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Spital Wallis

Managing drug incompatibilities associated with IV administration

***How can I deal with it
in my ICU on Monday ?***

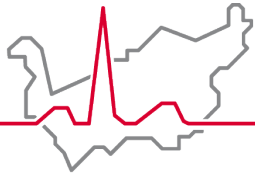


Dr Lucien Roulet, PhD
Clinical pharmacist

Muriel Joris-Frasseren
Head nurse of ICU

ICU Sion

SGI/GSASA Congress – September 15th, 2017 – St Gallen



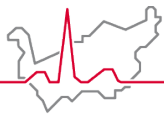
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Conflict of interest : none

Acknowledgement :

- Dr Emmanuel Benoit, PHNVB
- Clare Bechet, PHNVB

PCI = physical-chemical incompatibilities



Are PCI an issue in ICUs ? (1/3)

SCARCE DATA ON THIS TOPIC

Frequency

- Detected PCI = **18%** of all ME / of which life-threatening PCI = **26%**

Tissot E, et al. Intensive Care Med. 1999;25(4):353-9

- ME during preparation : PCI = minor issue
- ME during **administration** : **PCI = major issue in 8,6%**

Taxis K, et al. Eur J Clin Pharmacol. 2004;59(11):815-7

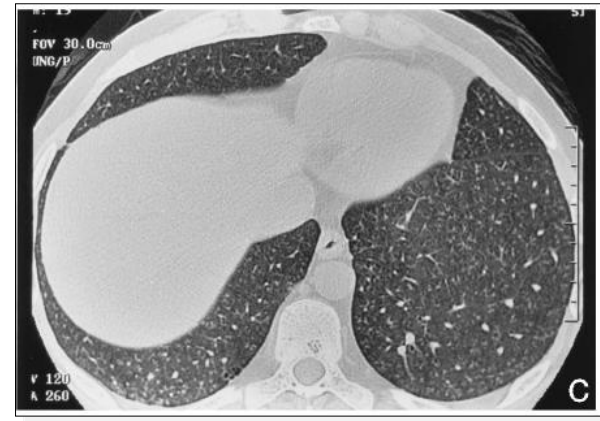
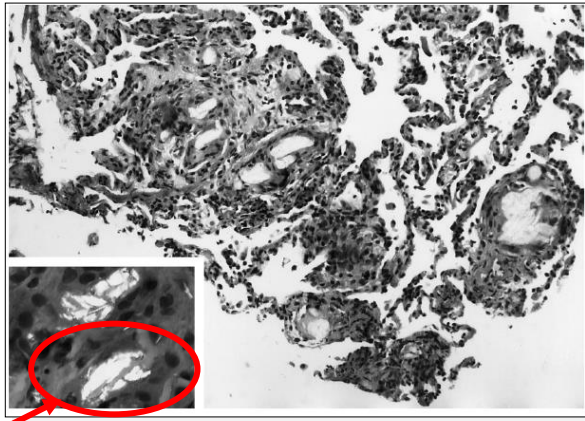
Clinical consequences

- Occlusion of venous catheter / thromboembolic event
- Loss of efficacy ⇔ active fraction = unbound fraction
- Toxic metabolites

Are PCI an issue in ICUs ? (2/3)

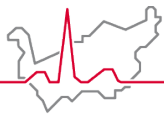
CLINICAL EVIDENCE = LOW (CASE REPORTS)

Ex : phosphate + calcium-containing solutions (incl. parenteralia)



Microvascular Pulmonary Emboli Secondary to Precipitated Crystals in a Patient
Receiving Total Parenteral Nutrition

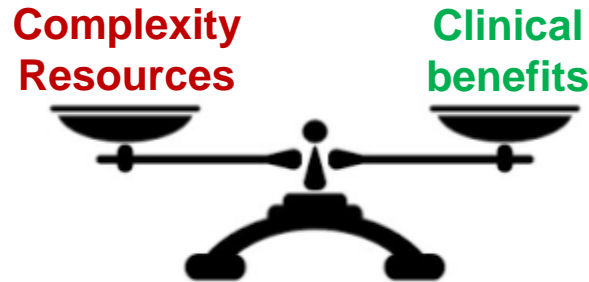
Jeremiah S. et al. CHEST 1999; 115:892-5



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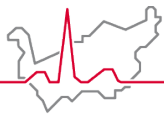
Are PCI an issue in ICUs ? (3/3)

- The relevance of managing PCI remains questionable :



