De l'épargne transfusionnelle au Patient Blood Management

Pr Sigismond LASOCKI

Département Anesthésie-Réanimation
Pole ASUR
CHU Angers
UMR CNRS 6214 – INSERM 771
Université d'Angers

RASA 2023 - Biarritz

Conflits d'intérêts

- J'ai, et/ou mon institution, avons reçu des subventions des laboratoires:
  - *Vifor Pharma*
  - *PHARMACOSMOS*
  - *Pfizer*
  - *SANOFI*

- Public grants (from French ministry of Health)
  - PHRC 2015: HiFIT study
  - PHRC 2019: MiVAR Study

Objectif Zero Transfusion

D'où vient-on?

1991

Nous sommes responsables…
… pas coupables !?

Le risque infectieux n'est pas le seul !

TRALI

TACO

Poumon

Muszynski *Transfusion* 2017

infections nosocomiales

Rohde *JAMA* 2014

TRIM

Cancer

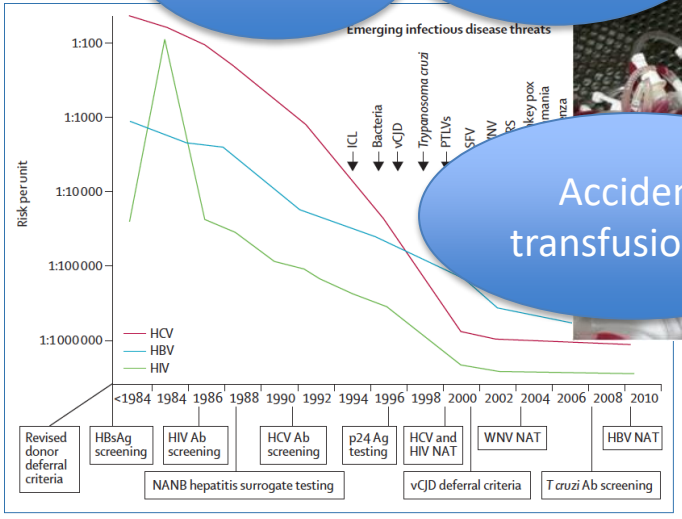
Cata *BJA* 2013

Atzil *Anesthesiology* 2008

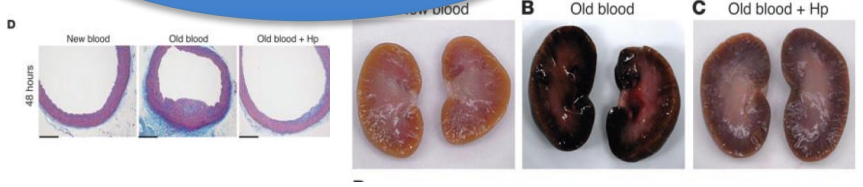
Accident transfusionnel

Lésions du « storage »

Baeck *JCI* 2012



Goodnough *Lancet* 2013



Anémie pré-op FDR indépendant de mortalité

- Registre américain (200 hôpitaux)
- 227.425 patients opérés de chir majeure en 2008
- Augmentation toutes les complications
- Indépendant transfusion

30% d'Anémie

	No anaemia (n=158 196)	Mild anaemia (n=57 870)	Moderate-to-severe anaemia (n=11 359)	Any anaemia (n=69 229)
Mortality		*84%*	*16%*	
n	1240 (0·78%)	2037 (3·52%)	1155 (10·17%)	3192 (4·61%)
$OR_{unadjusted}$	Reference	4·62 (4·30–4·96)	14·33 (13·19–15·56)	6·12 (5·73–6·54)
OR_{adj-1}	Reference	1·67 (1·54–1·80)	2·40 (2·18–2·65)	1·83 (1·70–1·97)
OR_{adj-2}	Reference	1·41 (1·30–1·53)	1·44 (1·29–1·60)	1·42 (1·31–1·54)

Musallam *Lancet* 2011

Rôle aggravant anémie + FDR

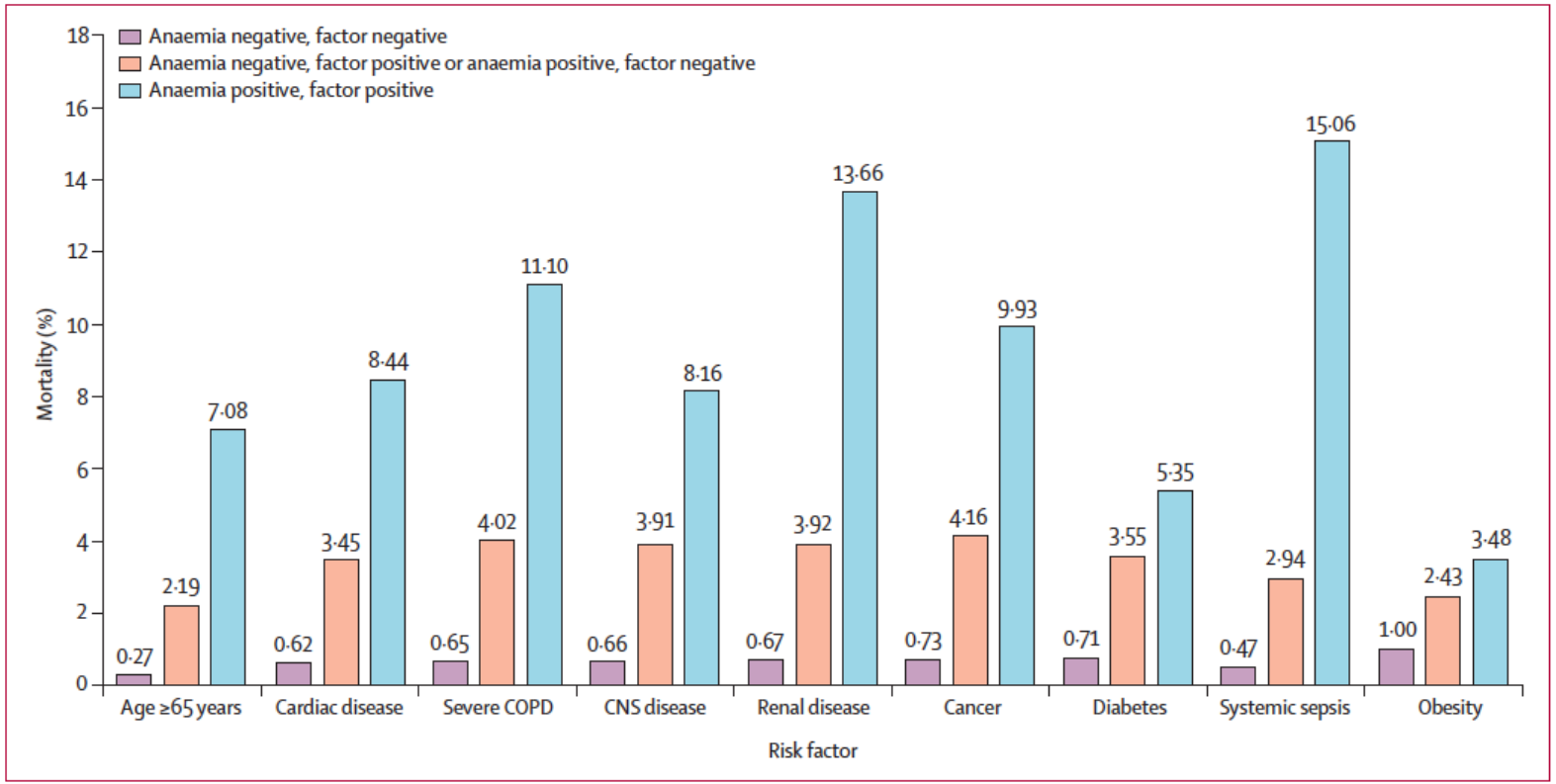
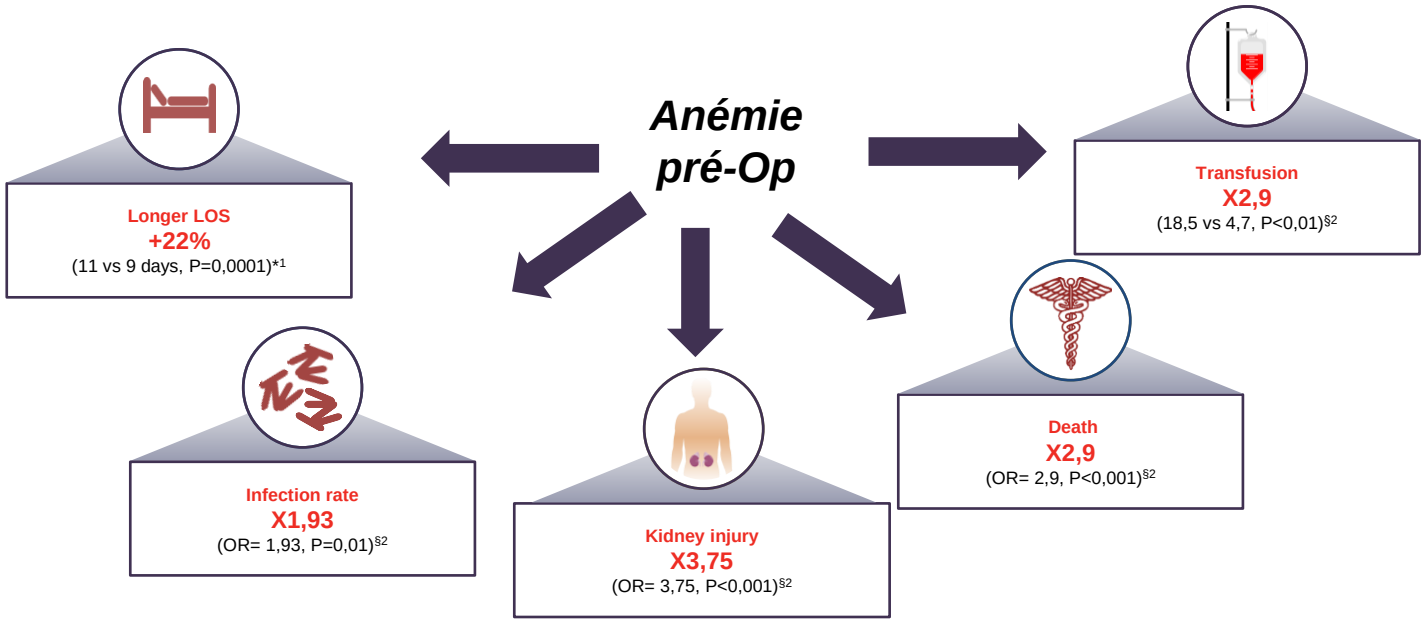


Figure 1: **30-day mortality, by anaemia and risk factor status**

Musallam *Lancet* 2011

L'anémie pré-op est associée à de la morbi-mortalité



1. Beattie WS et al. Anesthesiology. 2009;110(3):574–81
2. Fowler AJ et al. Br J Surg. 2015;102(11):1314–24
3. Musallam KM et al. Lancet. 2011;378:1396–1407

L'anémie pré-op est associée à la transfusion

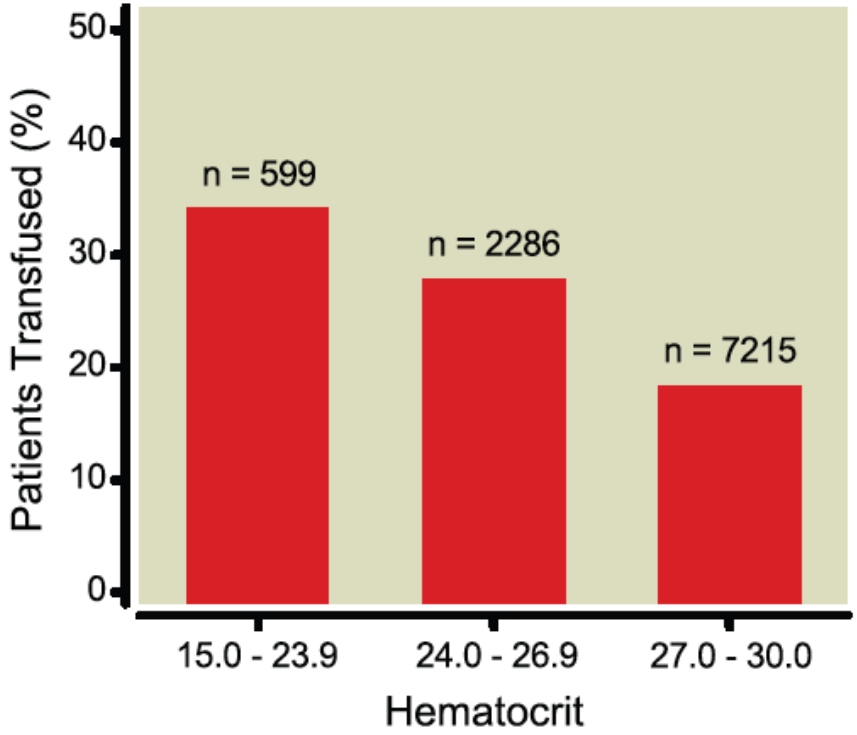


Fig. 1. Proportion of patients receiving one or two units of erythrocytes intraoperatively *versus* baseline hematocrit.

- n=10.100 pts, non-cardiac elective surgeries
- 21% received 1 or 2 unit intra-op
- Excluding emergent cases and intra-operative hemorrhage

Glance *Anesthesiology* 2011

La transfusion est également un FDR de morbi-mortalité

n=10.000 chirurgies majeures non cardiaques
Transfusion 1-2 CG en dehors de l'hémorragie

Table 3. Impact of Intraoperative Transfusion on 30-Day Mortality and 30-Day Complications

Outcome	Transfusion Group, Outcome Rate (%)	No Transfusion Group, Outcome Rate (%)	Unadj OR Txf *vs.* No Txf (95% CI)	Adj OR Txf *vs.* No Txf (95% CI)	Adj OR Txf *vs.* No Txf (PS Method) (95% CI)
Mortality	6.44	4.26	1.55 (1.24, 1.90)	1.29 (1.03, 1.62)	1.21 (0.96, 1.52)
Cardiac complications	2.08	1.40	1.50 (1.06, 2.12)	1.40 (0.97, 2.03)	1.31 (0.88, 1.95)
Pulmonary complications	12.6	6.03	2.24 (1.92, 2.63)	1.76 (1.48, 2.09)	1.75 (1.47, 2.08)
Renal complications	2.69	1.85	1.46 (1.08, 1.99)	1.32 (0.93, 1.88)	1.29 (0.91, 1.84)
CNS complications	0.69	0.58	1.20 (0.67, 2.15)	0.84 (0.43, 1.64)	0.68 (0.34, 1.38)
Sepsis complications	16.4	9.81	1.81 (1.58, 2.07)	1.43 (1.21, 1.68)	1.46 (1.24, 1.72)
Wound complications	9.17	4.65	2.07 (1.73, 2.48)	1.87 (1.47, 2.37)	1.89 (1.49, 2.41)
Thromboembolic complications	4.07	1.89	2.20 (1.69, 2.88)	1.77 (1.32, 2.38)	1.81 (1.34, 2.45)

Adj = adjusted; CI = confidence interval; CNS = central nervous system; OR = odds ratio; PS method = propensity score method; Txf = transfusion; Unadj = unadjusted.

Glance *Anesthesiology* 2011

JAMA Surgery | Original Investigation

Association of Perioperative Red Blood Cell Transfusions With Venous Thromboembolism in a North American Registry

Ruchika Goel, MD, MPH; Eshan U. Patel, MPH; Melissa M. Cushing, MD; Steven M. Frank, MD; Paul M. Ness, MD; Clifford M. Takemoto, MD; Ljiljana V. Vasovic, MD; Sujit Sheth, MD; Marianne E. Nellis, MD; Beth Shaz, MD; Aaron A. R. Tobian, MD, PhD

JAMA Surg. doi:10.1001/jamasurg.2018.1565
Published online June 13, 2018.

Perioperative RBC Transfusion	Adjusted OR (95% CI)[b]		
	VTE	DVT	PE
Perioperative RBC transfusion			
No	1 [Reference]	1 [Reference]	1 [Reference]
Yes	2.1 (2.0-2.3)	2.2 (2.1-2.4)	1.9 (1.7-2.1)
Time of perioperative transfusion			
None	1 [Reference]	1 [Reference]	1 [Reference]
Preoperative only	1.9 (1.5-2.3)	2.1 (1.6-2.6)	1.7 (1.2-2.5)
Intraoperative or postoperative only	2.1 (1.9-2.2)	2.2 (2.0-2.3)	1.9 (1.7-2.1)
Preoperative and intraoperative or postoperative	3.0 (2.5-3.5)	3.3 (2.7-3.9)	1.8 (1.3-2.6)

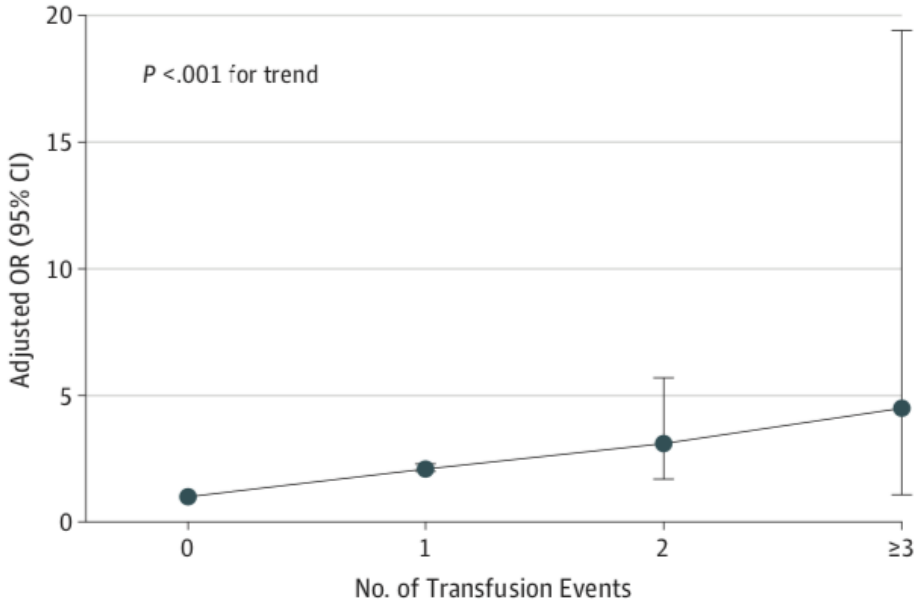
750.937 pts (6.3% transfusés)
6.309 MTEV

Goel *JAMA Surg* 2018

Pour toutes les Chirurgies et Dose dépendante !

Surgical Subspecialty[b]	Total No. of Patients	No. of Patients Receiving a Transfusion
General surgery	360 397	16 931
Neurosurgery	37 442	1900
Cardiothoracic surgery	13 113	2764
Orthopedic surgery	153 320	12 641
Vascular surgery	49 582	7197
Gynecological surgery	55 339	2933
Urological surgery	39 632	2388

Figure. Dose-Response Analysis



Goel *JAMA Surg* 2018

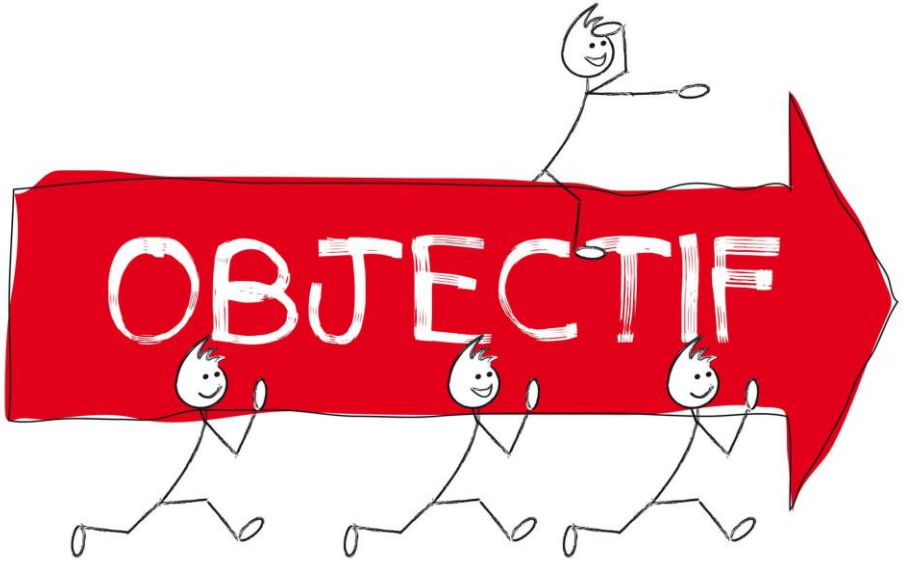
MESSAGE N° 1

L’anémie (Hb < 12-13) ET la transfusion sont fréquentes et délétères !

