

Iatrogenic Injuries During Vascular Access: How Safe ?

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so much
vodka
last night,
I woke up
with a
Russian accent.

Swiss Cheese Model

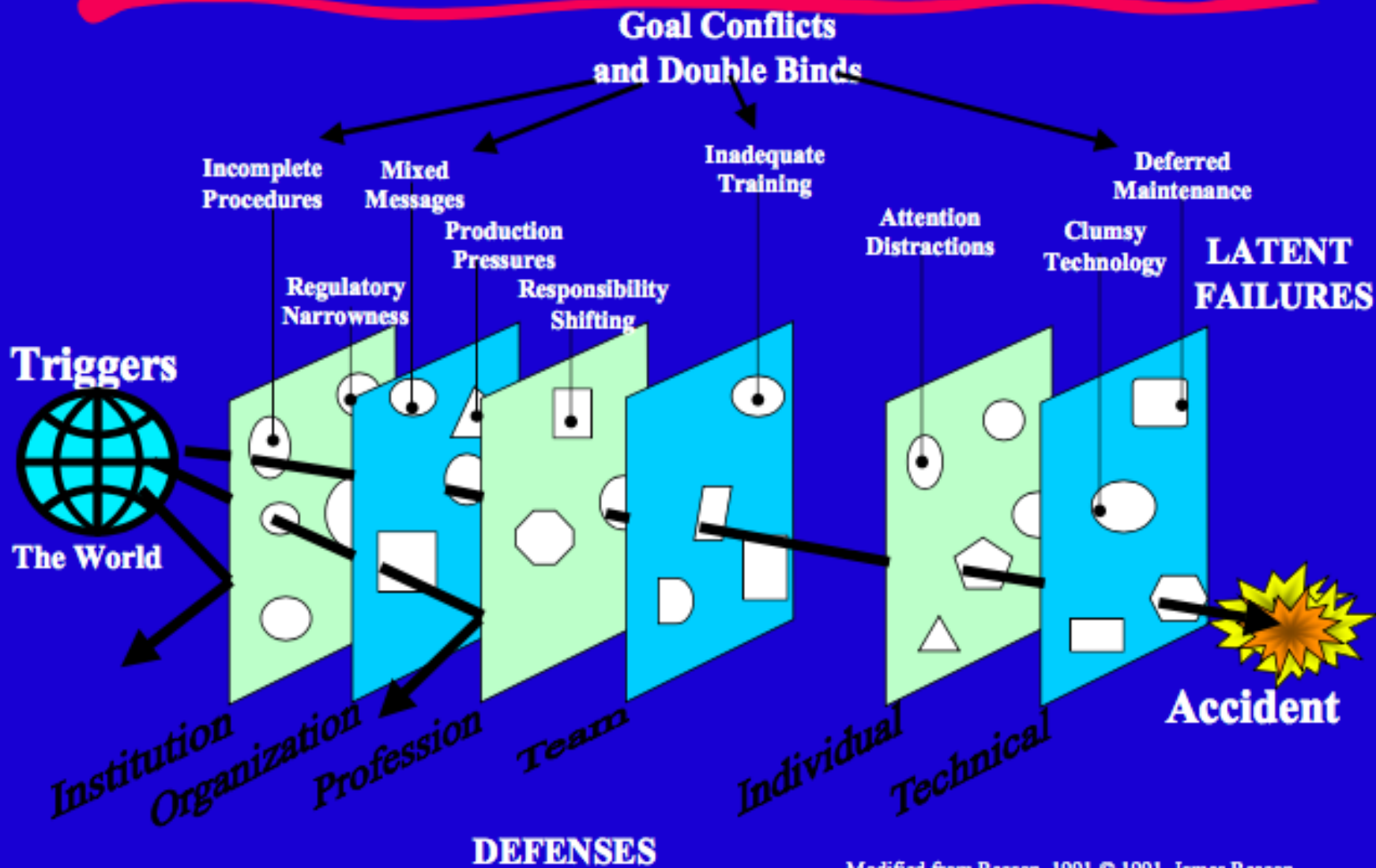


Figure 5.6 The Swiss Cheese Model (modified) of accident causation

NICU SCENARIO

- Boarder line PT admitted for routine care
- Duty Dr starts IVF , by peripheral cannula
- Stable , feeding well but partially , afebrile ,haemodynamically stable