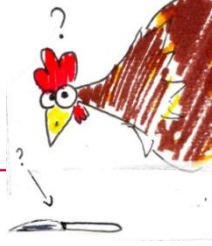
- Our approach :
 - literature data ⇔ a real issue
 - pragmatism ⇔ limited resources
- Need for a focus on patients
 - at highest risk of PCI ⇔ multiple IV infusions
 - with the greatest vulnerability to potential consequences of PCI

Focus on PCI in ICU patients

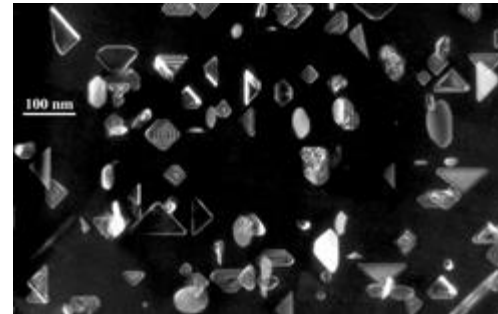
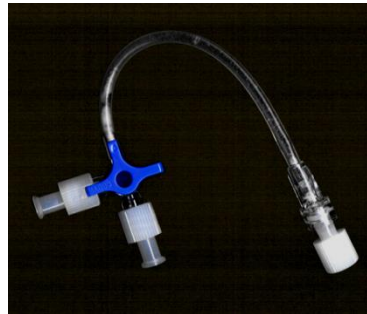


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What are PCI ?



- Unwanted reactions between 2 or more **drugs** → lead generally to a precipitate that is **visible** OR **invisible** to the naked eye



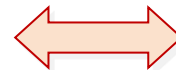
BUT it also depends on :

- the **concentration** of each drug
- the respective drug and **diluent** compatibility



Furosemide in glucose 5%

Furosemide : pH = 9



Glucose 5% pH = 3,5 - 6,5 ✗

NaCl 0,9% pH = 4,5 - 7 ✓



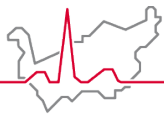
hospital pharmacy

 **THOMAS LAND**
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[illegible]

- frequency and burden of up-dating
- reading errors



How to format data on PCI ? (2/3)

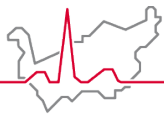


Based on drug pH

- Concept : no association between acid and basic drugs
- Advantages :
 - easy to document / little updating required
 - easy to use
- Limitations :
 - only takes into account 1 of the mechanisms of PCI
 - generally not based on real tests (theoretical approach)

Based on physical-chemical tests

- Concept : use literature data / specialized databases (Trissel™, King IV™), based on real tests
- Possibility to nuance the answer = yes or no, but also «it depends»
 - concentration of each drug
 - discrepant data (grey area)



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How to format data on PCI ? (3/3)



Online interfaces / apps :

 **Micromedex® 2.0**

IV Compatibility

Use the IV Compatibility tool to pinpoint potentially dangerous IV drug combinations.



[My Account](#) | [View Cart](#) | [A](#)

PRODUCTS

INSTITUTIONS

SOLUTIONS

INTEGRATION



RE

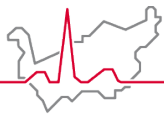
IV Compatibility Tool

Available online and in our mobile software packages, this tool helps you avoid adverse events encountered in dispensing IV preparations, and maximize productivity in IV administration. Quickly check the compatibility of specific drugs.

You have exceeded the maximum number of selected drugs (2) and can not add any more.

Limitations :

- Do not assume any risks thus make unrealistic and irrelevant proposals (« please add 4 central venous lines »)
- Foreigner software companies (USA+++)
↔ missing data on EU/CH drugs (ex : morphine sulfate  vs morphine HCl )



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How to format data on PCI ? (3/3)



Search for another drug to view drug/drug compatibility with MORPHINE HYDROCHLORIDE.

MORPHINE HYDROCHLORIDE ✕

Y-SITE Click to view drugs...	11 Drugs
SYRINGE Click to view drugs...	9 Drugs
ADMIXTURE Click to view drugs...	7 Drugs

Search for another drug to view drug/drug compatibility with MORPHINE SULFATE.