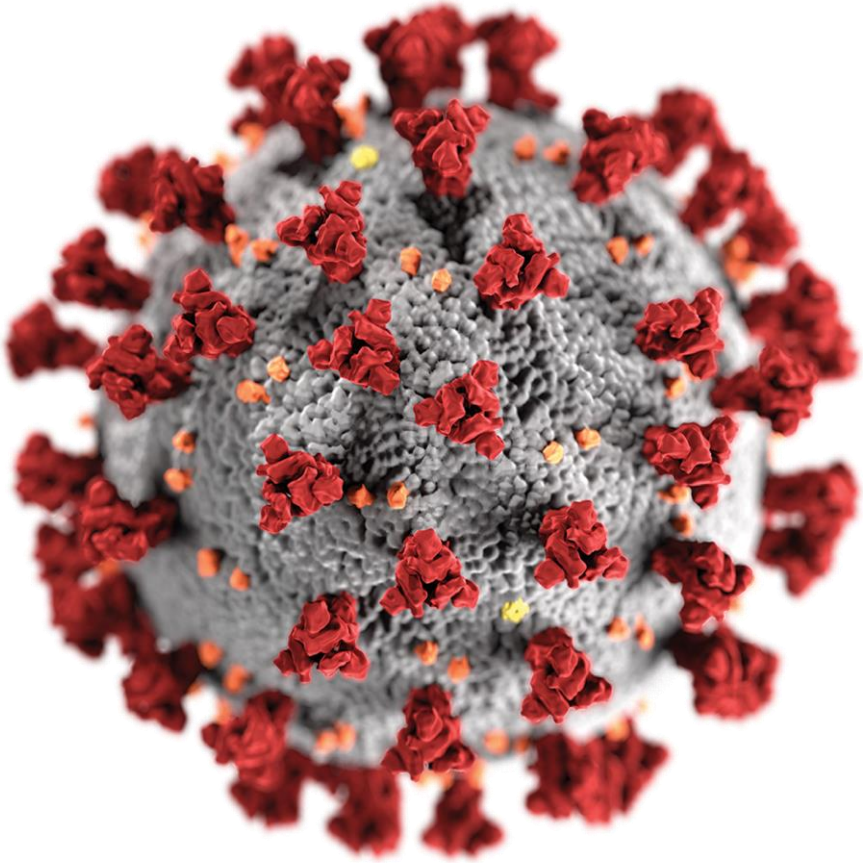
Il faut mettre en place une épargne transfusionnelle !

Organisation mondiale de la santé

1. Mise en place de services de transfusion sanguine bien organisés, coordonnés au niveau national, de politiques transfusionnelles reposant sur des données probantes, efficaces et éthiques, ainsi que de la législation et réglementation nécessaires pour garantir la mise à disposition rapide d'approvisionnements suffisants en sang et en produits sanguins sécurisés pour tous les patients ayant besoin d'une transfusion.
2. Collecte de sang, de plasma et d'autres produits sanguins auprès de donneurs volontaires non rémunérés réguliers, à faible risque, grâce au renforcement des systèmes de don à une prise en charge efficace des donneurs, soins et conseils compris.
3. Dépistage avec assurance de la qualité des infections à transmission transfusionnelle, dont le VIH, l'hépatite B et C et la syphilis, tests de confirmation des résultats de tous les donneurs réagissant aux marqueurs d'infections, recherche des groupes sanguins et tests de compatibilité et systèmes de transformation des produits sanguins (composants pour la transfusion et produits dérivés du plasma), le cas échéant, pour répondre aux besoins des soins de santé.
4. Usage rationnel du sang et des produits sanguins pour réduire les transfusions superflues et les risques associés aux transfusions, recours à d'autres solutions que la transfusion, si possible, et bonnes pratiques cliniques en matière de transfusion, y compris prise en charge des patients.
5. Mise en œuvre progressive de systèmes de qualité efficaces, y compris gestion de la qualité, normes, bonnes pratiques de fabrication, documentation, formation du personnel et évaluation de la qualité.



Réduire les transfusions évitables



2020

Maintaining a safe and adequate blood supply during the pandemic outbreak of coronavirus disease (COVID-19)

Interim guidance
20 March 2020

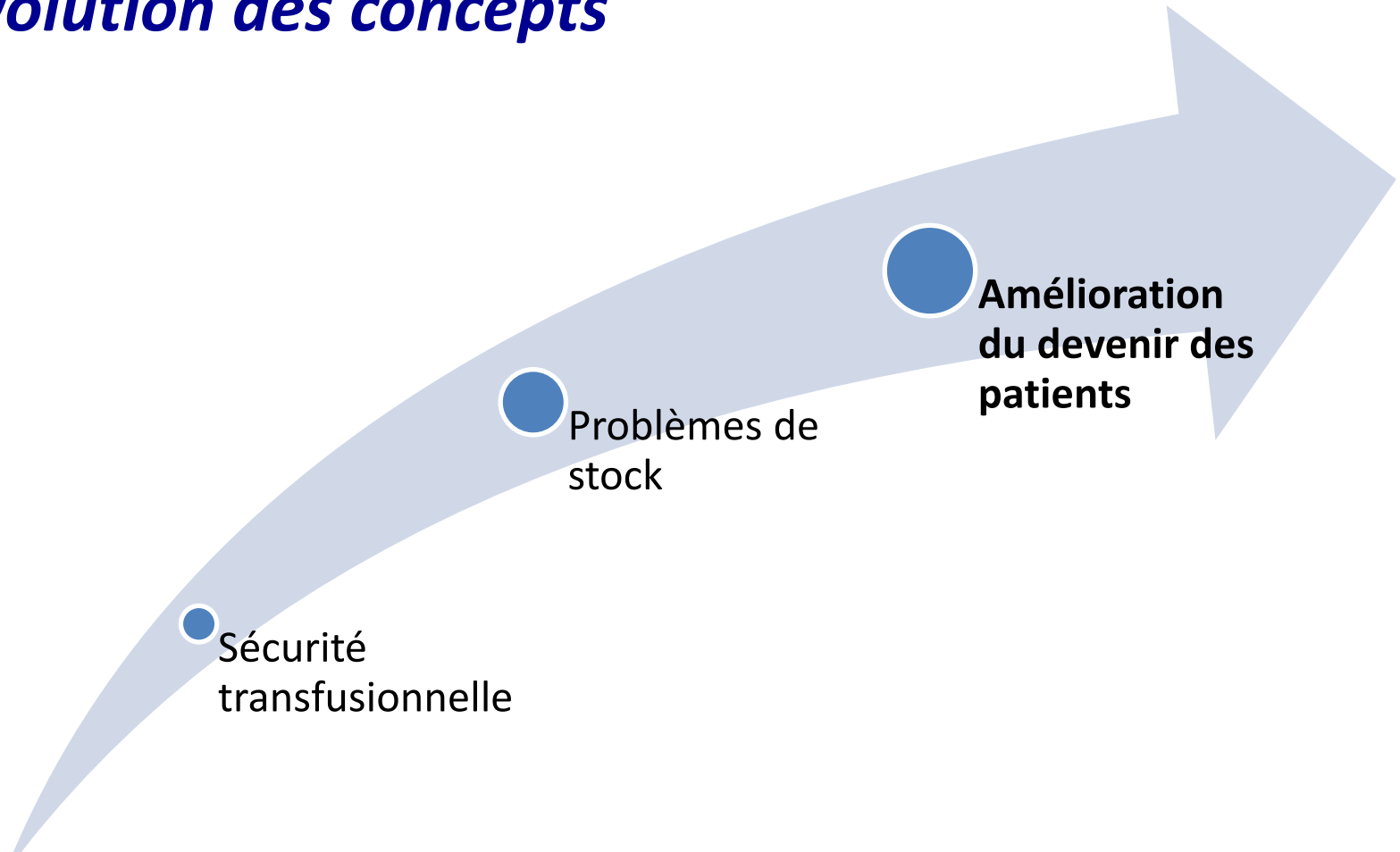
World Health Organization

4. Managing the demand for blood and blood products

Blood services should continually assess their blood stocks carefully in anticipation of uncertainty in the scale of collection activities. During widespread transmission, demand for blood and components may decrease as the health care system shifts toward treating increasing numbers of COVID-19 patients and elective surgeries and non-urgent clinical interventions are deferred. But blood transfusions will still be necessary for emergency situations such as trauma, post-partum haemorrhage, severe infant anaemia, blood dyscrasias, and urgent surgeries requiring availability of blood. Increased stocks may also be needed to support COVID-19 patients with severe sepsis or requiring extracorporeal membrane oxygenation support.

Good patient blood management will help safeguard blood stocks. The blood service must clearly communicate with health care professionals responsible for transfusion activities to ensure that blood and components are only used when clinically appropriate.

Evolution des concepts



WESTERN AUSTRALIA
PATIENT BLOOD MANAGEMENT PROGRAM

The Western Australian Patient Blood Management Program recently published the world's largest study on patient blood management outcomes. The study included over 600,000 patients admitted to Western Australia's four major adult hospitals between July 2008 and June 2014. Over the six-year study period, the program was associated with:

IMPROVED PATIENT OUTCOMES

mortality	infection	AMI/stroke	length of stay
DECREASED 28%	DECREASED 21%	DECREASED 31%	DECREASED 15%

IMPROVED KEY PROGRAM INDICATORS

pre-operative anaemia	pre-transfusion haemoglobin	single unit transfusions
DECREASED FROM 21% TO 14%	DECREASED FROM 79g/L TO 73g/L	INCREASED FROM 33% TO 64%

REDUCTIONS IN UNITS OF BLOOD TRANSFUSED

41% decrease in	47% decrease in	27% decrease in
red blood cells	plasma	platelets

PRODUCT COST SAVINGS

Over the six-year study period blood product cost savings were:

$18.5M

ACTIVITY BASED COST SAVINGS

...however with the hospital costs of administering a transfusion added, the gross savings are estimated to be between:

$80M–$100M

For more information see: Leahy MF et al. Improved outcomes and reduced costs associated with a health system-wide Patient Blood Management Program. *Transfusion*.

better health • better care • better value

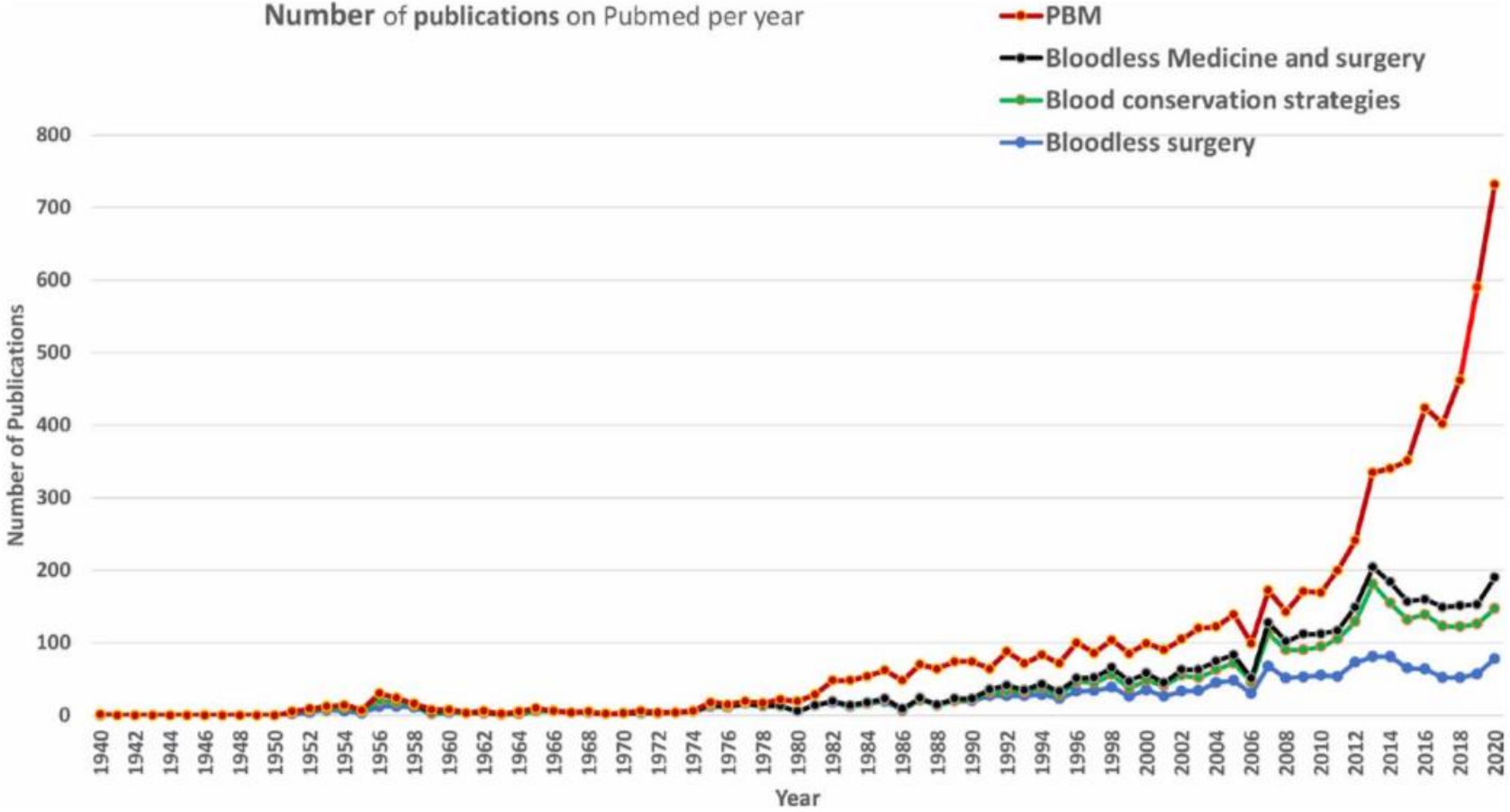


Figure. Growth in the annual number of publications indexed in PubMed focusing on PBM and related disciplines. PBM indicates patient blood management.

Shander *A&A* 2022

SPECIAL ARTICLE

A Global Definition of Patient Blood Management

Aryeh Shander, MD,*† Jean-Francois Hardy, MD,‡§ Sherri Ozawa, RN,†‖ Shannon L. Farmer, DHSc,¶#**†† Axel Hofmann, Dr.rer.medic,¶**‡‡ Steven M. Frank, MD,§§ Daryl J. Kor, MD,‖‖¶¶ David Faraoni, MD,§## and John Freedman, MD,***††† Collaborators

Patient Blood Management is a patient-centered, systematic, evidence-based approach to improve patient outcomes by managing and preserving a patient's own blood, while promoting patient safety and empowerment.

International Foundation for Patient Blood Management
www.ifpbm.org

SABM Society for the Advancement of Patient Blood Management
www.sabm.org

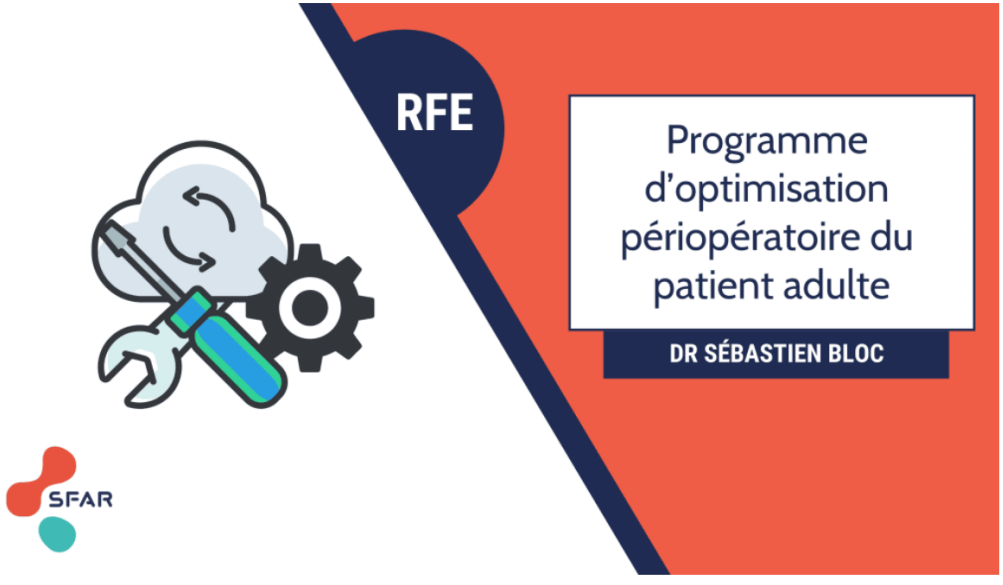
nata Network for the Advancement of Patient Blood Management, Haemostasis and Thrombosis
www.nataonline.com

Western Australia Patient Blood Management Group

Definition also endorsed by

American Society of Anesthesiologists (ASA)
American Society of Extracorporeal Technology (AmSECT)
Anemia Working Group Espana (AWGE)
Asia-Pacific Society for Patient Blood Management (ASPBM)
Chinese Society for Patient Blood Management (CSPBM)
Korean Society for Patient Blood Management (KPBM)
Korean Society of Anesthesiologists (KSA)
Malaysian Society of Haematology (MSH)
National Association of Specialists in Patient Blood Management (NASPBM)
Ontario Nurse Transfusion Coordinators Program, Canada (ONTRraC)
Sociedad IberoAmericano de Patient Blood Management (SIAPBM)
Society of Cardiovascular Anesthesiologists (SCA)
South African National Blood Service (SANBS)

Shander *A&A* 2022



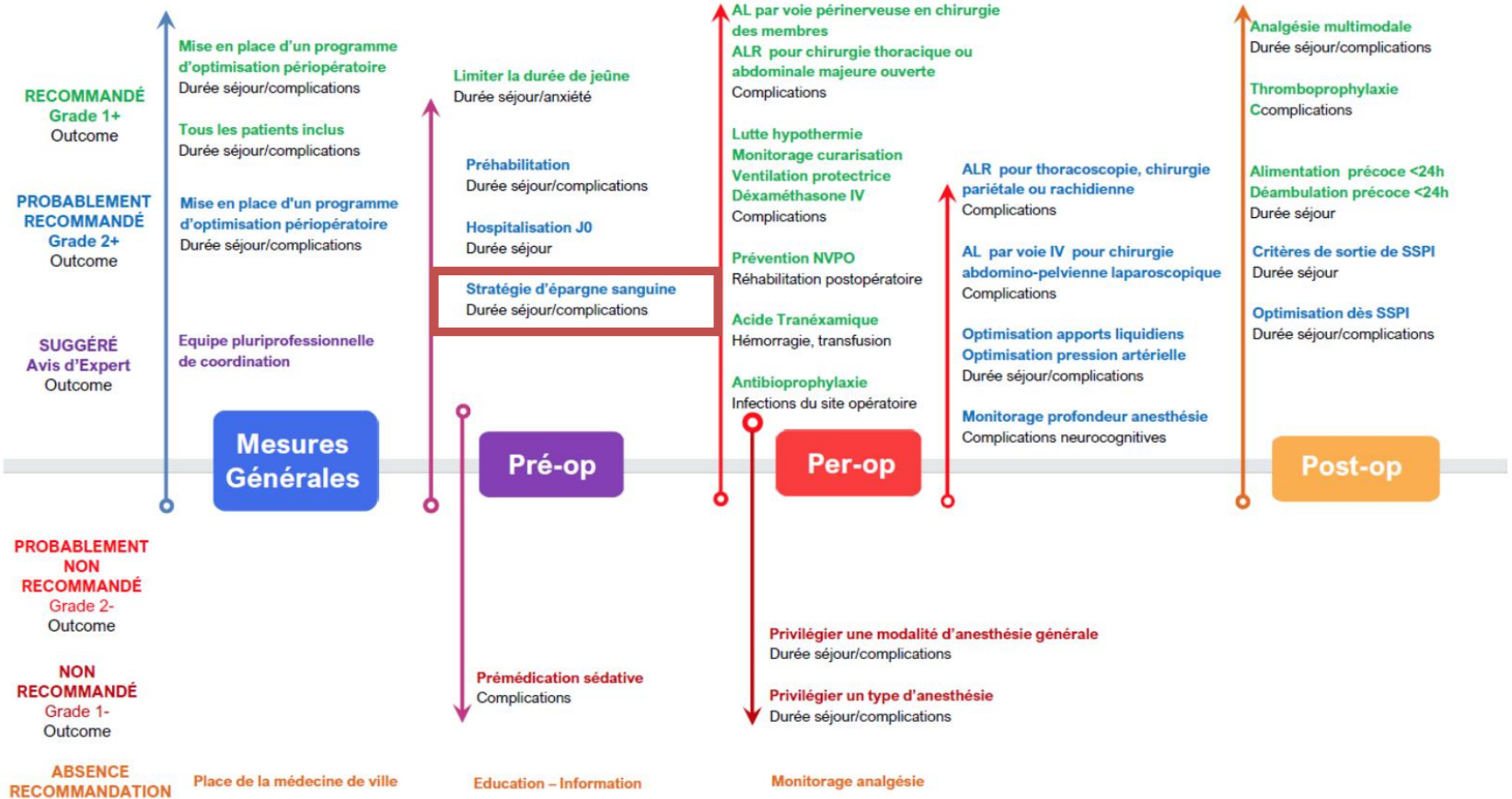
Question : Les différentes stratégies d'épargne sanguine préopératoire ont-elles un impact sur la durée de séjour ou la survenue de complications ?