- Day 3rd develops fever , otherwise stable
- Resident sends count , mild leukocytosis
- Informs consultant , starts antibiotic for suspected sepsis

NICU Scenario


- Day 5th fever persist , feeding well ,unit plans for sending septic screen and think of upgrading antibiotic
- Nursing staff says that they are facing problem with infusion pump
- Resident looks at the cannula site and finds redness , swelling
- IS IT SEPSIS ???
- OR THROMBOPHELEBITIS OVERLOOKED

What is a Vascular access procedure ?

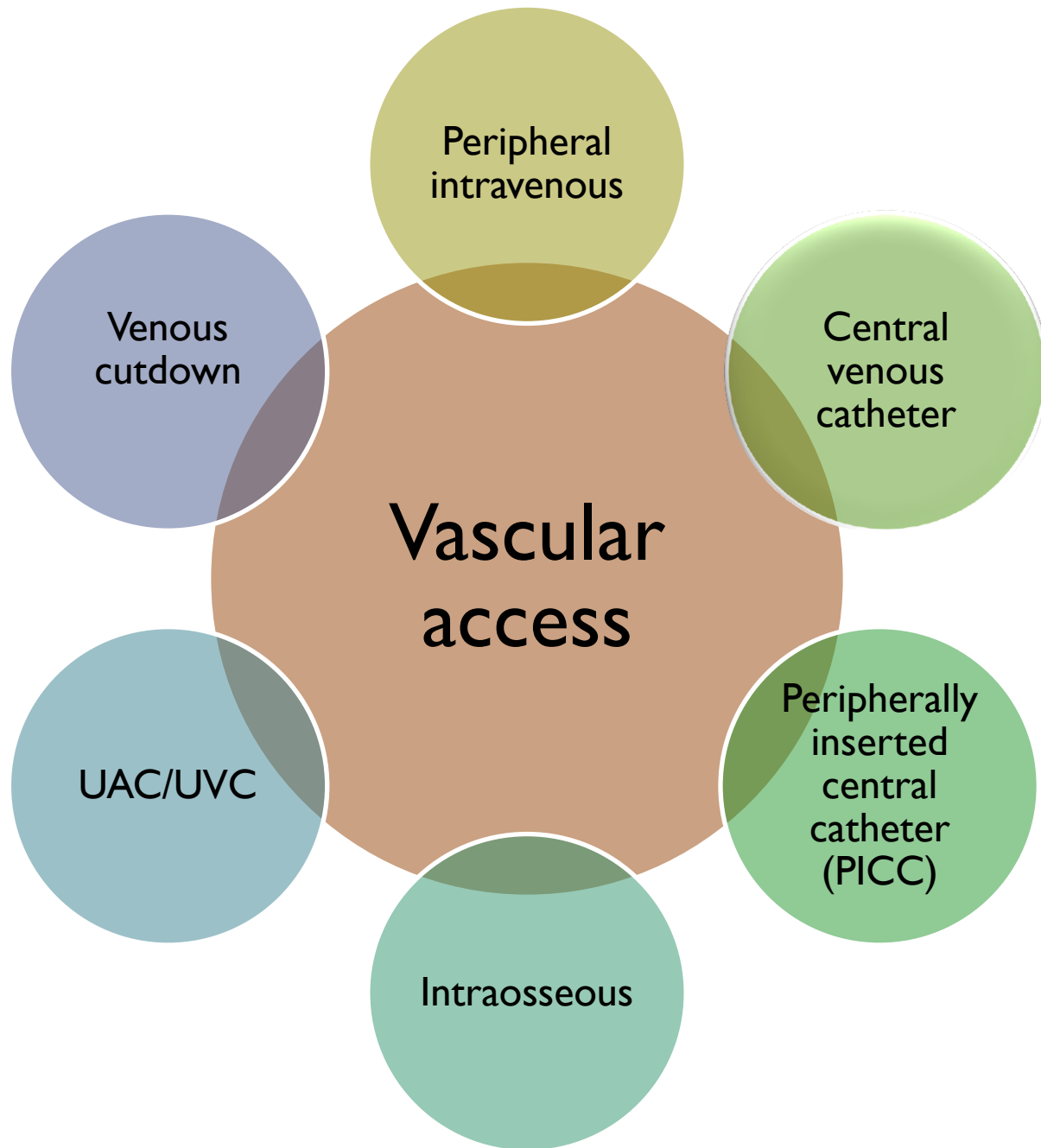
A vascular access procedure inserts a flexible, sterile plastic tube called a catheter into a blood vessel to allow blood to be drawn from or medication to be delivered to a patient's bloodstream over an extended period.