MORPHINE SULFATE ✕

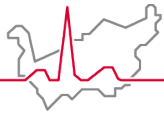
Y-SITE Click to view drugs...	183 Drugs
SYRINGE Click to view drugs...	86 Drugs
ADMIXTURE Click to view drugs...	115 Drugs

X 16

King™ Guide

Limitations :

- Do not assume any risks thus make unrealistic and irrelevant proposals (« please add 4 central venous lines »)
- Foreigner software companies (USA+++)
↔ missing data on EU/CH drugs (ex : morphine sulfate  vs morphine HCl )



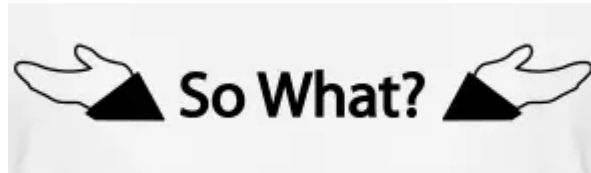
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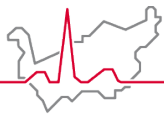
And now ?...

A real issue, especially in ICUs

Presentation of the concepts → table

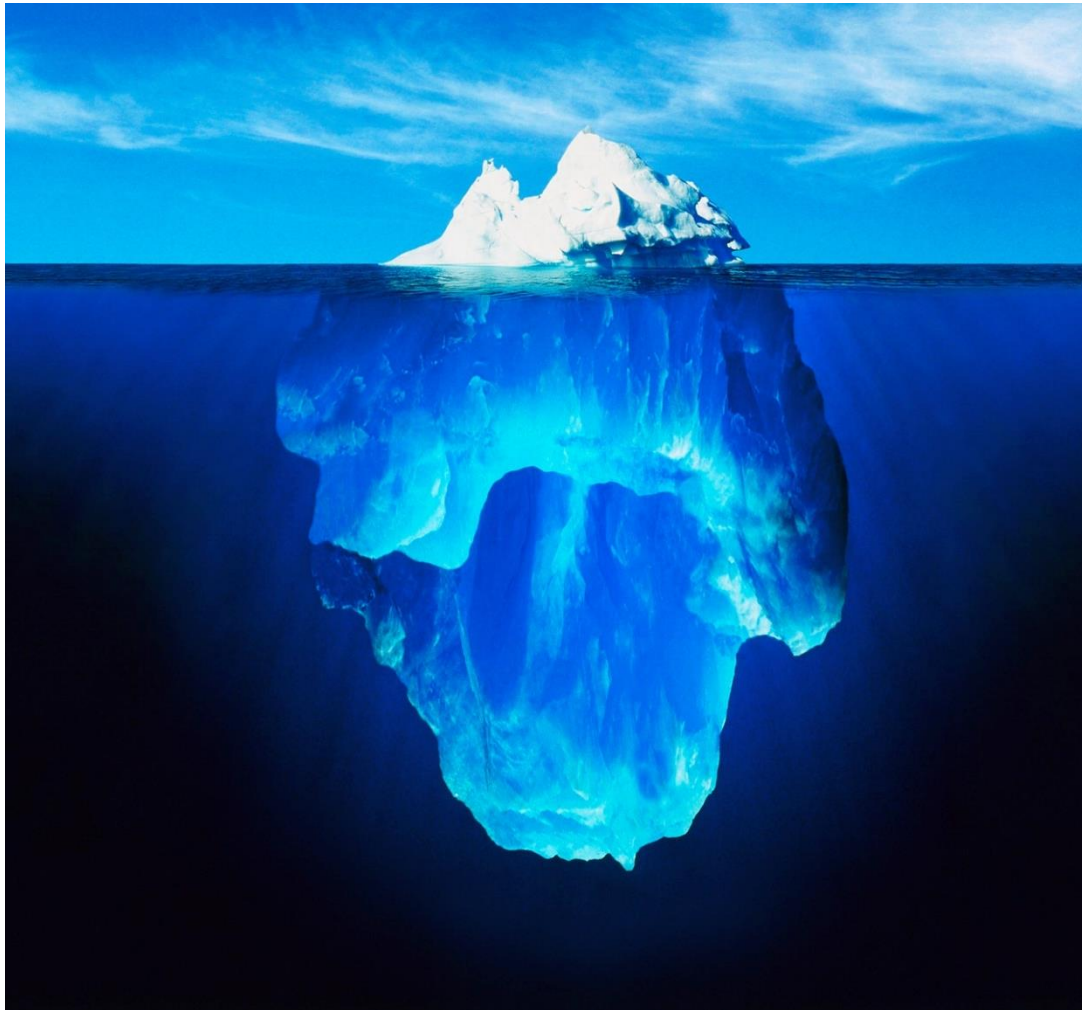
But how should you deal with PCI in your ICU on Monday ?