Expert : Sigismond Lasocki (Angers)

R2.5 - Il est probablement recommandé de mettre en place un programme de gestion personnalisée du capital sanguin (ou « patient blood management »), pour réduire la durée de séjour et les complications postopératoires.
GRADE 2+ (Accord fort)

RFE Programme d'Optimisation Périopératoire – Socle Commun

Critères d'évaluation: durée de séjour / réduction des complications



PBM
=
Amélioration du devenir des patients

donc oui: ***pour tous*** *(chirurgies non mineures)!!*

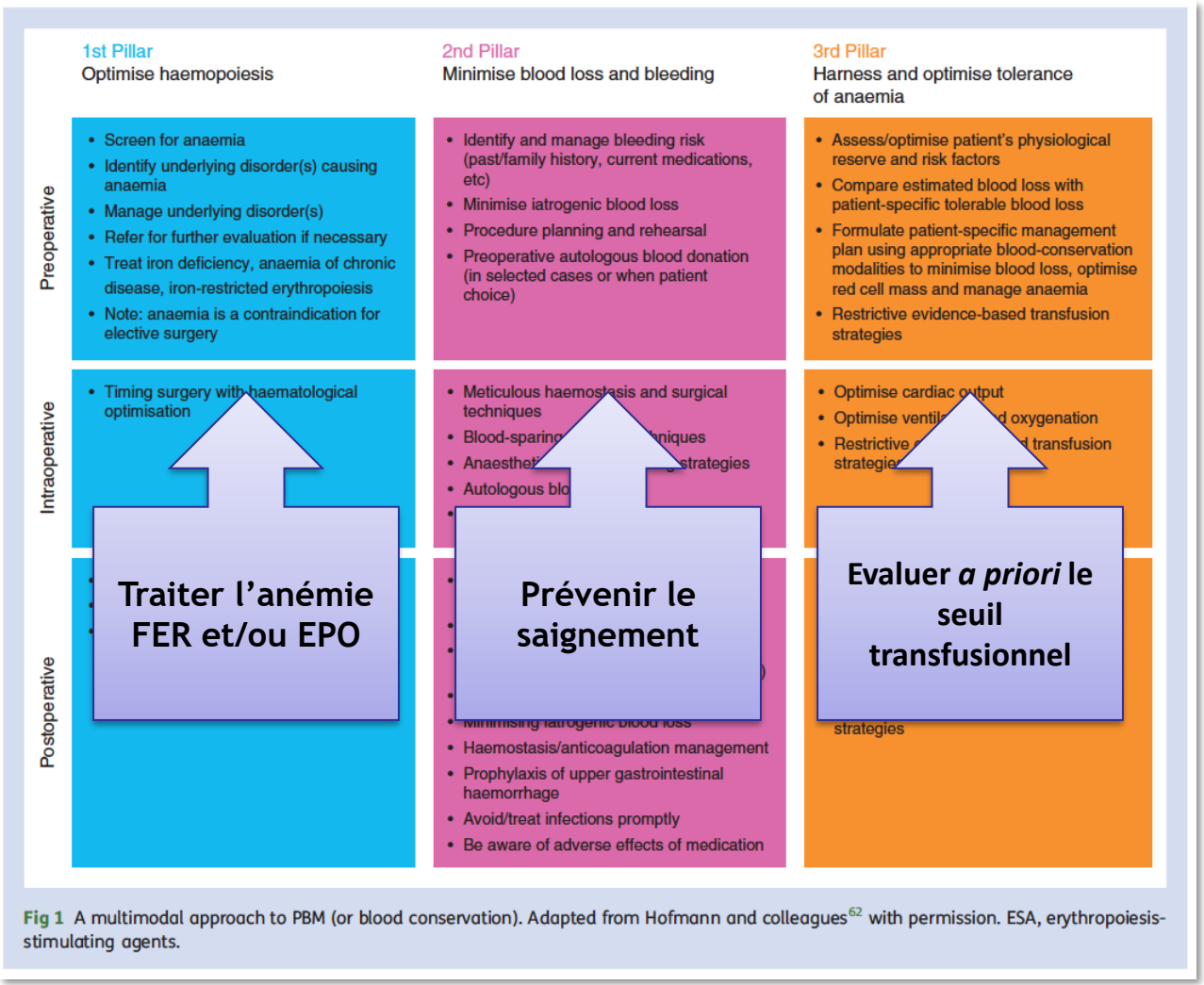
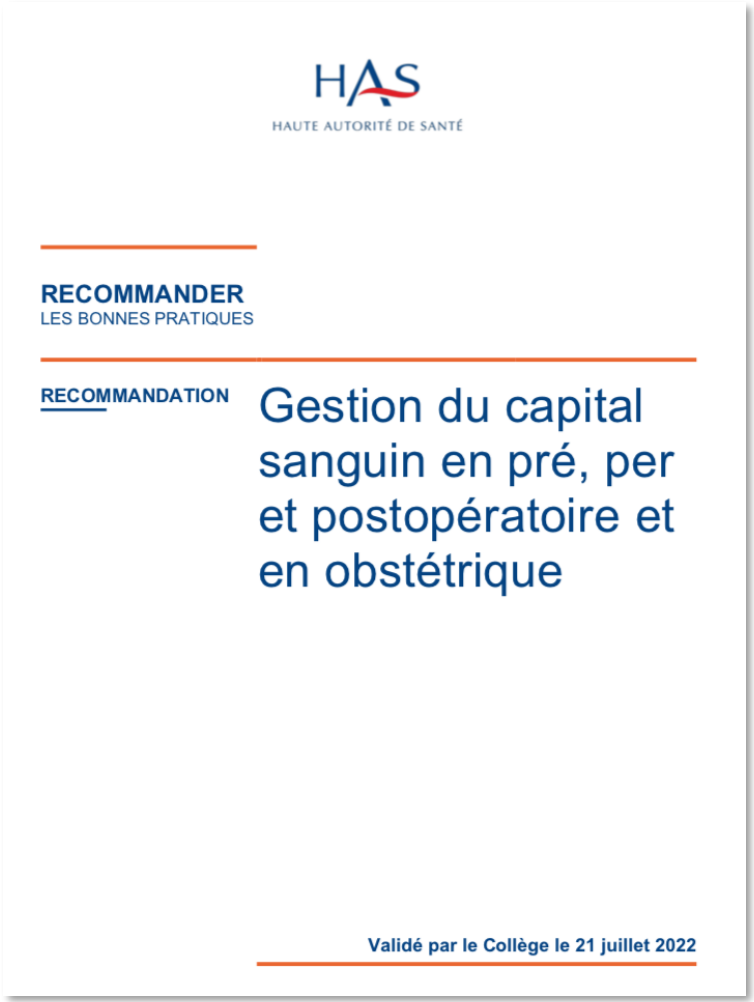


Fig 1 A multimodal approach to PBM (or blood conservation). Adapted from Hofmann and colleagues[62] with permission. ESA, erythropoiesis-stimulating agents.

Les principes du « PBM » sont simples et connus…

Shander *BJA* 2012



- **Gestion PRE-opératoire**
- Gestion PER-opératoire
- Gestion POST-opératoire

- Gestion en obstétrique

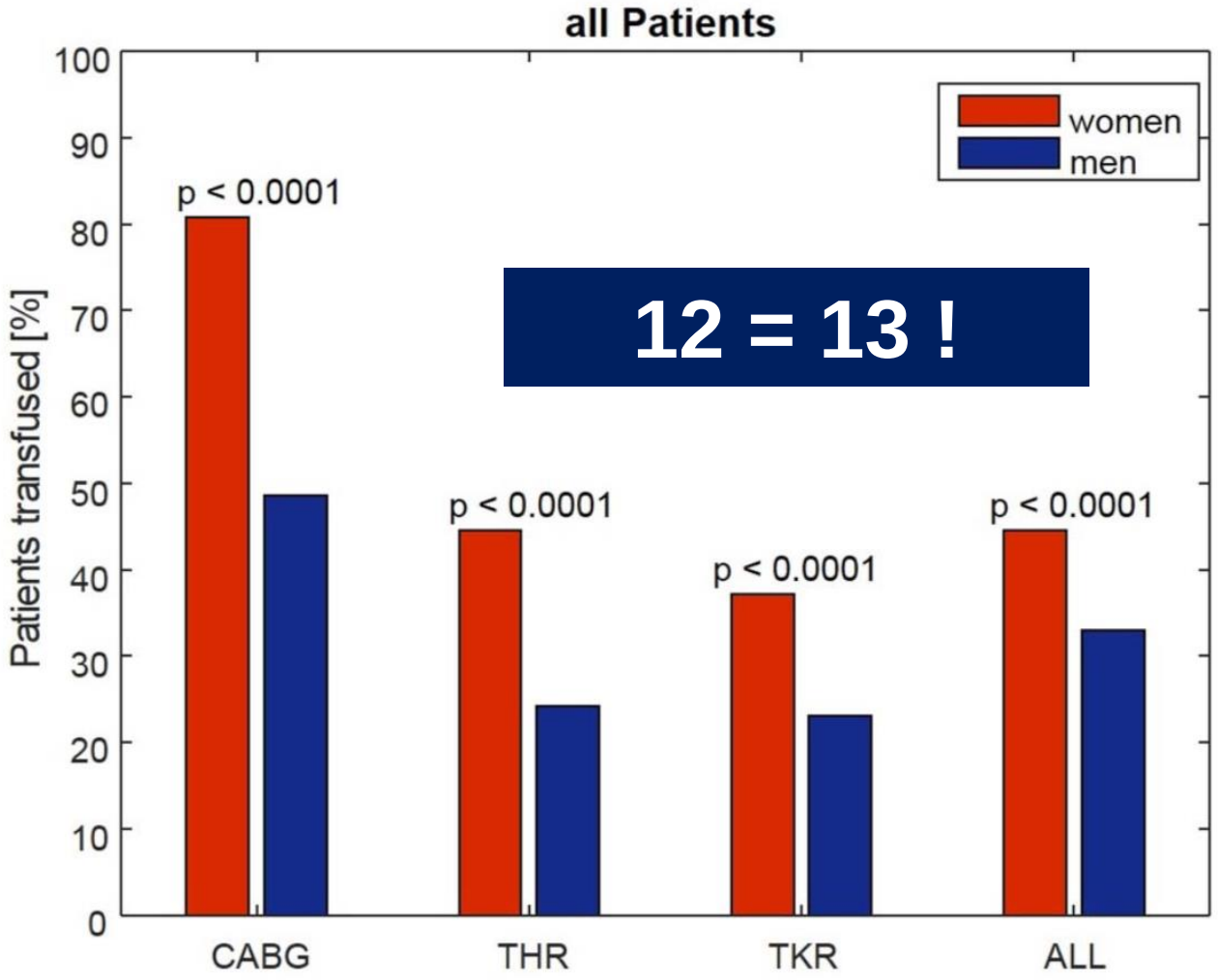
Le pilier 1: EPO et Fer

HAUTE AUTORITÉ DE SANTÉ

Gestion PRE-opératoire

- **Dépistage Anémie et Carence martiale SYSTEMATIQUE** en cas de chirurgie à risque hémorragique (A) ou de fragilité (A)
- Traitement pour **Hb < 13 g/dL chez Homme et Femme** (A)
- Traitement anémie par carence martiale (A) (Ferritine <100 µg/L et/ou TSAT <20%)(C) avec du FER IV (B)
- ASE en Orthopédie et chirurgie cardiaque (A)
- ASE en cas d'anémie inflammatoire (AE)

Non à la discrimination !



Les femmes sont plus transfusées

- N=6530 pts, 23 centres
- Transfusion jusqu'à J5 post-op

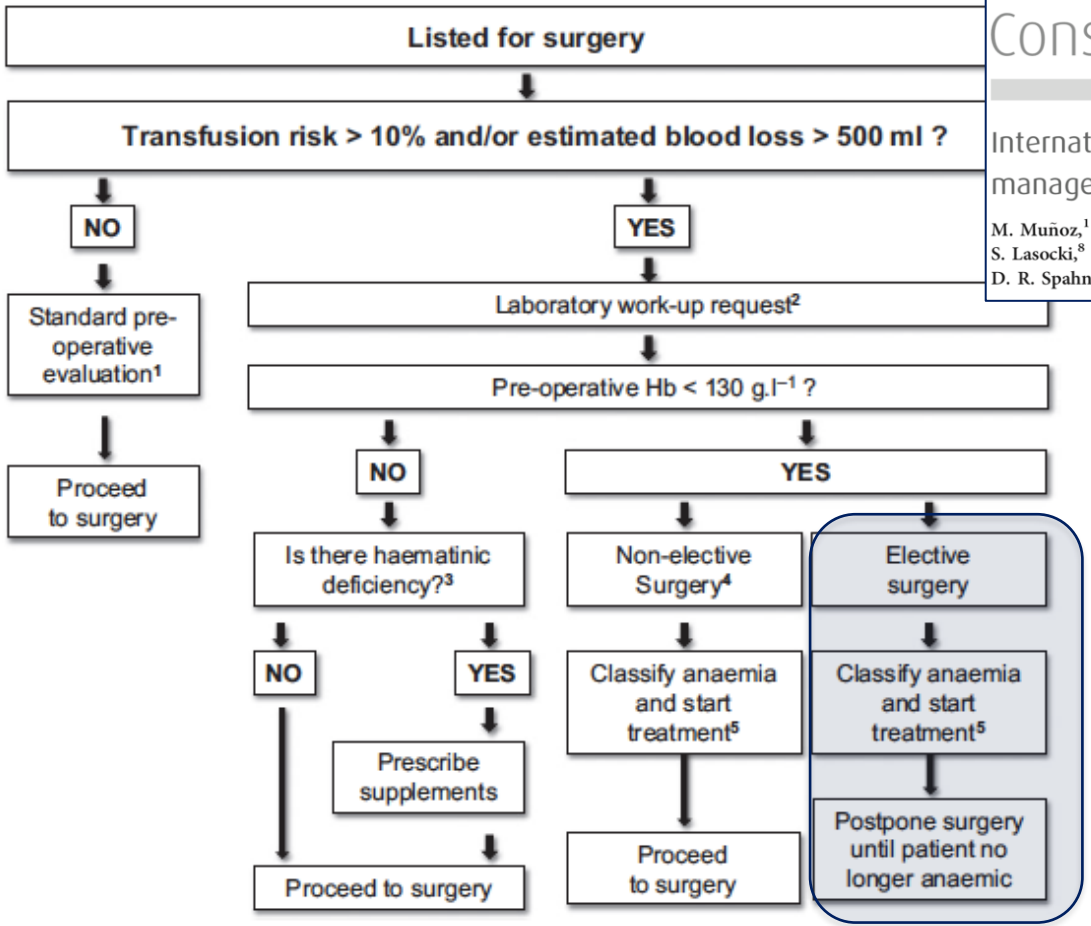
Gombotz *BMJ Open* 2016

Anaesthesia 2017, 72, 233–247 doi:10.1111/anae.13773

Consensus Statement

International consensus statement on the peri-operative management of anaemia and iron deficiency

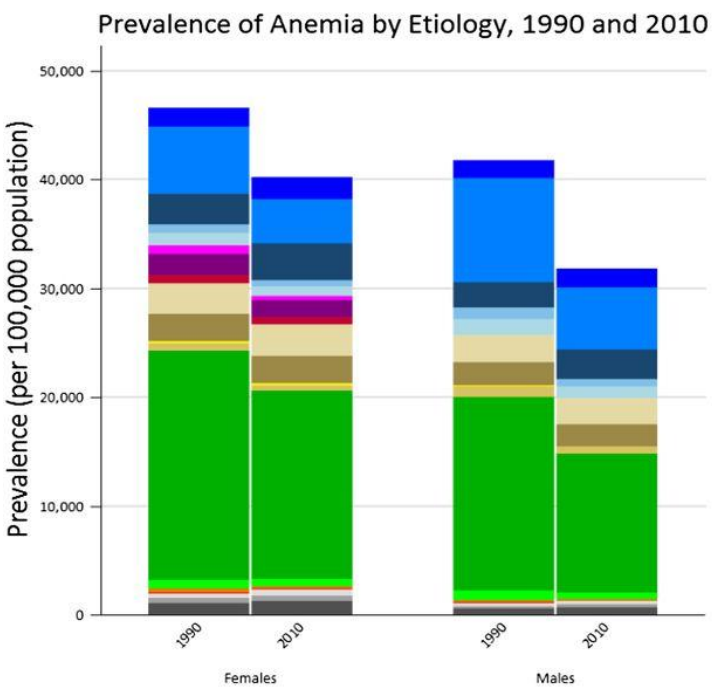
M. Muñoz,[1] A. G. Acheson,[2] M. Auerbach,[3] M. Besser,[4] O. Habler,[5] H. Kehlet,[6] G. M. Liumbruno,[7] S. Lasocki,[8] P. Meybohm,[9] R. Rao Baikady,[10] T. Richards,[11] A. Shander,[12] C. So-Osman,[13] D. R. Spahn[14] and A. A. Klein[15]