They may be used for intravenous (IV) antibiotic treatment, chemotherapy, long-term IV feeding and blood transfusions.



Vascular access spares patients the stress of repeated needle sticks and provides a painless way to draw blood or deliver medication.



Peripheral
intravenous

Venous
cutdown

Central
venous
catheter

Vascular
access

Peripherally
inserted
central
catheter
(PICC)

Intraosseous

UAC/UVC

Complications

More than 15% of all central lines have a complication

1. Mechanical 5-19%
2. Infectious 5-26%
3. Thrombotic 2-26%

Complications of vascular access)



IMMEDIATE

1. VASCULAR
2. CARDIAC
3. PULMONARY
4. PLACEMENT



DELAYED

1. DEVICE DYSFUNCTION
2. DEVICE INFECTION

SIGNIFICANCE

1. More than 5 million catheters are inserted in US alone
2. Many mediclaim companies do not reimburse for catheter related preventable complications.
3. This unnecessarily increases the cost of treatment hospital stay and increases morbidity.

A. IMMEDIATE COMPLICATIONS

Table 2. Frequency of Mechanical Complications, According to the Route of Catheterization.*

Complication	Frequency		
	Internal Jugular	Subclavian <i>percent</i>	Femoral
Arterial puncture	6.3–9.4	3.1–4.9	9.0–15.0
Hematoma	<0.1–2.2	1.2–2.1	3.8–4.4
Hemothorax	NA	0.4–0.6	NA
Pneumothorax	<0.1–0.2	1.5–3.1	NA
Total	6.3–11.8	6.2–10.7	12.8–19.4

Mechanical Injuries

Most common complications:

Type of complication	Number (/110)
Wire/catheter embolus	20
Cardiac tamponade	16
Carotid artery Cannulation/puncture	16
hemothorax	15
pneumothorax	14
Misc. (PA rupture, vessel injury, air embolism etc)	29

The Left Side is Sinister

Left internal jugular has unique complications

– thoracic duct injury

Left innominate vein can be lacerated →

hemothorax and → OR

VASCULAR COMPLICATIONS

I. Operator experience greatly influence them

Other Risk Factors

- Number of needle passes, with the incidents increasing with 2 punctures to a six fold increase with three or more.
- BMI greater than 30 and less than 20
- Previous catheterization
- Severe dehydration
- Hypovolemia
- Larger Catheter Size
- Overall rates of unsuccessful insertion for –
 - IJV 12 %
 - SCV 12 to 20%

VASCULAR COMPLICATIONS -Contd...

- Abnormal vessel anatomy
- Existing central venous devices, IVC filters, existing sutures increasing the risk
- Catheter angle greater than 40 degree against a vessel increases the risk
- Arterial puncture occur in 4.2% to 9.3%, more common in femoral artery and least in subclavian

PULMONARY COMPLICATIONS

PNEUMOTHORAX

1. Commonest complications of CVC insertion
2. Incidents varies between 0.6 to 6.6 %
3. Delayed pneumothorax 0.5 to 4 %
4. Highest incidents for SCV canulation

OTHER COMPLICATIONS –

- Pneumediastinum
- Chylothorax- upto 25%
- Injury to recurrent laryngeal nerve
- Airaembolus

CARDIAC COMPLICATIONS

A. ARRYTHMIA

- Due to guidewire contact,

- Atrium- premature atrial & ventricular contraction,
incidents reaching 75% as the wire is between 25 &
32 cm from IJV entry site

- AV Node- SVT

- Ventricular ectopy- 25 %

B. CARDIAC ARREST

CARDIAC COMPLICATIONS -Contd...

