
 - Each tip
 - Each insertion site
- Single lumen CVC should be used unless additional therapies are required

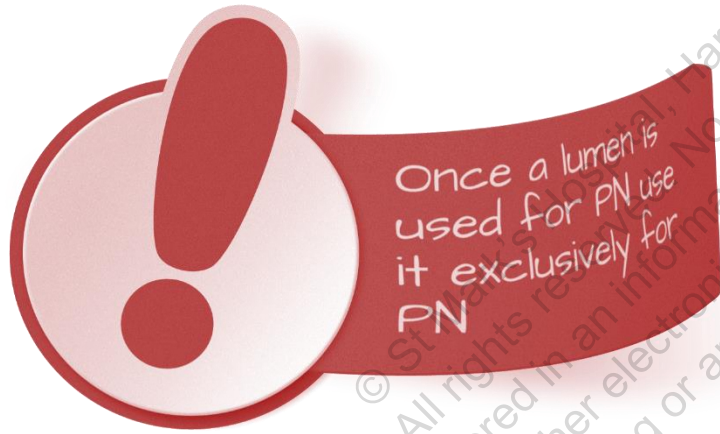
If a multi-lumen CVC is used for PN
which lumen should be used?

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Which lumen for PN?

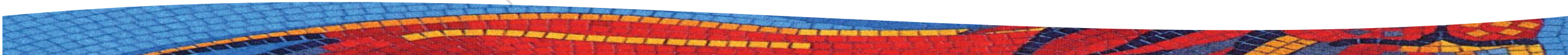
- No formal guidance
- There *may* be a theoretical benefit in choosing the smaller lumen (less catheter surface exposed to the nutrient solution) thereby less CVC colonisation & infection
- Choosing the most distal lumen (exits lowest in the SVC) will reduce risk of thrombosis



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Do anti-microbial CVC reduce the risk of infection?

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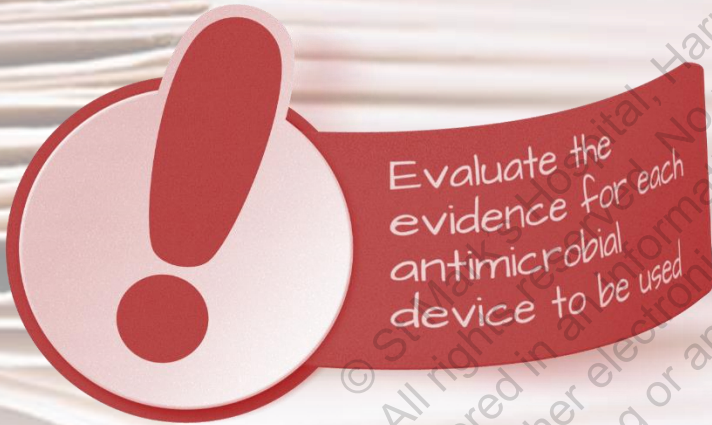


Antimicrobial CVC

- Many different combinations
 - Chlorhexidine-silver sulfadiazine
 - Silver alloy
 - Minocycline-rifampicin
 - Silver iontophoretic & benzalkonium chloride
- Most choice non tunnelled & PICC
- Different modes of action
- Differing length of action

Antimicrobial CVC

- Systematic review & meta-analysis of 34 RCTs
- Antimicrobial CVC should be considered in adult pts, requiring short term catheterization who are at high risk of infection, &/or have restricted venous access/history of catheter related infection, if rates of infection remain high despite strategies to reduce infection



How long should a CVC remain in-situ?



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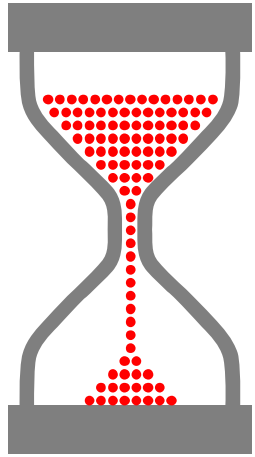


Dwell time of multilumen CVC

- The duration of CVC has been associated with a slight risk of infection in patients receiving PN
 - Risk from insertion site & CVC hub
- The routine replacement of non tunnelled multilumen CVC does not reduce the risk and incidence of infection

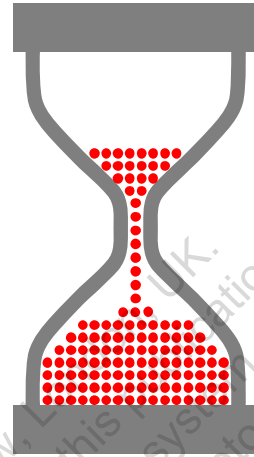


Dwell time of other devices



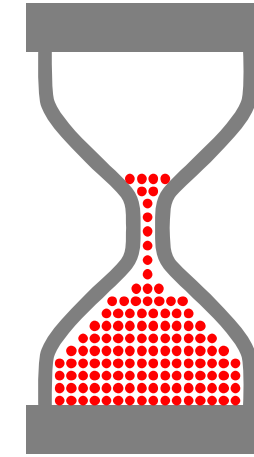
PICC

- Unknown
- Reports of up to 4 years
- Local experience 3 years



Tunneled

- Unknown
- Reports of up to 25 years
- Local experience 14 years
- Routinely replace at 10 years



Port

- Unknown
- Determined by needle & silicone disc size & frequency of use
- Local experience 9 years



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