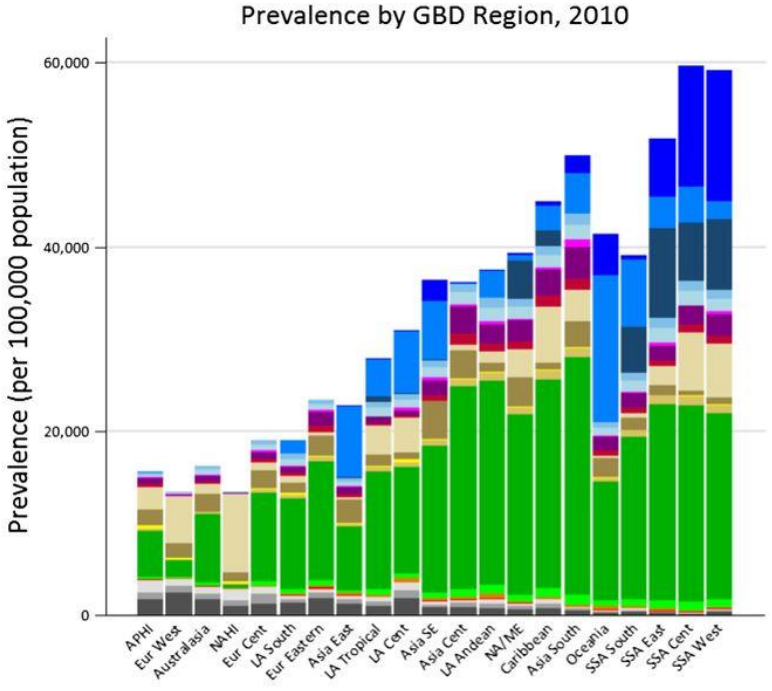


Chirurgie à risque:
Il faut avoir un **bilan pré-op** et éventuellement **décaler la chirurgie**

Munoz *Anaesthesia* 2017

La carence martiale reste la première cause d'anémie au monde





blood

Malaria
Hookworm
Schistosomiasis
Other infectious diseases
Other NTD
Maternal hemorrhage
Fibroids
Other gynecological disorders
Sickle cell
Thalassemias
G6PD deficiency
Other hemog
Iron-deficiency anemia
Other endocrine
Gastritis & duodenitis
Peptic ulcer
Diabetic CKD
Hypertensive CKD
Other CKD

Kassebaum *Blood* 2014

Recommandations pour le diagnostic de la carence martiale: HAS 2011

Prendre en compte le contexte clinique et réaliser préalablement l'hémogramme

Ferritinémie

OUI

- En **première intention** lors d'une recherche de carence en fer
- Elle est témoin des réserves en fer
- Si son taux est diminué, inutile de rechercher un autre marqueur
- Son taux peut être augmenté dans les situations inflammatoires

Ferritine basse
=
Réserves basses

Coefficient de Saturation de la Transferrine (CST)

OUI DANS LES SITUATIONS COMPLEXES

- **Pour aider au diagnostic dans les situations inflammatoires** (cancer, maladies inflammatoires chroniques intestinales), insuffisance rénale chronique, résultat de la ferritine sérique non contributif
- Il est calculé à partir du fer sérique et de la transferrine

CST bas
=
Défaut d'apport

Fer seul

Fer + Ferritine

NON

- Le dosage du fer seul est **moins informatif** que celui de la ferritine (importante variabilité nycthémérale)
- Le dosage du fer en plus de celui de la ferritine n'apporte pas d'informations supplémentaires

Diagnostic Carence Martiale

Ferritine<30 µg/l → CM absolue

CST <20% et/ou CRP>5mg/l

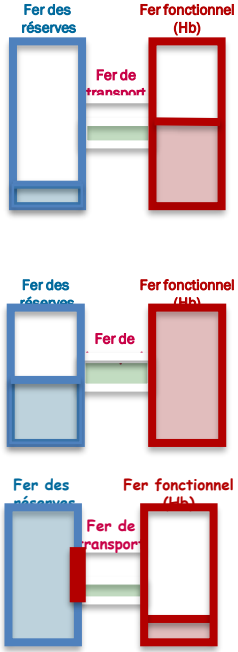
Ferritine 30 – 100 µg/l

CST >20% → Réserves basses

Ferritine >100 µg/l

CST <20% ± CRP>5mg/l → CM fonctionnelle

CST >20% → Pas de CM

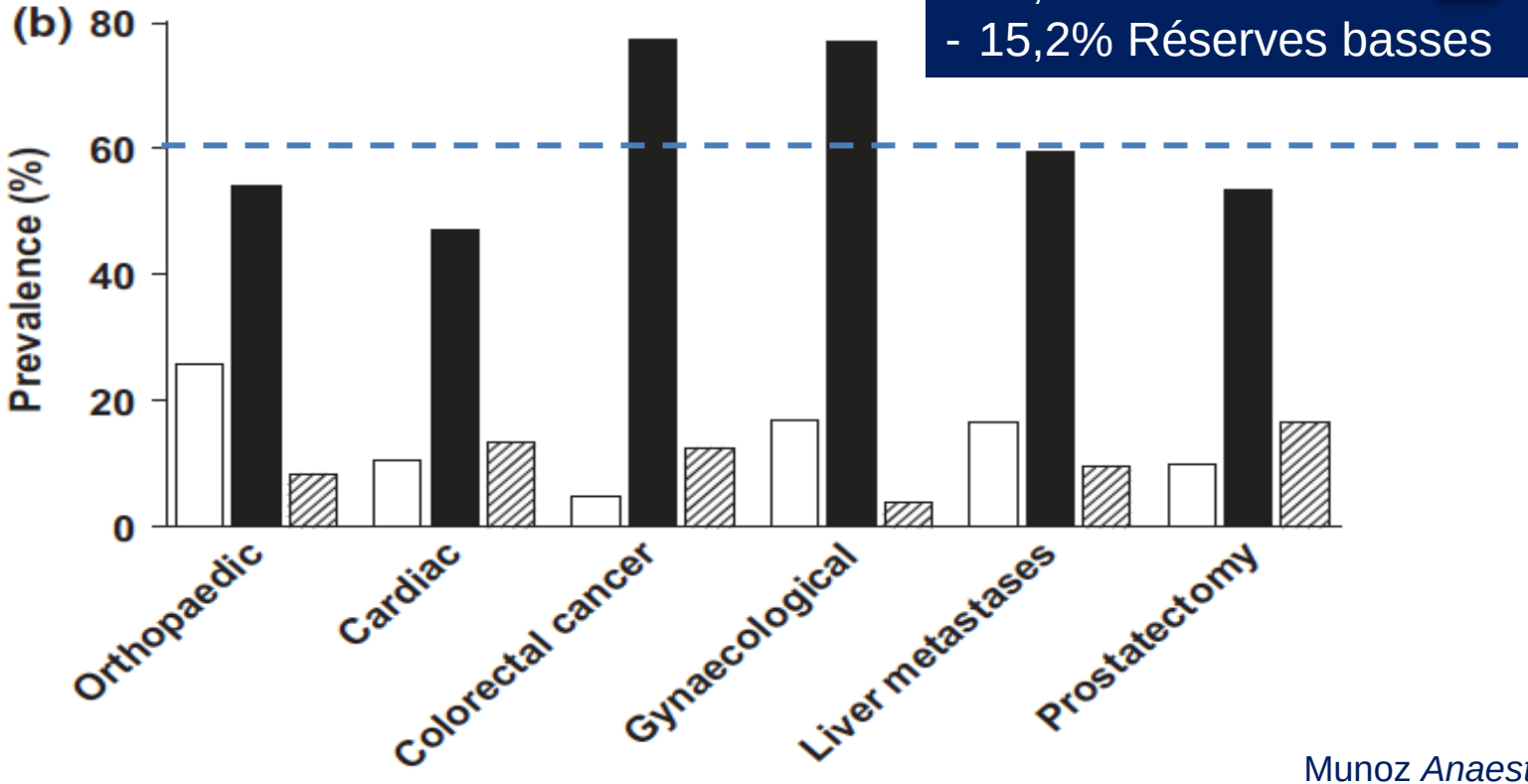


Ferritine < 100 µg/L = CM

Munoz *Anaesthesia* 2017

Prévalence de l'anémie par CM

986 patients anémiques (Hb<13 /dl)
- 61,6 % CM absolue
- 15,2% Réserves basses



Munoz *Anaesthesia* 2017

Comment je fais en CS?

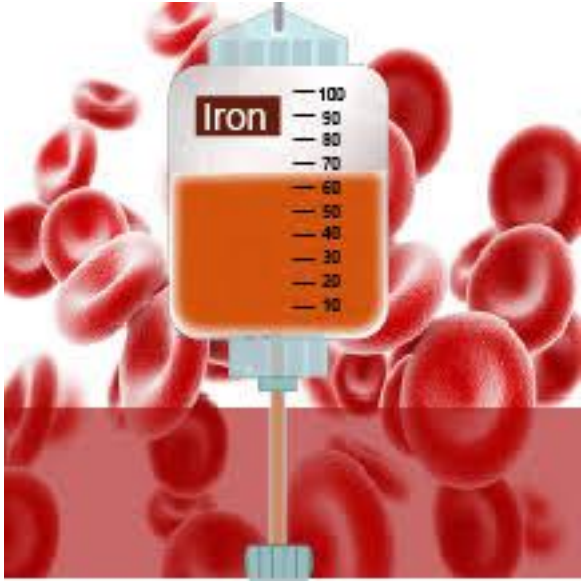
En pratique ?

Il est possible de faire
une **ordonnance conditionnelle** :

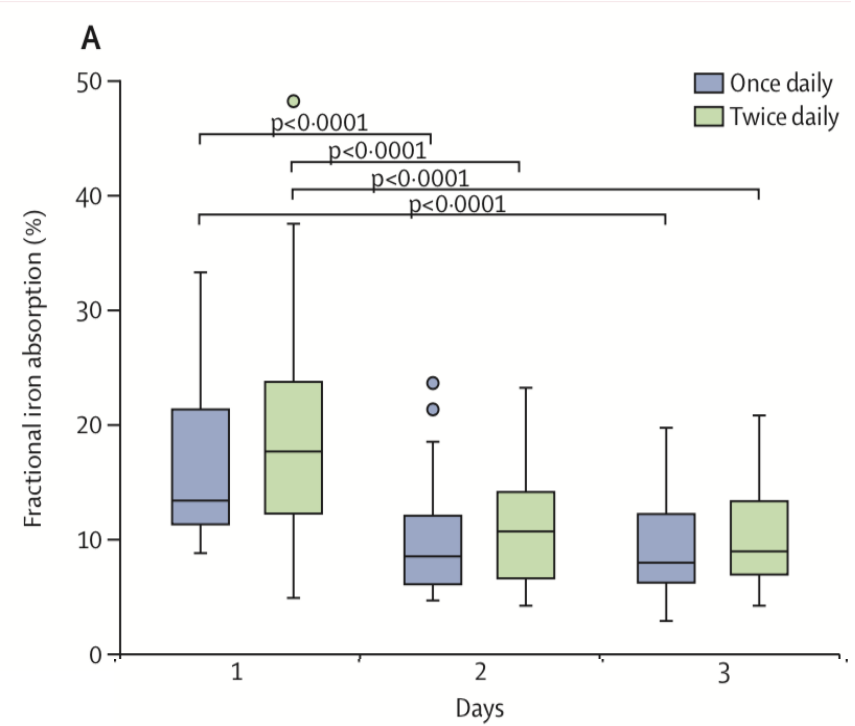
- **Prélèvements de 2 tubes**
- **Réalisation d'une NFS**
- **Bilan martial** *(ferritine + Tsat)* **si Hb <13 g/dL**

Populations à risque:
•Insuffisants cardiaques,
•Végétariens, femmes jeunes
•Cancer (45%)
•Saignements chroniques...

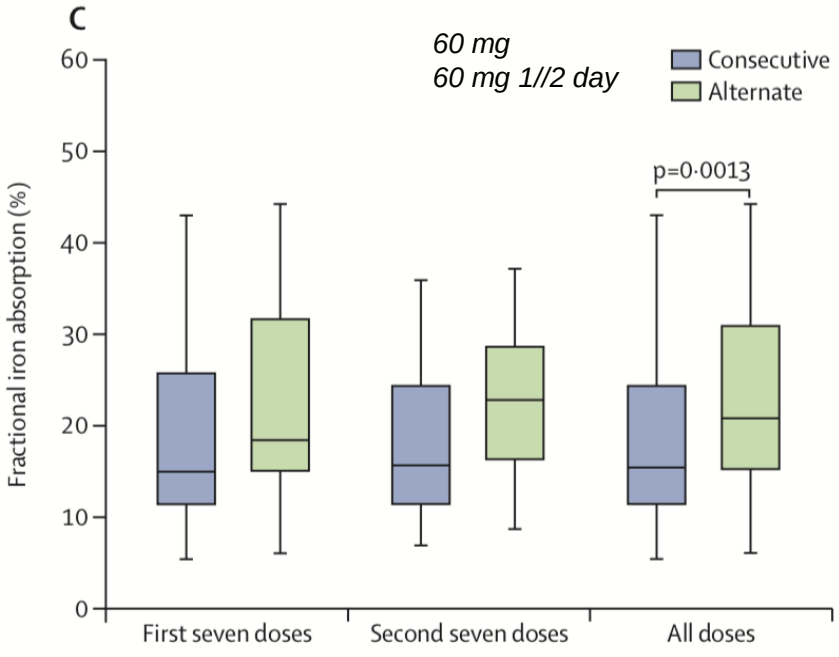
IV ou per OS ?



120 mg
60mgx2

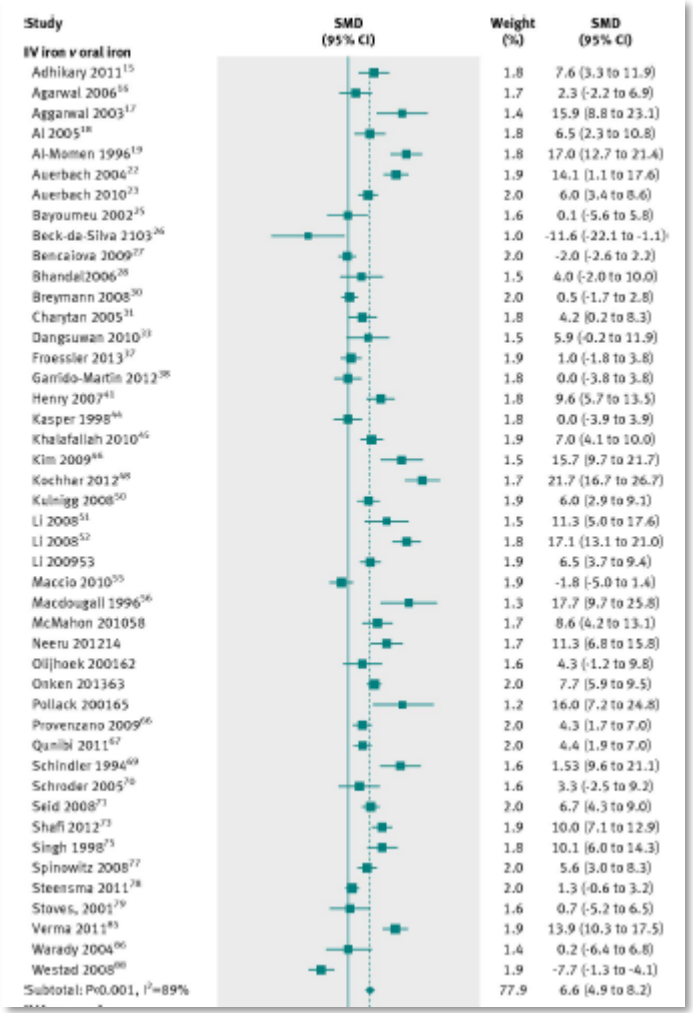


Absorption <10% !



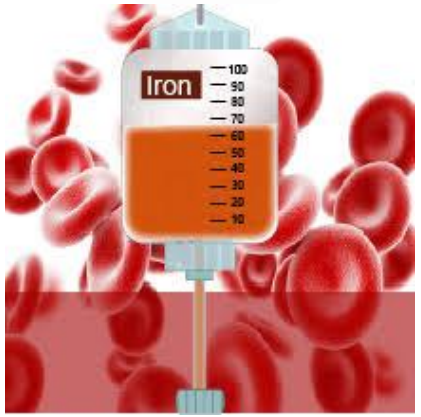
Total iron dose absorbed after 28 days:
131 mg (71·4, 240·5) versus **175·3 mg** (110·3, 278·5; p=0·0010)

Stoffel *Lancet Haematology* 2017



Fer IV vs Oral

72 études
10.605 patients
-**Delta Hb 6,5[4,9-8,2] g/L**
-**Transfusion 0,74[0,62-0,88]**



Litton *BMJ* 2013

La dose compte!

Table 3: Average calculated iron deficit dose in clinical Studies 1–5.

Study	Patient population	Calculated mean iron deficit based on the modified Ganzoni formula* (mg)	Standard deviation	Number of patients
(1) van Wyck et al., 2007 [38]	Postpartum	1458	330	182
(2) van Wyck et al., 2009 [39]	Heavy uterine bleeding	1608	383	251
(3) Seid et al., 2008 [40]	Postpartum	1539	351	143
(4) Barish et al., 2012 [41]	IDA various etiologies	1520	342	348
(5) Hussain et al., 2013 [42]	IDA various etiologies	1508**	359	161
Overall mean		1531	NC	1085

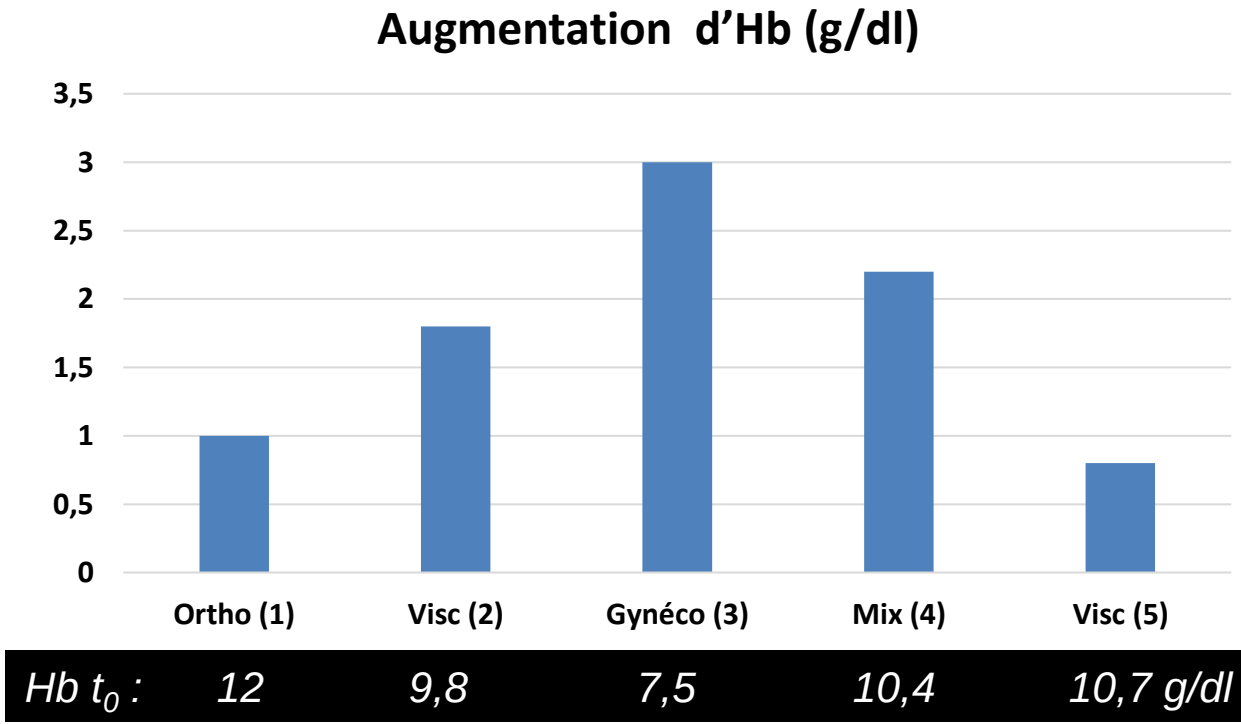
IDA = iron deficiency anemia; NC = not calculated.