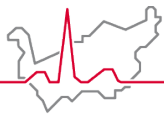
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A table is not enough (1/4)



Table

**PCI
MANAGEMENT**



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A table is not enough (2/4)

PCI table...



...without training



A table is not enough (3/4)



2005 - *Introduction of PCI table in ICU (V1)*

KALIUM CHLORID	OK	EVITER	EVITER	OK	n.d.	OK	n.d.	OK	OK	OK	OK	OK	EVITER	OK	OK	OK	OK	OK
----------------	----	--------	--------	----	------	----	------	----	----	----	----	----	--------	----	----	----	----	----

[1 information fitted all concentrations of KCl]



2012 - *Introduction of drug concentrations in PCI table (V4)*

KALIUM CHLORID [MAX. 0.04mmol/l]	OK	EVITER	EVITER	OK	n.d.	OK	n.d.	OK	OK	OK	OK	OK	EVITER	OK	OK	OK	OK	OK
KALIUM CHLORID [2mmol/l]	EVITER	EVITER	EVITER	EVITER	n.d.	EVITER	n.d.	OK	OK	EVITER	EVITER	EVITER	EVITER	EVITER	EVITER	EVITER	EVITER	EVITER

[2 different information depending on the concentration of KCl]

ICU team suddenly felt insecure

**Conclusion : the pharmacy underestimated++
the impact of this change**

A table is not enough (4/4)

A table is just **1 piece** in the puzzle



Several issues should be addressed in addition to

(and ideally **BEFORE**) the table implementation

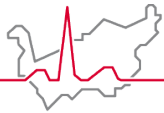
1. Endorsement of ICU physicians



STARTING

ICU physicians are essential stakeholders in the process :

- PCI management \Leftrightarrow need for **supplementary** central venous lines (**24hours/7days**)
- Optimisation of CVC availability \Leftrightarrow **switch IV** \rightarrow **PO** (nursing staff's role)

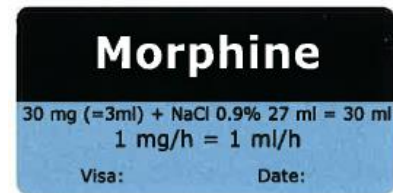


2. Standardisation of drug dilutions

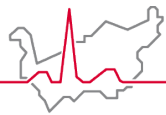
- As often as possible : **1 drug** ⇔ **1 dilution**
- Look for the **best compromise** between
 - need for concentration ⇔ minimisation of fluid intake
 - need for dilution ⇔ optimisation of compatibility between drugs and minimisation of grey areas
 - need for easy calculation
 - example : amiodarone 6mg/ml (*vs 12,5mg/ml in other ICUs*)
- Supplementary benefit : **better security** while preparing infusions



STARTING



Nemec K, et al. *Am J Health Syst Pharm.* 2008;65(17):1648-54
Kane-Gill SL, et al. *Crit Care Med.* 2017;45(9):e877-e915

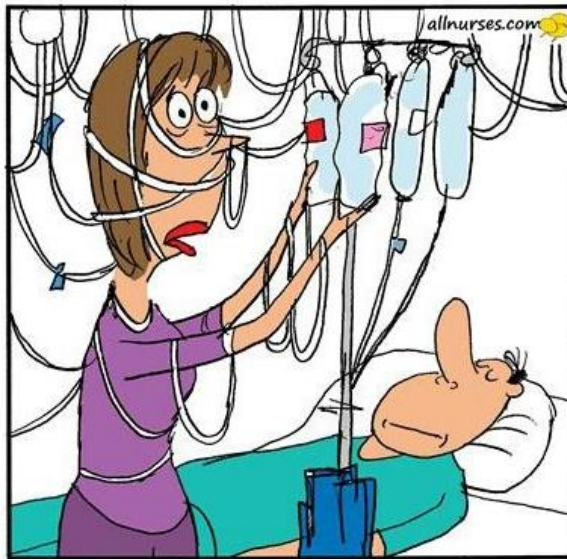


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3. Team training (1/3)

Not an option ⇔ **complexity +++**

About a Nurse



“Help.”