PULMONARY ARTERY CATHETER

- Dysrhythmias-72 %
- ventricular ectopy- 65 to 68 %
- Persistent PVC - 3 %
- Ventricular tachycardia- 1.5 %

NEUROLOGICAL COMPLICATIONS

1. CVA-
2. Brachial plexus injury-1.7%
3. Horner syndrome- 2%

B. DELAYED COPLICATIONS

I. DEVICE DYSFUNCTION

1. FIBRIN SHEATH-

- Usually within one week
- Can occlude distal opening
- Alteplase can be used or catheter should be removed

2. CATHETER FRACTURE

- Common in subclavian vein
- PINCH OF SYNDROME- Subclavius –costoclavicular complex compression

B. DELAYED COPLICATIONS- Contd...

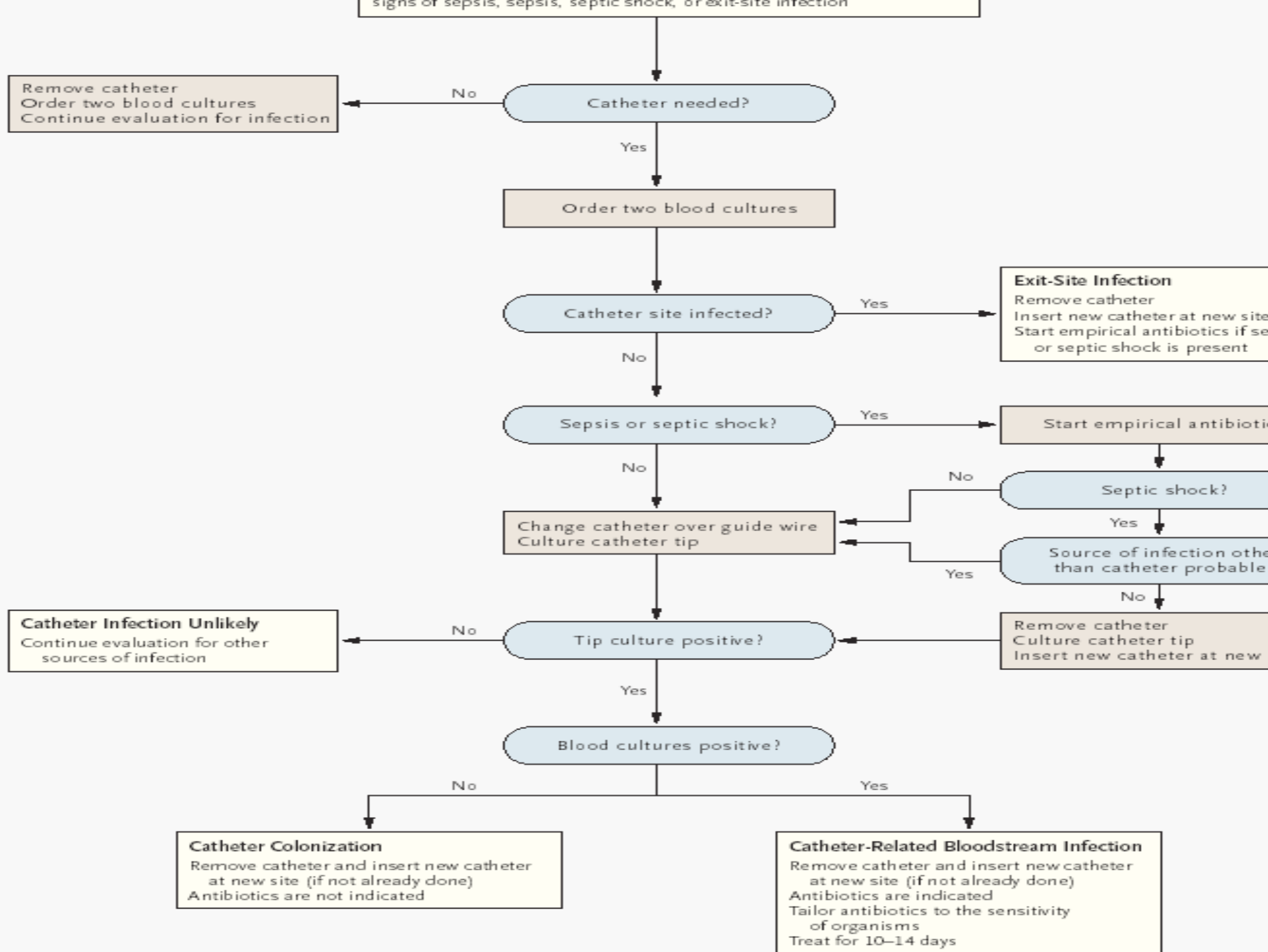
- Fracture can occur during removal
- In growth of vascular endothelium around catheter causes blockade
- Other delayed complications are venous thrombosis which is highest in femoral
- Cancer patient have highest risk of catheter thrombosis