Analyse de 5 études randomisées contrôlées
Déficit moyen calculé = **1531 mg !**

Koch *Anemia* 2015

Le fer IV est efficace en pré-opératoire

Traitement pré-op,
de 4 à 21 jours
Doses entre 900
mg et 1,2g



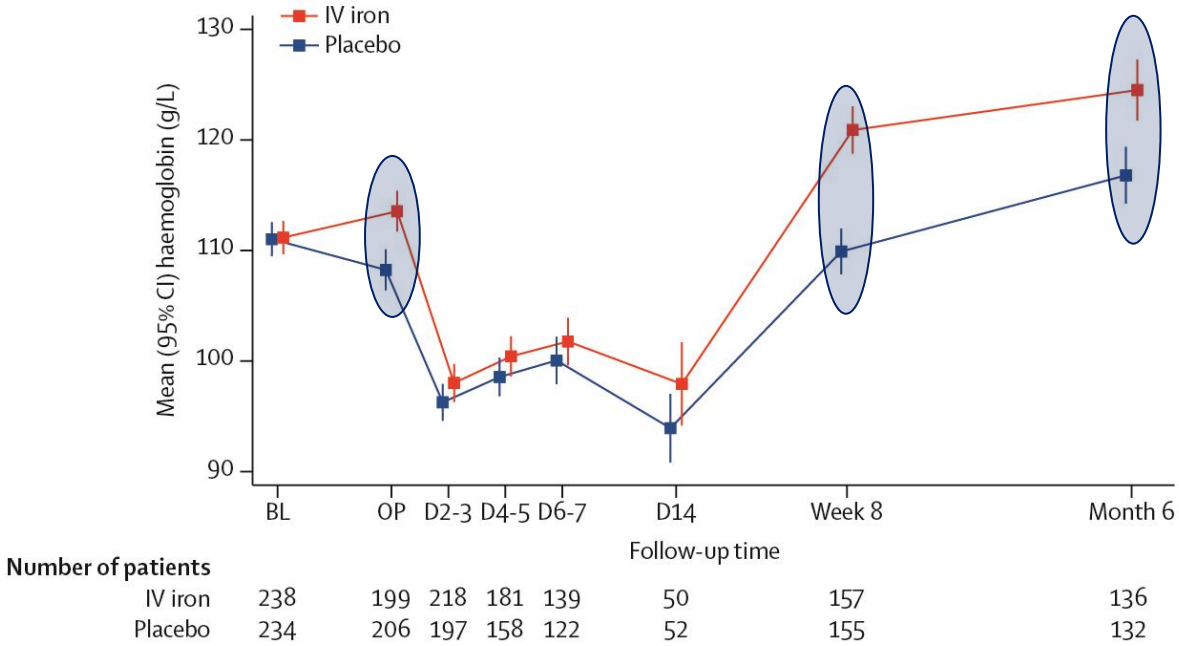
1. *Theusinger Anesthesiology 2007*
2. *Keeler Colorectal Dis 2014*
3. *Kim Acta Haematol 2009*
4. *Bisbe BJA 2011*
5. *Froessler Ann Surg 2016*

FER pré-opératoire pour traiter l'anémie?

PREVENTT study

- RCT 487 anemic patients *(Hb<13 g/dL)*
- Abdominal surgery
- CMF (1000 mg) or placebo
- Primary endpoint: **Blood transfusion (ns)**

(RR 1.03, 95% CI 0.78–1.37; p=0.84)



Richards *Lancet* 2020

FER pré-opératoire pour traiter l'anémie?

PREVENTT study

- RCT 487 anemic patients *(Hb<13 g/dL)*
- Abdominal surgery
- CMF (1000 mg) or placebo
- Primary endpoint: **Blood transfusion (ns)**

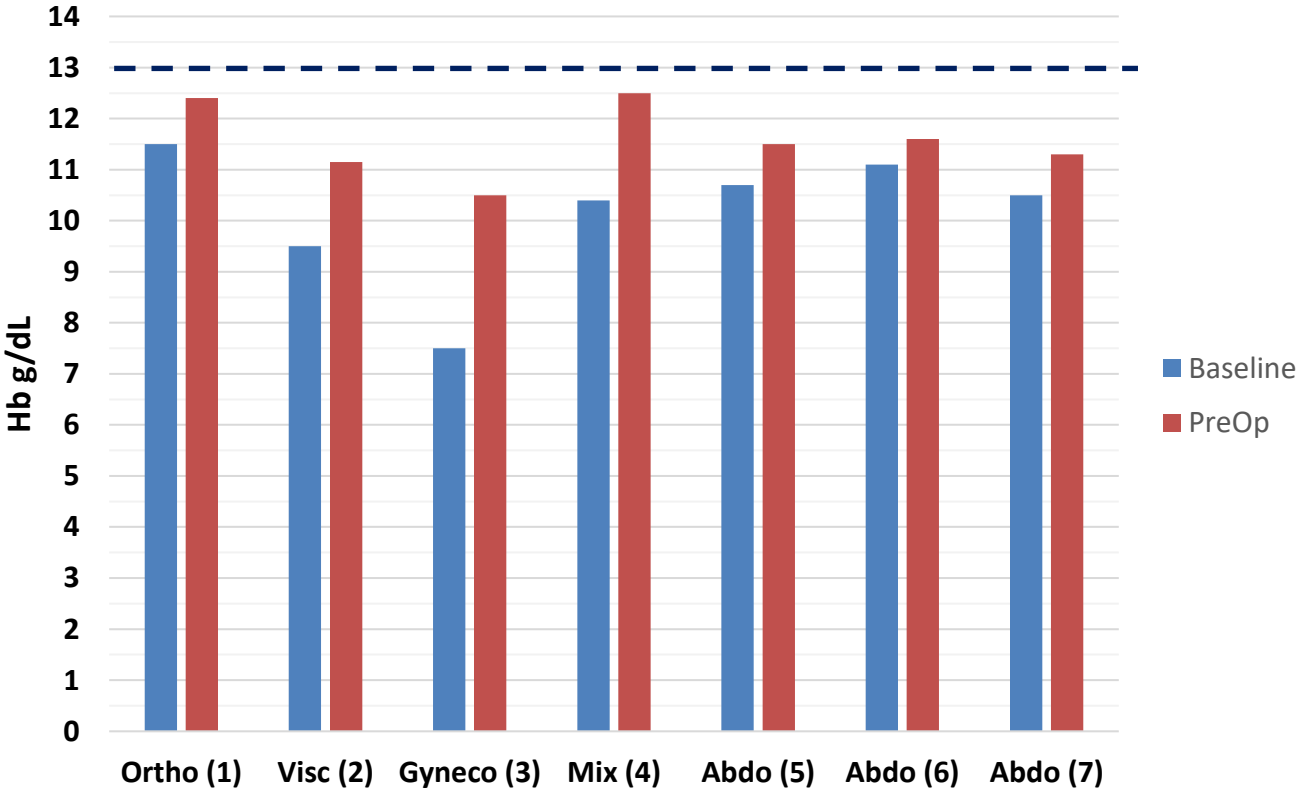
(RR 1.03, 95% CI 0.78–1.37; p=0.84)

Readmission to hospital for complications			
Discharge to 8 weeks			
Any readmission	51/234 (22%)	31/234 (13%)	0·61 (0·40 to 0·91)‡
Total number of readmissions	71	38	0·54 (0·34 to 0·85)†
Discharge to 6 months			
Any readmission	73/223 (32%)	58/227 (26%)	0·78 (0·58 to 1·04)‡
Total number of readmissions	130	84	0·64 (0·44 to 0·92)†

Moins de readmissions !

Richards *Lancet* 2020

Le fer IV est insuffisant pour augmenter l'Hb >13 g/dl

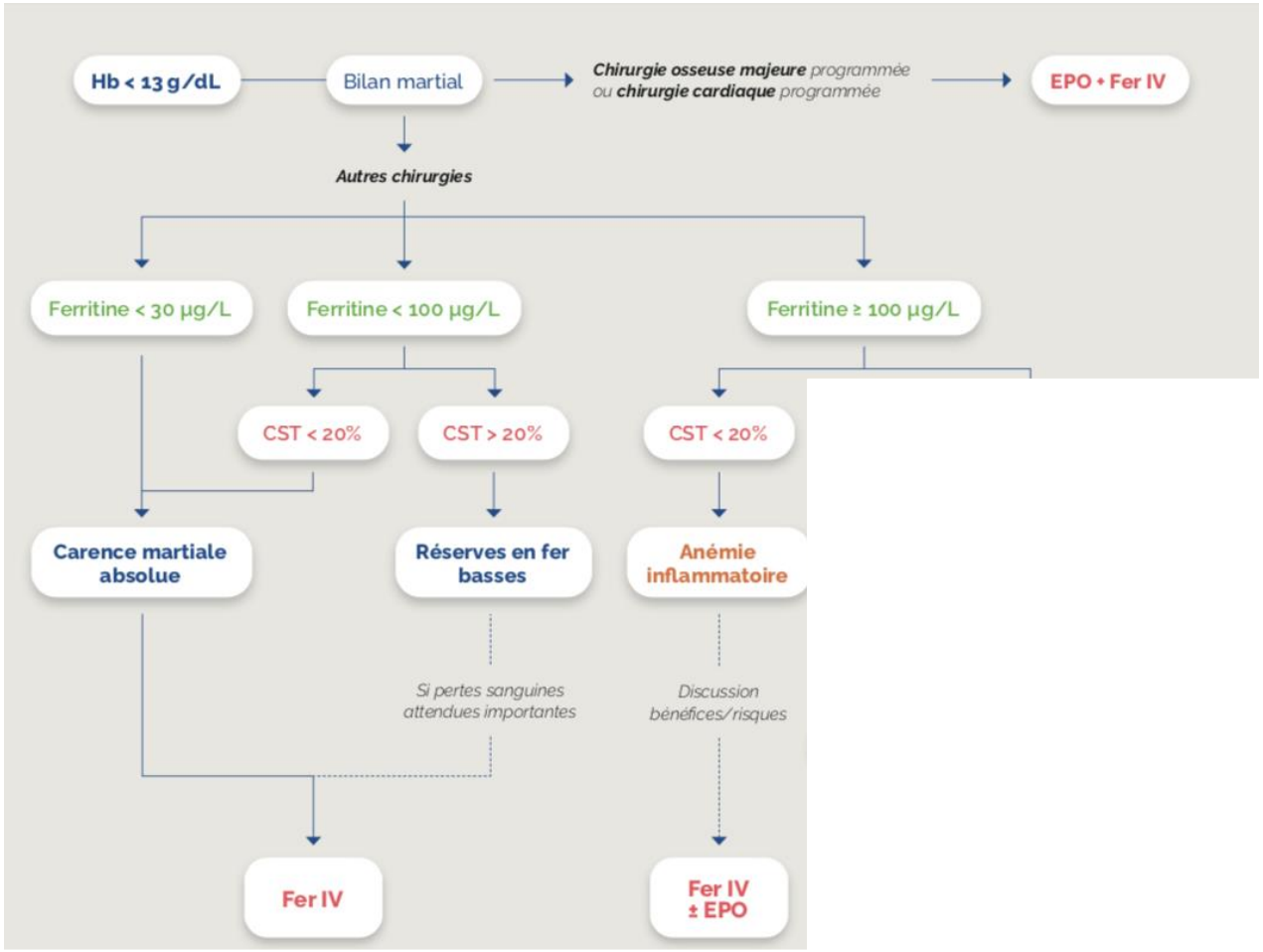


1. *Theusinger Anesthesiology 2007*
2. *Keeler Colorectal Dis 2014*
3. *Kim Acta Haematol 2009*
4. *Bisbe BJA 2011*
5. *Froessler Ann Surg 2016*
6. *Richards Lancet 2020*
7. *Talboom Lancet Haematol 2023*

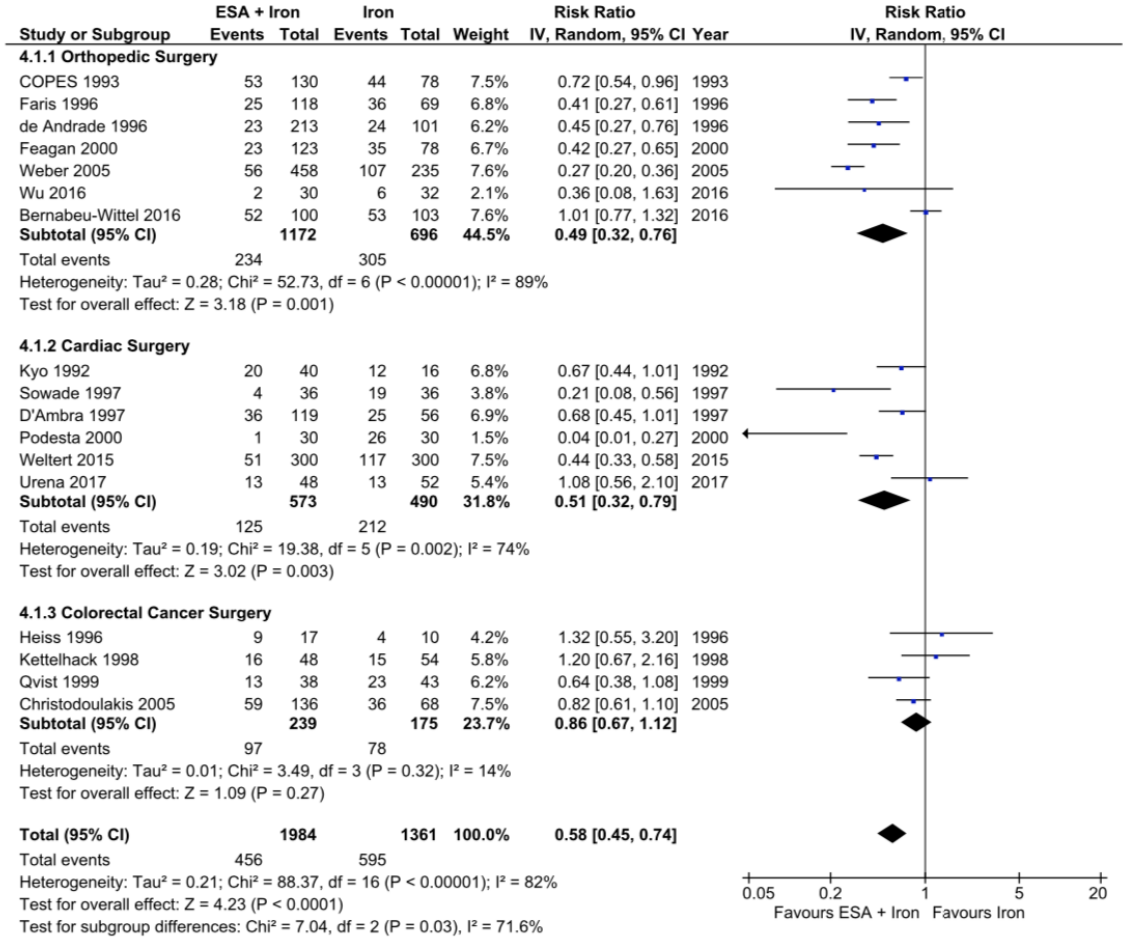
HAUTE AUTORITÉ DE SANTÉ

HAUTE AUTORITÉ DE SANTÉ

HAS
HAUTE AUTORITÉ DE SANTÉ



Anémie inflammatoire: EPO ?



EPO +FER pré-op

Meta-analyse
(EPO+FER *vs FER*)

25 RCT, 4719 pts
RR transfusion 0.58

Kei *Can J Anesth* 2019

EJA

Eur J Anaesthesiol 2023; **40:**226–304

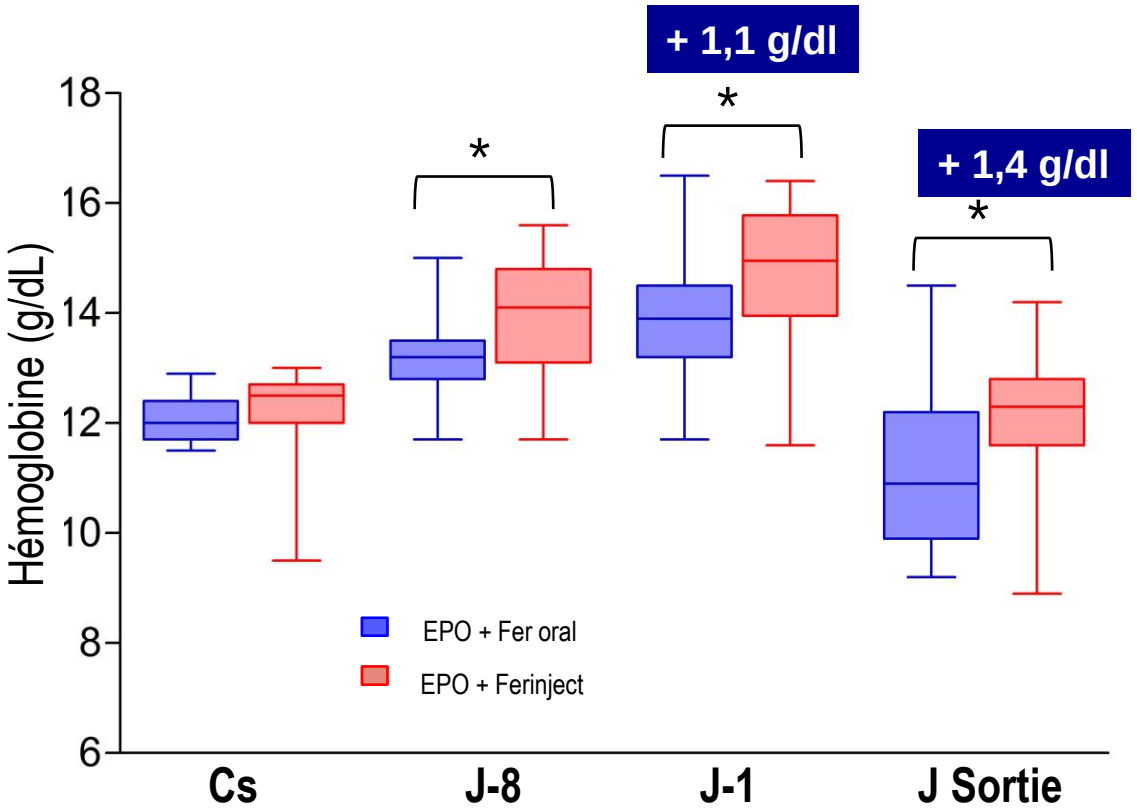
GUIDELINES

Management of severe peri-operative bleeding: Guidelines from the European Society of Anaesthesiology and Intensive Care