AFTER



STARTING

3. Team training (2/3)

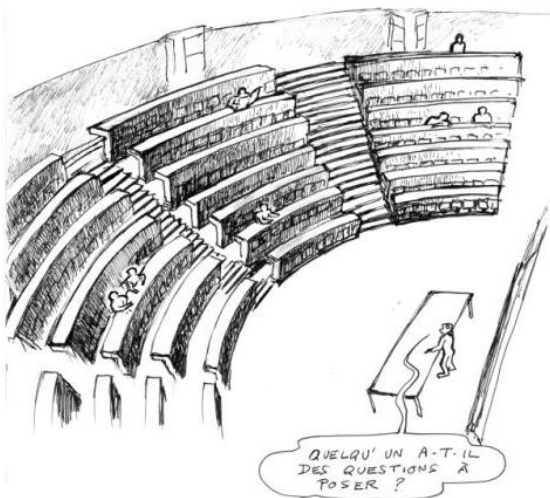
3a. Initial training



« Lecture course »

VS

« On-the-job » training



Based on real patients in the ICU

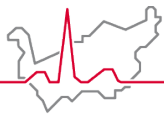
**The best way to convince of the feasibility,
within a reasonable time frame (5 min)**

3. Team training (3/3)

3b. Continuing training

- Take every opportunity to **reinforce the message** :
 - **proactively** when the pharmacist is physically present in the unit
 - **on-demand** intervention
- Why is it essential ?
 - knowledge **reminder**
 - prevention/detection of **practice drifts**
 - **constant turnover** of the team





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What are the key barriers ? (1/2)

For ICU physicians

- Accept and promote **changes in practice**

Endorsement of the medical direction

For ICU nurses

- Complex and time-consuming if data **interpretation** is required

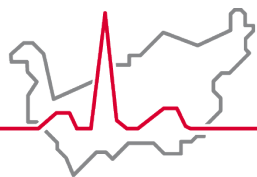
**The more drug dilutions are standardised,
the less interpretation is required**

What are the key barriers ? (2/2)

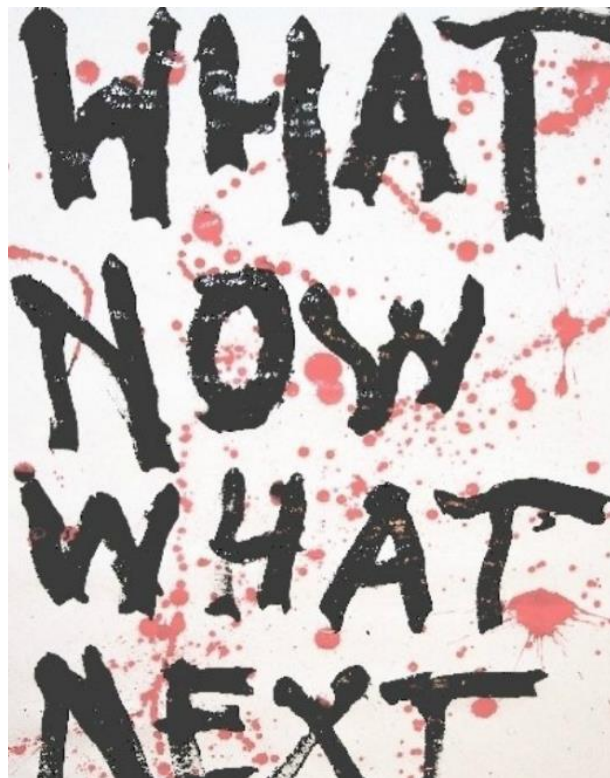
For ICU pharmacists

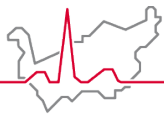
- Challenge = **physical presence** in the unit
 - to arouse/answer **questions**
 - to **check** how IV lines are associated and make some proposals if necessary

Workaround solution : well-trained clinical nurse in the unit, with back-up support of the pharmacy



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Interactions with up-/downstream units

Emergency
department

Anesthesia
Operating rooms

INTENSIVE CARE UNIT

Continuing care unit

Transfert in
another unit



Stimulate the use of **standard ICU dilutions** in up-/downstream units

⇔ prevent redundant preparation
of infusions :

- infectious risk minimization
- cost minimization

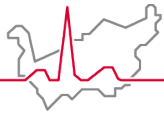
(example of a good starter : heparin)

The struggle for lumens (1/3)



- Alert anesthesists to the need for **more lumens** in CVC :
 - motivation : the less lumens, the less infections
 - BUT 1 or 2-lumen CVC = insufficient in most cases (especially in patients with TPN)
- Over the short term (7-10 days), infection risk seems to be associated with hygiene at the insertion point of CVC (and thus independent from the number of lumens)