INFECTION

- Serious delayed complication
 - Incidents of 80 -189/lac patient years
 - Approximate mortality 0 to 35 % within average of 18 %
 - Femoral catheter have highest risk
 - In new born almost all catheter carry the same risk
 - Contaminations come from-
 - Skin
 - Infused Substance
 - Haematogenous Spread
- Non Cuffed, Multiple lumen catheters have highest rate

INFECTION- Contd...

- Preferably use upper limb
- Follow central line bundle
- Preferably use a PICC
- If catheter placed during CPR or emergency situation then always have a high degree of suspicion
- Use of antibiotic impregnated catheters is still debatable



EXTRACTTION COMPLICATIONS

-Air embolism-

- 0.13 % to .05 %

- 100 ml of air can pass through a 14 G needle in one second

- Can cause CVA

-Separation from the Hub

-Knotting of catheter or guide wire

PICC COMPLICATIONS

- Most preferred in neonates and even adults
- Recent studies show that complications rate are same as that of any other catheters

PREVENTION POLICIES

Mechanical

Recognize risk factors for difficult catheterization

A history of failed catheterization attempts or the need for catheterization at sites of prior surgery, skeletal deformity, or scarring suggests that catheterization may be difficult⁸

Seek assistance from an experienced clinician

Insertion by a physician who has performed ≥ 50 catheterizations is half as likely to result in a mechanical complication as insertion of a catheter by a physician who has performed < 50 catheterizations⁶

Avoid femoral venous catheterization

The frequency of mechanical complications with femoral catheterization is higher than with subclavian or internal jugular catheterization^{5,6,8,22-24}; the rates of serious complications are similar with the femoral and subclavian approaches⁵

Use ultrasound guidance during internal jugular catheterization

The use of ultrasound guidance during internal jugular catheterization reduces the time required for insertion and reduces the rates of unsuccessful catheterization, carotid-artery puncture, and hematoma formation^{25,26}

Do not schedule routine catheter changes

Scheduled, routine replacement of catheters at new sites increases the risk of mechanical complications^{19,27}

Ultrasound!

Prevention is always better than treatment

Use ultrasound probe to localize vessel

Cannulate vessel under direct vision

Ultrasonographic Guidance: Dynamic vs. Static

Dynamic

1. Consists of ultrasonic localization, and image-guided cannulation
2. More precise and “real time”
3. Difficult to keep sterility of transducer and site.
4. More hand to screen coordination, unless two persons involved

Static

1. Consists of ultrasonic localization and marking of landmarks only
2. Cannulation is not image-guided, but is separate
3. Time delay between marking and cannulation
4. Easy to keep sterility of transducer and site
5. Less demanding technically

FUTURE DIRECTIONS

1. STICK TO A POLICY OF DO NO HARM
2. LIKE AVIATION INDUSTRY MAKE, INTERNATIONAL COMMUNITY SHOULD SIT TOGETHER & PREPARE PROTOCOLS FOR SAFE VASCULAR ACCESS WHICH NEEDS TO BE FOLLOWED WHEREVER CENTRAL ACCESS IS USED
3. USE OF ULTRASOUND SHOULD BE ENCOURAGED FOR CENTRAL ACCESS

MERCI