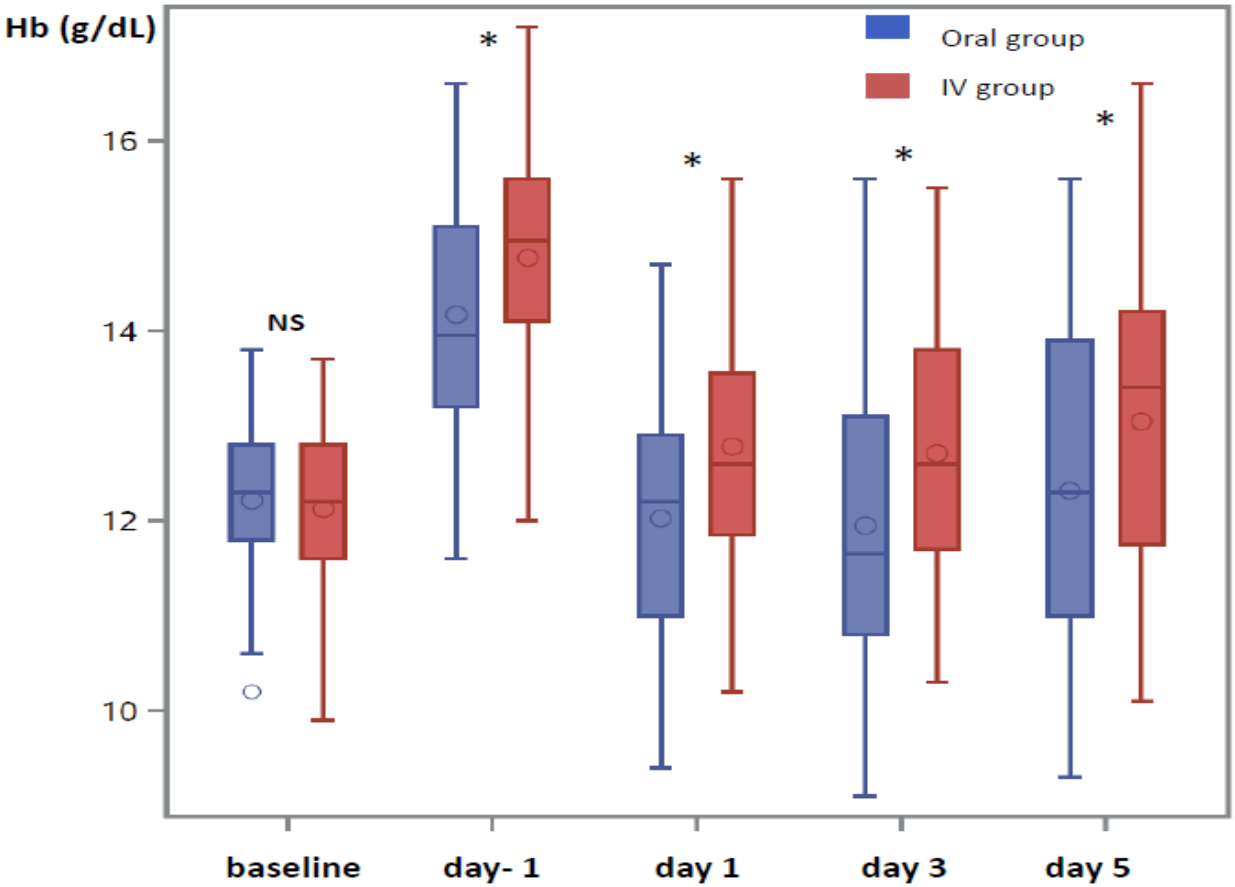
Second update 2022

We suggest erythropoietin-stimulating agents (ESA) if pre-operative anaemia is present and other causes (autoimmune, bone marrow dysfunction, nutritional deficiencies) have been excluded or treated. 2A

EPO = FER IV !



Rineau, Lasocki *BJA* 2014

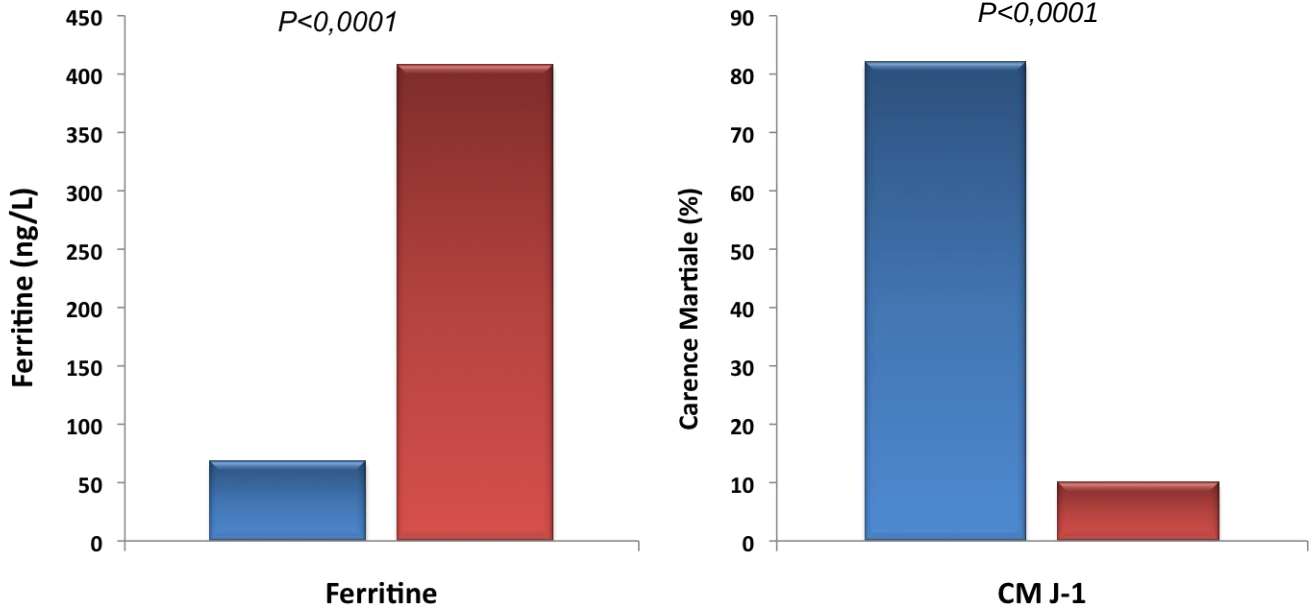


N=100 pts
PTH/PTG
Fer oral 160 mg/j ou CMF 1g

Biboulet *Anesthesiology* 2018

Réduction de la Carence Martiale

EPO + Fer O n=19
EPO + FCM n=34



CM pré-opératoire 10 vs 82 %

Rineau, Lasocki *BJA* 2014

OK, mais je vais devoir décaler tous mes patients !

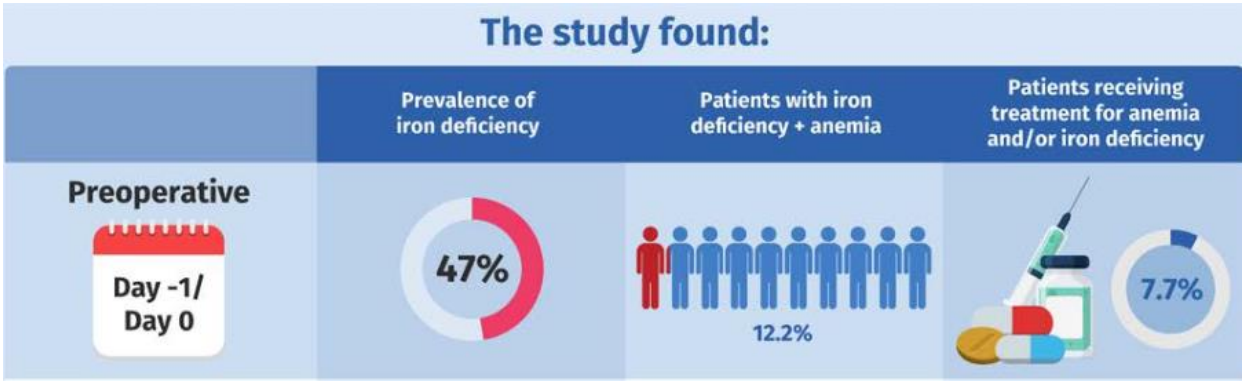
Chirurgien pas content !

Original Clinical Research Report

BLOOD MANAGEMENT

Perioperative Iron Deficiency in Patients Scheduled for Major Elective Surgeries: A French Prospective Multicenter Cross-Sectional Study

Xavier Capdevila, MD, PhD,*† Sigismond Lasocki, MD, PhD,‡ Alexis Duchalais, MD,§ Jean-Christophe Rigal, MD,‖ Patrice Mertl, MD, PhD,¶ Pierre Ghewy, MD,# Frédéric Farizon, MD,**†† Thomas Lanz, MD,‡‡ Axel Buckert, MD,§§ Samia Belarbia, DVM, ‖‖ Jean-Noël Trochu, MD, PhD,¶¶ and Patrice Cacoub, MD, PhD##



FR

Ortho / Uro-Visc /
Cardiaque / Gyneco

Capdevilla *A&A* 2023

ORIGINAL CLINICAL RESEARCH REPORT

Evaluation of Anemia and Iron Deficiency in French Surgical Departments: The National Multicenter Observational PERIOPES Study

Sigismond Lasocki, MD, PhD,* Anissa Belbachir, MD,† Paul-Michel Mertes, MD, PhD,‡ Eric Le Pelley, MD,§ and Xavier Capdevila, MD, PhD‖

Table 2. Treatments of Anemia and Iron Deficiency

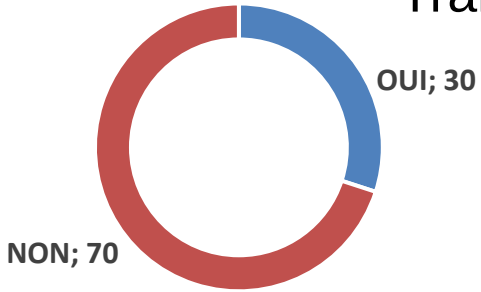
Iron deficiency and anemia status[a] at preoperative anesthesia visit	n	Treated patients
Anemia and/or iron deficiency	928	266 (28.7)
No anemia and no iron deficiency	365	23 (6.3)
Anemia not evaluated and/or iron deficiency not evaluated	1052	66 (6.3)
Overall	2345	355 (15.1)

Etude observationnelle
16 centres
Ortho / CCVT / Uro-Dig / Gyneco
Anémie 34%

Lasocki *A&A* 2023

13,6 [12,4 ; 14,7] g/dL
30% anémie
(ortho 13,4% ; Obst 68,5%)

Traitement



Bilan préop:
- **Hb: 90%**
- *Bilan CM : 40%*

Cs Anesthésie → Bloc → Hospit

21 [11;30] jours

Bonne nouvelle: on peut faire mieux !

HAUTE AUTORITÉ DE SANTÉ

Gestion PER-opératoire

- **Acide Tranexamique prophylactique orthopédie et chirurgie cardiaque (A)** *(1g IVL incision ± 1g IVSE)*
- **Acide tranéxamique en cas d'hémorragie** (A)
- Hémostase chrirurgicale
- Pas de garrot pour la chirurgie du genou (A)
- Cell Saver pour chirurgie cardiaque, Aortique, Rachis, reprise (B) discuter en en cas de cancer (AE)
- Limiter les drainages (sauf chirurgie cardiaque)
- Normothermie (B)
- Monitorage pertes

Le pilier 2: Réduire le Saignement

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Tranexamic Acid in Patients Undergoing Noncardiac Surgery

P.J. Devereaux, M. Marcucci, T.W. Painter, D. Conen, V. Lomivorotov,

Devereaux (POISE-3) *NEJM* 2022

Table 1. Baseline Characteristics of the Patients, Type of Surgery, and Medications.*

Characteristics	Tranexamic Acid (N=4757)	Placebo (N=4778)
Age — yr	69.5±9.5	69.3±9.4
Surgery — no./total no. (%)		
Any procedure	4729/4757 (99.4)	4740/4778 (99.2)
General‡	1769/4729 (37.4)	1773/4740 (37.4)
Orthopedic	1083/4729 (22.9)	1063/4740 (22.4)
Vascular	699/4729 (14.8)	700/4740 (14.8)
Urologic	598/4729 (12.6)	624/4740 (13.2)
Spinal	237/4729 (5.0)	206/4740 (4.3)
Gynecologic	162/4729 (3.4)	171/4740 (3.6)
Thoracic	127/4729 (2.7)	146/4740 (3.1)
Low-risk	39/4729 (0.8)	34/4740 (0.7)
Plastic	14/4729 (0.3)	23/4740 (0.5)

Devereaux (POISE-3) *NEJM* 2022

Table 2. Effects of Tranexamic Acid on 30-Day Outcomes.*

Outcome	Tranexamic Acid (N = 4757)	Placebo (N = 4778)	Hazard Ratio (95% CI)†	P Value
Primary efficacy outcome: composite bleeding outcome — no. (%)‡	433 (9.1)	561 (11.7)	0.76 (0.67–0.87)	<0.001§
Individual components of composite bleeding outcome — no. (%)				
Life-threatening bleeding¶	78 (1.6)	79 (1.7)	0.99 (0.73–1.36)	
Major bleeding¶	363 (7.6)	496 (10.4)	0.72 (0.63–0.83)	
Bleeding into a critical organ¶	12 (0.3)	21 (0.4)	0.57 (0.28–1.16)	
Primary safety outcome: composite cardiovascular outcome — no./total no. (%)‖	649/4581 (14.2)	639/4601 (13.9)	1.02 (0.92–1.14)	0.04**
Individual components of composite cardiovascular outcome — no. (%)				
MINS¶	608 (12.8)	602 (12.6)	1.02 (0.91–1.14)	

TXA 1 g + 1g

Devereaux (POISE-3) *NEJM* 2022

JAMA Surgery | Original Investigation

Association of Intravenous Tranexamic Acid With Thromboembolic Events and Mortality

A Systematic Review, Meta-analysis, and Meta-regression

Isabel Taeuber; Stephanie Weibel, PhD; Eva Herrmann, PhD; Vanessa Neef, MD; Tobias Schlesinger, MD; Peter Kranke, MD; Leila Messroghli, MD; Kai Zacharowski, MD, PhD; Suma Choorapoikayil, PhD; Patrick Meybohm, MD

216 études, 125 550 patients

Pas plus de complications thromboemboliques

Table 1. TXA and Total Thromboembolic Events

Medical discipline	No. of included studies	TXA		Control		Model	Risk difference (95% CI)	*P* value	I^2, %
		Events	No. of included patients	Events	No. of included patients				
Cardiothoracic	16	72	3171	74	3009	Fixed effect	−0.001 (−0.009 to 0.007)	.83	0
						Random effects	−0.001 (−0.007 to 0.008)	.91	
Neurological	12	282	2007	230	2000	Fixed effect	0.026 (0.007 to 0.045)	.01	57
						Random effects	0.018 (−0.013 to 0.048)	.26	
Gynecological	26	35	12 356	41	12 286	Fixed effect	−0.001 (−0.002 to 0.001)	.53	0
						Random effects	−0.001 (−0.002 to 0.001)	.50	
Orthopedic	101	172	4787	113	4149	Fixed effect	0.001 (−0.007 to 0.009)	.79	0
						Random effects	0.001 (−0.004 to 0.007)	.64	
Major trauma	1	204	10 060	233	10 067	Fixed effect	−0.003 (−0.007 to 0.001)	.16	NA
						Random effects	−0.003 (−0.007 to 0.001)	.16	
Maxillofacial	6	0	265	0	192	Fixed effect	0.000 (−0.023 to 0.023)	>.99	0
						Random effects	0.000 (−0.019 to 0.019)	>.99	
Pediatric	2	0	42	0	40	Fixed effect	0.000 (−0.067 to 0.067)	>.99	0
						Random effects	0.000 (−0.064 to 0.064)	>.99	
Other	12	14	799	15	670	Fixed effect	−0.004 (−0.021 to 0.013)	.62	0
						Random effects	−0.004 (−0.018 to 0.011)	.63	
Total	176	779	33 487	706	32 413	Fixed effect	0.001 (−0.002 to 0.003)	.66	0
						Random effects	−0.001 (−0.002 to 0.001)	.39	

Tauber *JAMA Surgery* 2021

Baisse de la mortalité par saignement

Table 3. TXA and Bleeding Mortality

Medical discipline	No. of included studies	TXA		Control		Model	Risk difference (95% CI)	*P* value	I^2, %
		Events	No. of included patients	Events	No. of included patients				
Cardiothoracic	12	0	543	1	478	Fixed effect	−0.002 (−0.016 to −0.012)	.77	0
						Random effects	−0.004 (−0.012 to 0.011)	.94	
Neurological	8	43	685	91	678	Fixed effect	−0.071 (−0.102 to −0.041)	<.001	60
						Random effects	−0.056 (−0.11 to −0.002)	.04	
Gynecological	8	155	10 871	191	10 814	Fixed effect	−0.003 (−0.007 to −0.000)	.05	0
						Random effects	−0.002 (−0.005 to 0.001)	.12	
Orthopedic	13	0	647	0	461	Fixed effect	0.000 (−0.014 to 0.014)	.77	0
						Random effects	0.000 (−0.013 to 0.013)	>.99	
Major trauma	1	489	10 060	574	10 067	Fixed effect	−0.008 (−0.015 to −0.002)	.01	NA
						Random effects	−0.008 (−0.015 to −0.002)	.01	
Pediatric	1	0	40	0	42	Fixed effect	0.000 (−0.046 to 0.046)	>.99	NA
						Random effects	0.000 (−0.046 to 0.046)	>.99	
Other	6	5	655	17	661	Fixed effect	−0.018 (−0.033 to −0.004)	.02	53
						Random effects	−0.01 (−0.028 to −0.009)	.30	
Total	49	692	23 501	874	23 201	Fixed effect	−0.008 (−0.011 to −0.005)	<.001	9
						Random effects	−0.004 (−0.008 to −0.001)	.02	

Tauber *JAMA Surgery* 2021

HAS
HAUTE AUTORITÉ DE SANTÉ

Acide Tranexamique

10 à 20 mg/kg IV (souvent 1 g) sur 10 min environ à l'incision (ou avant lâcher garrot)

Jusqu'à 100 mg/kg (maximum !) en chirurgie cardiaque (par exemple bolus de 50 mg/kg sur 1 h à l'incision)

± Entretien

jusqu'à la fin de la chirurgie, ou pendant 8 à 18 h

- Bolus itératifs : ex : 10-15 mg/kg (souvent 1 g) toutes les 4 h (espacer si insuffisance rénale, par exemple toutes les 6-8 h).
- Ou IVSE : 1-5 mg/kg/h pendant la chirurgie.
- Ou IVSE : 1 g sur 8 h.

± Administration topique

par le chirurgien

- Par exemple : 3 g dans 120 mL : 1,5 g pendant puis 1,5 g à la fin.
- Ou par exemple : 1 g dans le cotyle, 1 g dans le fût fémoral avant implant, 1 g espace sous-cut lors fermeture.