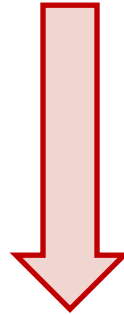
Cicalini S, et al. Critical Care 2004;8(3):157-62
Zürcher M, et al. Anesth Analg. 2004;99(1):177-82
Pawar M, et al. J Cardiothorac Vasc Anesth. 2004;18(3):304-8
Templeton A, et al. Infection. 2008;36(4):322-7



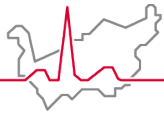
The struggle for lumens (2/3)



- Over medium to long term (> 7 days) : increase in infectious risk with the number of lumens (CVC colonization)



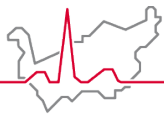
**It is our responsibility to promote a de-escalation
in the number of «open» lumens**



The struggle for lumens (3/3)

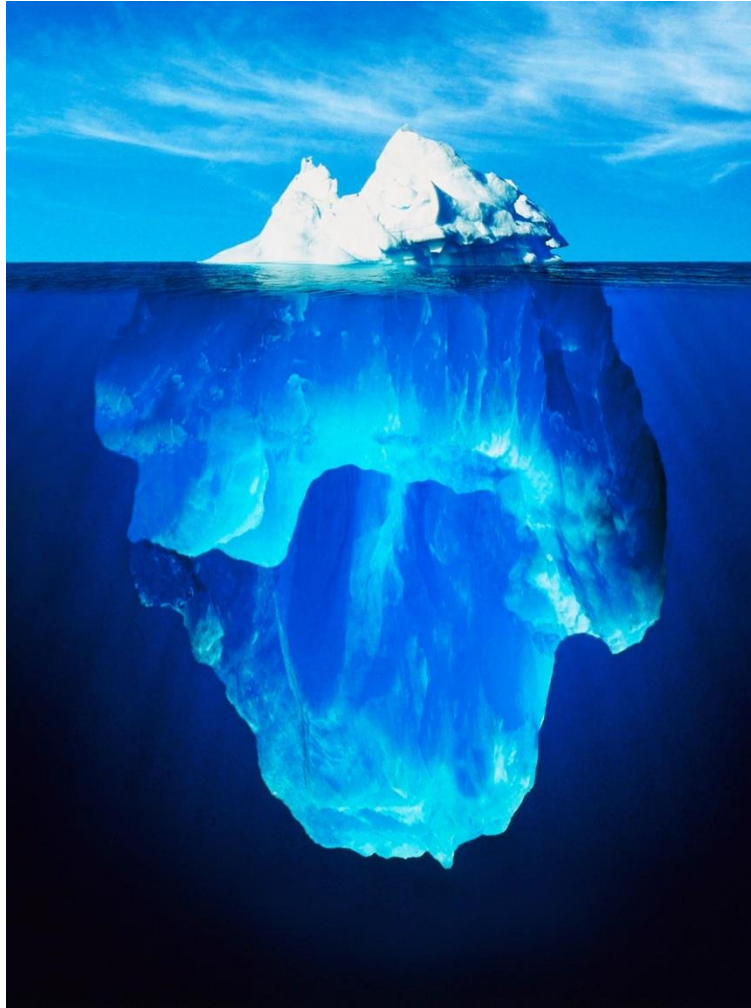
Complementary approaches :

- Promote the use of **peripheral venous catheters**
 - much safer alternative to transcatheterization
 - reluctance of nursing staff = generally unfounded
- **Free some CVC lumens** ⇔ sequential administration of intermittent infusions (PPI, antibiotics, antiemetics...)
 - use of the emergency line
 - temporary interruption of a non-critical infusion line (heparin, furosemide...) – flush between drugs with appropriate diluent



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Take home message

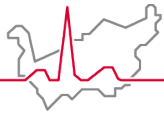


Table

+

**PCI
MANAGEMENT**

- Endorsement of ICU physicians
- Standardisation of drug dilutions
- Team training with «daily» user support and physical presence



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Your battle plan for Monday...



- STEP 1** Work in ICU to address the issue of PCI, with
the involvement of both nursing and medical staffs

- STEP 2** Cooperate with upstream and downstream partners

- STEP 3** Find a balance between complexity and overquality, between
what should be done and can realistically be done

Discussion

- **PCI table :**



- **What about the topic of PCI during the post-grade formation of :**
 - ICU nurses ?
 - ICU physicians ?
 - clinical pharmacists ?