HAS
HAUTE AUTORITÉ DE SANTÉ

Gestion POST-opératoire

- Surveillance saignement et anémie post-op (AE)
- **Faire un bilan à 4 semaines post-op** (medecin traitant)(AE)
- **Transfusion**
  - **Seuils restrictifs (7-8 g/dL) selon tolérance**
  - **Transfusion unitaire**

- **Anémie post-op (Hb<12 g/dl) = apport de FER (IV) (B)**

Anémie / Fonction post-opératoire: exemple de la Fracture du col

Table 2. Associations between anaemia, functional mobility and mobilization on the first three post-operative days in 487 hip fracture patients

		Walking independently	Walking with human assistance	Not able to walk	*P*	Mobilisation (hours out of bed)	
1st post-operative day	No anaemia $n = 317$	52 (16%)	160 (51%)	105 (33%)	0.049	3 (1–5)	0.011
	Anaemia $n = 170$	9 (5%)	103 (61%)	58 (34%)		2 (0.5–4.5)	
2nd post-operative day	No anaemia $n = 330$	82 (25%)	175 (53%)	73 (22%)	0.007	4 (2–6)	0.024
	Anaemia $n = 132$	24 (18%)	62 (47%)	46 (35%)		3 (1–5.5)	
3rd post-operative day	No anaemia $n = 314$	124 (40%)	130 (41%)	60 (19%)	0.001	5 (3–7)	0.129
	Anaemia $n = 116$	30 (26%)	47 (41%)	39 (34%)		4 (2.5–6)	

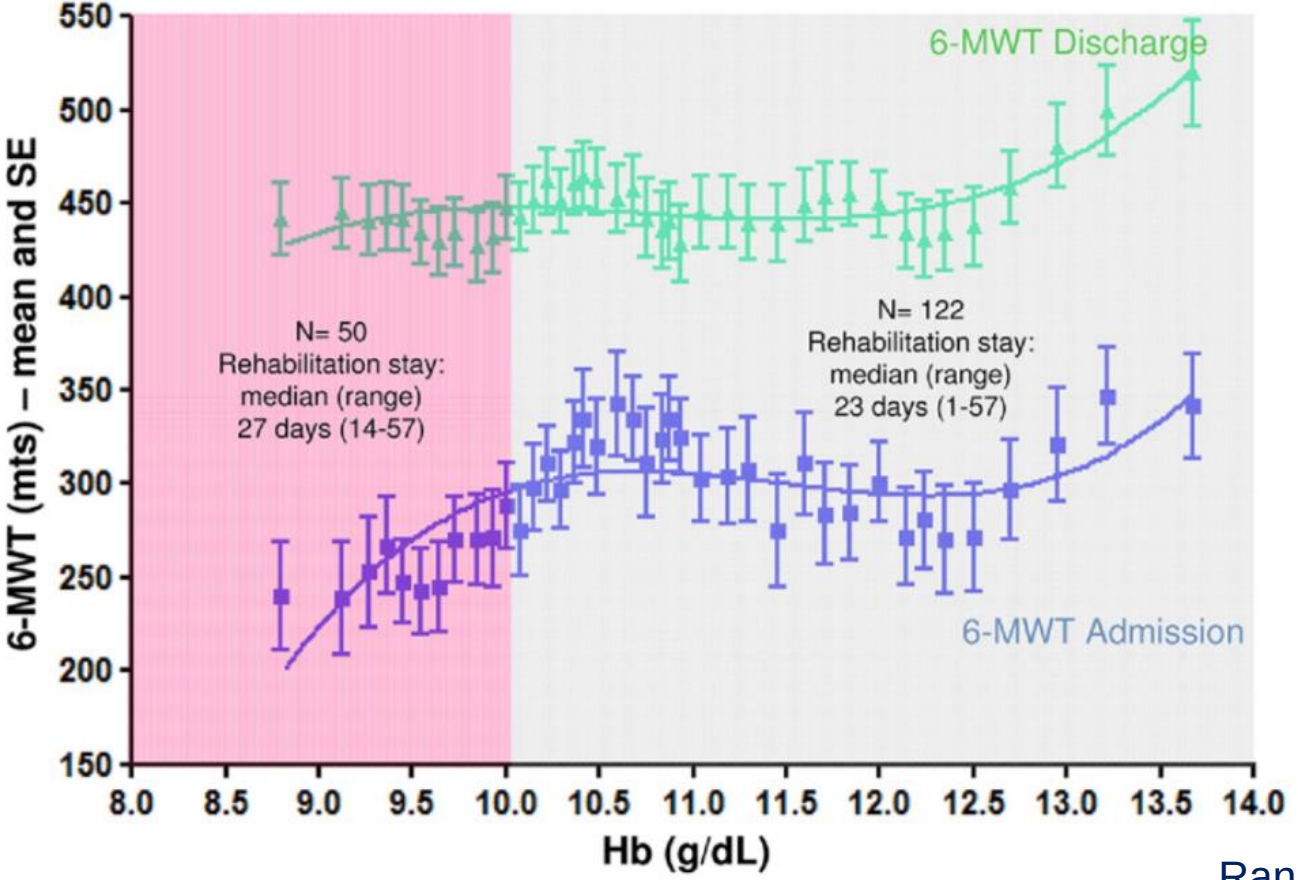
Anaemia defined to be present in any patient who on that given day had a hb measurement of <100 g/l. Data are presented as number of patients (%) for categorical variables and as median (25–75% quartiles) for continuous data. Test for statistical significance performed with chi-square corrected for linear-by-linear association for categorical data.

Hb <100 g/l 1st post-operative day	0.47 (0.29–0.75)	0.002	0.41 (0.23–0.73)	0.002

L'anémie (sévère, Hb<10 g/dl) est associée à une moindre capacité de marche

Foss *Age and Ageing* 2008

Association Anémie / récupération post-opératoire



n=172 pts
post-op de CEC

Durées de séjour pos-op **+4 jours** si Hb<10 g/dl

Ranucci *Ann Thorac Surg* 2011

Anaesthesia 2022 doi:10.1111/anae.15859

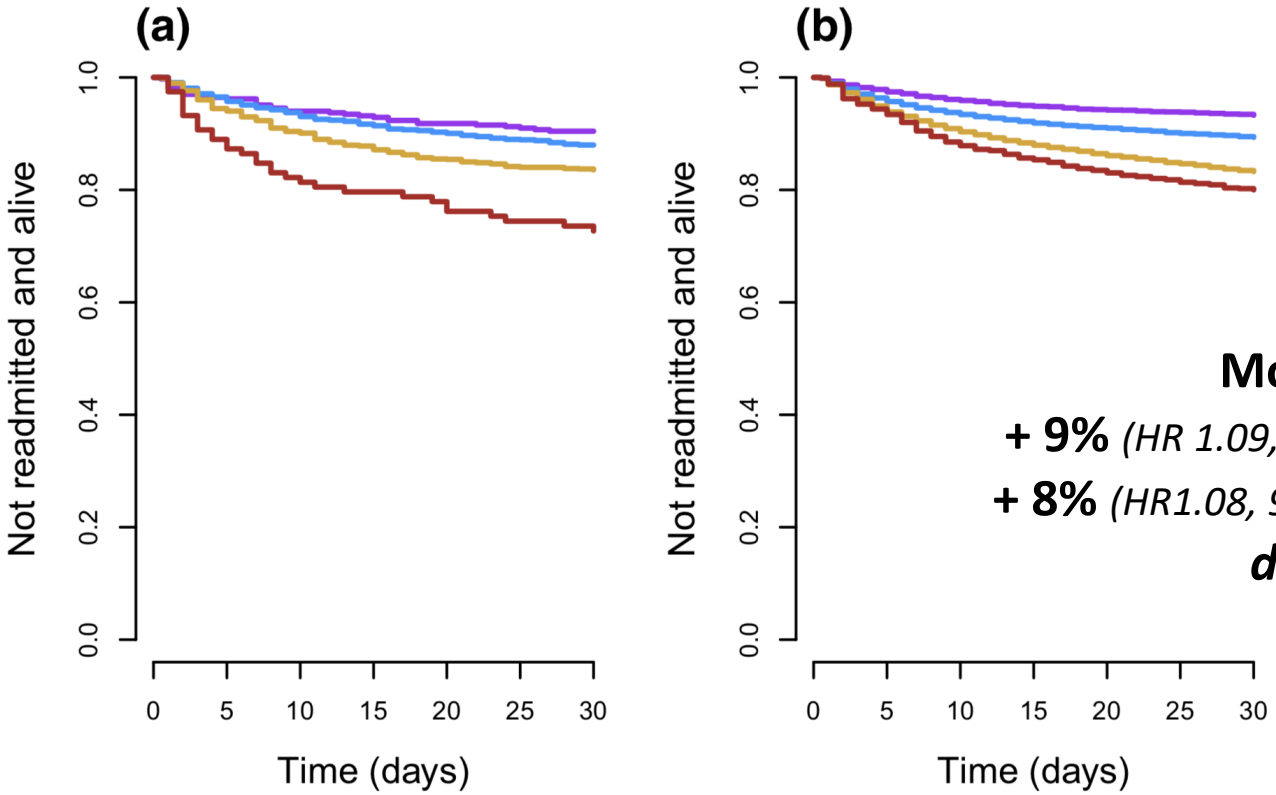
Original Article

Association between anaemia and hospital readmissions in patients undergoing major surgery requiring postoperative intensive care

M. A. Warner,[1] A. C. Hanson,[2] C. Plimier,[3] C. Lee,[4,5] V. X. Liu,[6] T. Richards,[7] D. J. Kor[8] and N. H. Roubinian[9,10]

Études US: 2 cohortes 3260 et 29452 pts,
chirurgies lourdes (USI postop)
Evaluation Hb sortie hopital - Réadmissions

Plus de réadmissions quand Anémie post-op



Moins 1 g/dL d'Hb =

+ 9% *(HR 1.09, 95%CI 1.02–1.18; p = 0.014) et*

+ 8% *(HR1.08, 95%CI 1.06–1.11; p < 0.001)*

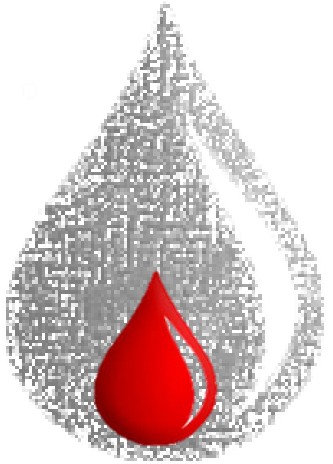
de réadmissions !

Warner *Anaesthesia* 2022

Le saignement opératoire fait le lit de la Carence Martiale

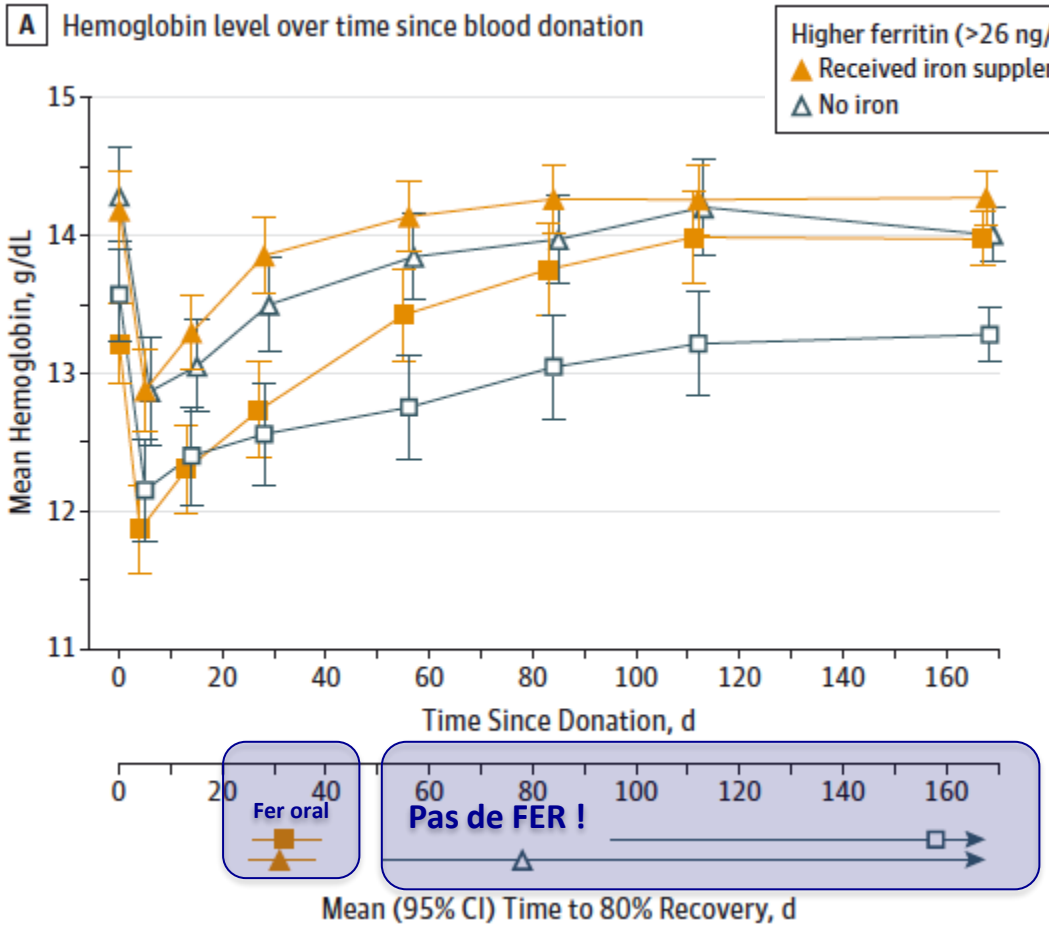
PRE-op

Chirurgie…



POST-op

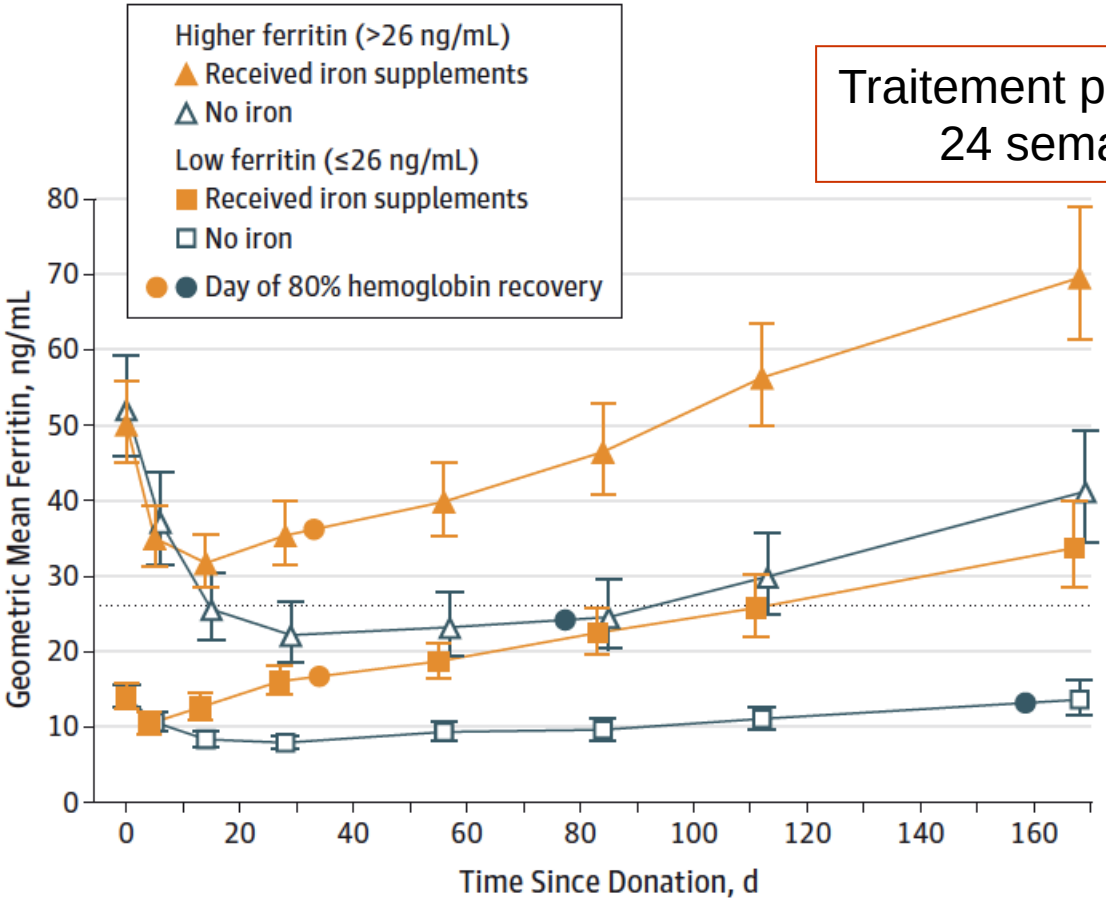
Evolution de l'Hb après don de 500 ml de sang



- 215 donneurs de sang (500 ml)
- Randomisés: fer oral vs controle pdt 24 semaines

Kiss *JAMA* 2015

Mais pas de correction de la CM !

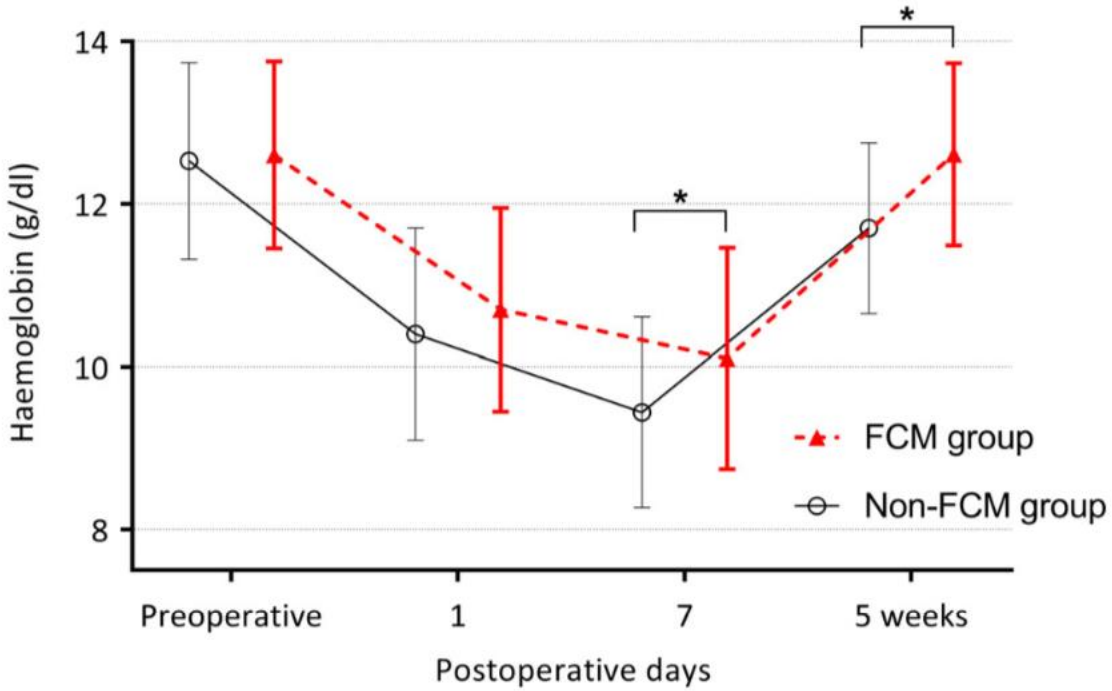


Traitement par fer oral
24 semaines!

Kiss *JAMA* 2015

Fer IV en SSPI

- Étude rétrospective coréenne
- PTG
- Propensity score
- 231 FCM (1g à H1 post-op) vs 231 control



Park *Vox Sanguinis* 2021

Moins d'anémies et de transfusion

TABLE 3 The rate of postoperative anaemia and its severity after propensity scored matching

	Non-FCM group N = 231	FCM group N = 231	*p*-Value
Overall anaemia			
POD-1	207 (89.6)	197 (85.3)	0.206
POD-7	225 (97.4)	213 (92.2)	0.021
POW-5	140 (60.6)	75 (32.5)	<0.001
Moderate to severe anaemia			
POD-1	180 (77.9)	161 (69.7)	0.057
POD-7	197 (85.3)	162 (70.1)	<0.001
POW-5	54 (23.4)	19 (8.2)	<0.001

⇩ Anémie –50%

Transfusion post-op
13.4 vs 5.2 %
p=0.008

Park *Vox Sanguinis* 2021

Un exemple de Fer IV en post-opératoire

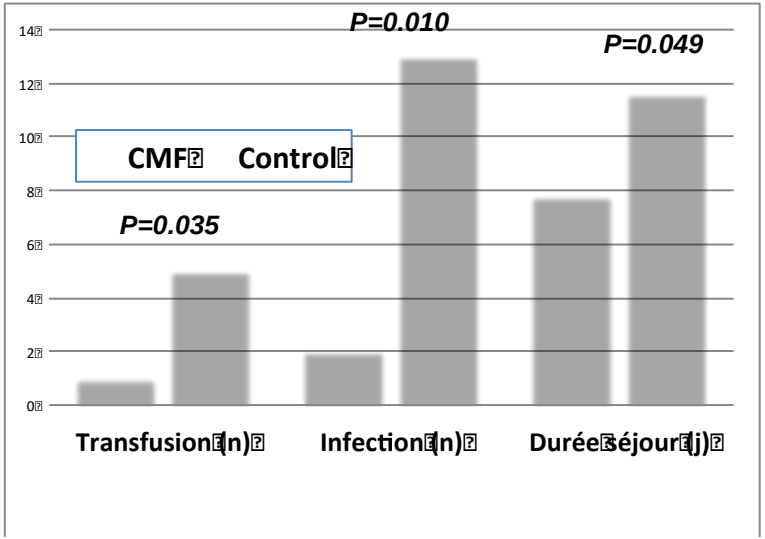
- Etude randomisée, ouverte, bi-centrique
- J1 post op (ortho++, Visc, Uro, gyneco)
  - Chirurgie réglée
  - Séjour≥ 2 nuits
  - Hb [7 – 12 g/dl]
  - CM= Ferritine<100 ou TSAT<20%
- Randomisation CMF 1g vs standard of care

Khallafallah *Lancet Haematol* 2016

	Standard care (control; n=98)	Intravenous ferric carboxymaltose (intervention; n=103)	Treatment effect*	p value
Haemoglobin (g/L)				
Preoperative	134·40 (13·10)	134·50 (11·10)	−0·61 (−4·31 to 3·09)	0·094
Postoperative (day 1)	105·50 (13·80)	106·20 (11·90)	0·00	
4 weeks	121·50 (14·50)	130·10 (11·30)	7·84 (3·79 to 11·9)	<0·0001
12 weeks	133·60 (11·30)	137·50 (11·10)	3·07 (−0·99 to 7·14)	0·24
Iron saturation (%)				
Preoperative	22·60 (6·70)	22·30 (4·70)	0·01 (−2·82 to 2·83)	0·82
Postoperative (day 1)	12·00 (5·60)	11·70 (6·60)	0·00	
4 weeks	19·70 (10·70)	30·90 (11·70)	11·40 (8·33 to 14·50)	<0·0001
12 weeks	25·30 (13·10)	31·70 (9·50)	6·62 (2·78 to 10·50)	0·0026
Serum ferritin (µg/L)				
Preoperative	188·00 (103·00)	118·00 (185·00)	−45·20 (−148·00 to 57·50)	0·18
Postoperative (day 1)	329·00 (335·00)	304·00 (423·00)	0·00	
4 weeks	274·00 (296·00)	717·00 (410·00)	468·00 (355·00 to 582·00)	<0·0001
12 weeks	196·00 (231·00)	481·00 (611·00)	309·00 (159·00 to 460·00)	0·0026

Baisse Hb
=
CM post opératoire

Khallafallah *Lancet Haematol* 2016



- ↓ **Transfusion** *(IRR 0.10 [0.01-0.85])*
- ↓ **Infection** *(IRR 0.14 [0.03-0.63])*
- ↓ **Durée de séjour** *(-3.8 j [-7.7 - -0.02])*

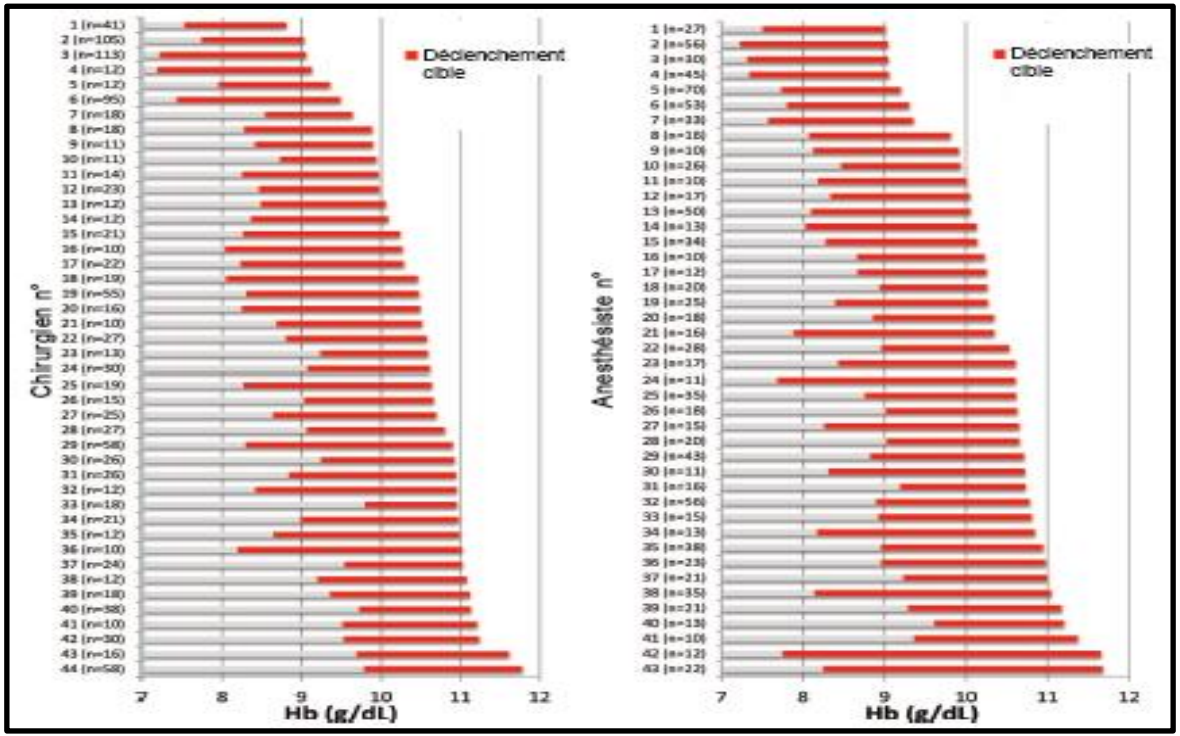
	Standard care (control; n=73)	Intravenous ferric carboxymaltose (intervention; n=97)	Treatment effect*	p value
Physical scales				
Physical functioning				
Postoperative (day 1)	45·7 (31·4)	45·7 (29·6)	0·00	
4 weeks	33·6 (23·5)	42·1 (28·9)	8·47 (–3·50 to 20·40)	0·17
12 weeks	53·4 (27·6)	55·9 (26·7)	2·45 (–9·90 to 14·80)	0·70
Role physical†				
Postoperative (day 1)	52·8 (27·0)	41·2 (31·3)	0·00	
4 weeks	27·6 (25·6)	30·0 (26·8)	14·00 (0·18 to 27·80)	0·047
12 weeks	52·4 (28·6)	58·4 (27·5)	17·60 (4·37 to 30·90)	0·0092

- ↓ **Fatigue physique**

Khallafallah *Lancet Haematol* 2016

Le pilier 3: Tolérance à l'anémie

Les seuils transfusionnels sont très variables !



N = 2 981 patients recevant des transfusions

Bord gauche de la **barre rouge** : Valeur moyenne de l'Hb au début de la transfusion
Bord droit de la **barre rouge** : Valeur moyenne de l'Hb après la dernière transfusion

Frank S et al. Anesthesiology. 2012. 117(1): 99–106.

JAMA | Special Communication

Patient Blood Management
Recommendations From the 2018 Frankfurt Consensus Conference

Markus M. Mueller, MD; Hans Van Remoortel, PhD; Patrick Meybohm, MD, PhD; Kari Aranko, MD, PhD; Cécile Aubron, MD, PhD; Reinhard Burger, PhD; Jeffrey L. Carson, MD, PhD; Klaus Cichutek, PhD; Emmy De Buck, PhD; Dana Devine, PhD; Dean Fergusson, PhD; Gilles Folléa, MD, PhD; Craig French, MB, BS; Kathrine P. Frey, MD; Richard Gammon, MD; Jerrold H. Levy, MD; Michael F. Murphy, MD, MBBS; Yves Ozier, MD; Katerina Pavenski, MD; Cynthia So-Osman, MD, PhD; Pierre Tiberghien, MD, PhD; Jimmy Volmink, DPhil; Jonathan H. Waters, MD; Erica M. Wood, MB, BS; Erhard Seifried, MD, PhD; for the ICC PBM Frankfurt 2018 Group

Les stratégies transfusionnelles restrictives sont recommandées!

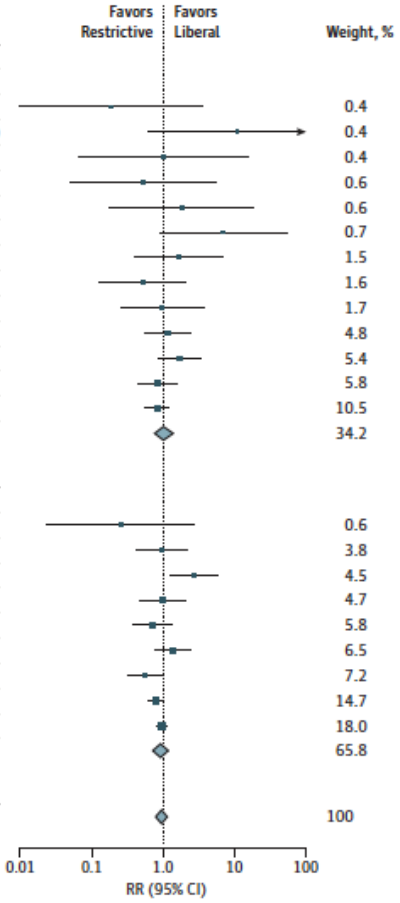
Table 2. Clinical Recommendations: Red Blood Cell Transfusion Thresholds

Clinical Recommendation	Level of Evidence
CR5—Restrictive RBC transfusion threshold (hemoglobin concentration <7 g/dL) in critically ill but clinically stable intensive care patients	Strong recommendation, moderate certainty in the evidence of effects
CR6—Restrictive RBC transfusion threshold (hemoglobin concentration <7.5 g/dL) in patients undergoing cardiac surgery	Strong recommendation, moderate certainty in the evidence of effects
CR7—Restrictive transfusion threshold (hemoglobin concentration <8 g/dL) in patients with hip fracture and cardiovascular disease or other risk factors	Conditional recommendation, moderate certainty in the evidence of effects
CR8—Restrictive transfusion threshold (hemoglobin concentration 7-8 g/dL) in hemodynamically stable patients with acute gastrointestinal bleeding	Conditional recommendation, low certainty in the evidence of effects

Mueller *JAMA* 2019

Figure 1. Comparison of 30-Day Mortality Using Restrictive vs Liberal Hemoglobin Transfusion Thresholds in Randomized Clinical Trials

Source	Restrictive Transfusion Threshold: No. of Deaths	Restrictive Transfusion Threshold: Total No.	Liberal Transfusion Threshold: No. of Deaths	Liberal Transfusion Threshold: Total No.	RR (95% CI)	Weight, %
Restrictive threshold, hemoglobin <8 to 9 g/dL						
Lotke et al,[75] 1999	0	62	0	65	Not estimable	
Blair et al,[53] 1986	0	26	2	24	0.19 (0.01-3.67)	0.4
Foss et al,[63] 2009	5	60	0	60	11.00 (0.62-194.63)	0.4
Carson et al,[58] 1998	1	42	1	42	1.00 (0.06-15.47)	0.4
Webert et al,[86] 2008	1	29	2	31	0.53 (0.05-5.58)	0.6
Cooper et al,[61] 2011	2	23	1	21	1.83 (0.18-18.70)	0.6
Carson et al,[56] 2013	7	55	1	55	7.00 (0.89-55.01)	0.7
Parker,[78] 2013	5	100	3	100	1.67 (0.41-6.79)	1.5
Bracey et al,[54] 1999	3	215	6	222	0.52 (0.13-2.04)	1.6
Bush et al,[55] 1997	4	50	4	49	0.98 (0.26-3.70)	1.7
Hajjar et al,[68] 2010	15	249	13	253	1.17 (0.57-2.41)	4.8
Gregersen et al,[64] 2015	21	144	12	140	1.70 (0.87-3.32)	5.4
Jairath et al,[72] 2015	14	257	25	382	0.83 (0.44-1.57)	5.8
Carson et al,[60] 2011	43	1009	52	1007	0.83 (0.56-1.22)	10.5
Subtotal	121	2321	122	2451	1.05 (0.78-1.40)	34.2
Heterogeneity: $\tau^2=0.02$; $\chi^2_{12}=13.14$; $P=.36$; $I^2=9\%$						
Tests for overall effect: z score = 0.31; $P=.76$						
Restrictive threshold, hemoglobin <7 g/dL						
DeZern et al,[87] 2016	1	59	2	30	0.25 (0.02-2.69)	0.6
Hébert et al,[70] 1995	8	33	9	36	0.97 (0.42-2.22)	3.8
de Almeida et al,[79] 2015	23	101	8	97	2.76 (1.30-5.87)	4.5
Lacroix et al,[74] 2007	14	320	14	317	0.99 (0.48-2.04)	4.7
Walsh et al,[85] 2013	12	51	16	49	0.72 (0.38-1.36)	5.8
Murphy et al,[76] 2015	26	1000	19	1003	1.37 (0.76-2.46)	6.5
Villanueva et al,[84] 2013	19	416	34	417	0.56 (0.32-0.97)	7.2
Hébert et al,[69] 1999	78	418	98	420	0.80 (0.61-1.04)	14.7
Holst et al,[71] 2014	168	502	175	496	0.95 (0.80-1.13)	18.0
Subtotal	349	2900	375	2865	0.94 (0.74-1.19)	65.8
Heterogeneity: $\tau^2=0.05$; $\chi^2_8=16.09$; $P=.04$; $I^2=50\%$						
Tests for overall effect: z score = 0.53; $P=.59$						
Overall	470	5221	497	5316	0.97 (0.81-1.16)	100
Heterogeneity: $\tau^2=0.04$; $\chi^2_{21}=29.75$; $P=.10$; $I^2=29\%$						
Tests for overall effect: z score = 0.29; $P=.77$						
Tests for subgroup differences: $\chi^2_1=0.34$; $P=.56$; $I^2=0\%$						



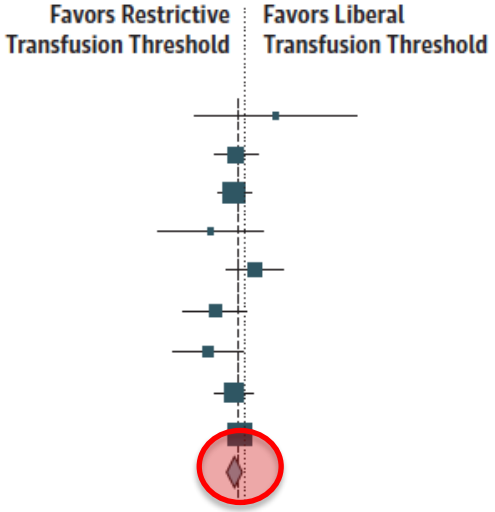
Les stratégies restrictives ne font pas moins bien

Carson *JAMA* 2016

La transfusion restrictive réduit le risque d'infection nosocomiale

Figure 2. Forest Plot of Risk Ratios for Infection Comparing Restrictive vs Liberal Transfusion Strategies

Source	Restrictive Transfusion Threshold		Liberal Transfusion Threshold		Risk Ratio (95% CI)
	No. of Events	Total No. of Patients	No. of Events	Total No. of Patients	
All serious infections, combined					
Bracey et al,[20] 1999	5	212	3	216	1.70 (0.41-7.02)
Hébert et al,[26] 1999	42	418	50	420	0.84 (0.57-1.24)
LaCroix et al,[27] 2007	65	320	79	317	0.82 (0.61-1.09)
Foss et al,[31] 2009	6	60	11	60	0.55 (0.22-1.38)
Hajjar et al,[21] 2010	29	249	25	253	1.18 (0.71-1.95)
So-Osman et al,[32] 2010	18	299	31	304	0.59 (0.34-1.03)
Karam et al,[35] 2011	12	69	23	68	0.51 (0.28-0.95)
Gregersen et al,[14] 2012					0.81 (0.58-1.14)
Villanueva et al,[11] 2013	84	444	94	445	0.90 (0.69-1.17)
Subtotal $I^2 = 0.0\%$, $P = .46$					0.82 (0.72-0.95)



18 études 7593 patients
Infections 11.8 vs 16.9%; RR 0.82[0.72-0.95]

Rohde *JAMA* 2014

méta-analyse
Seuils & « pts cardiaques »

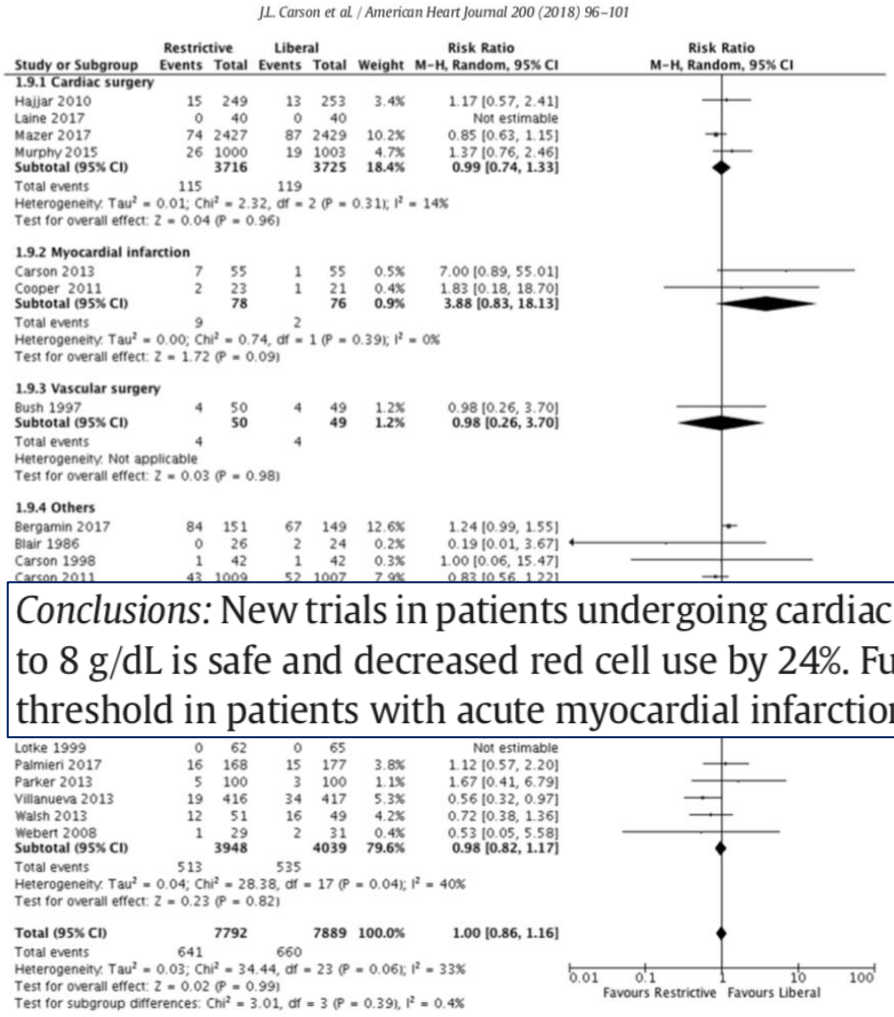


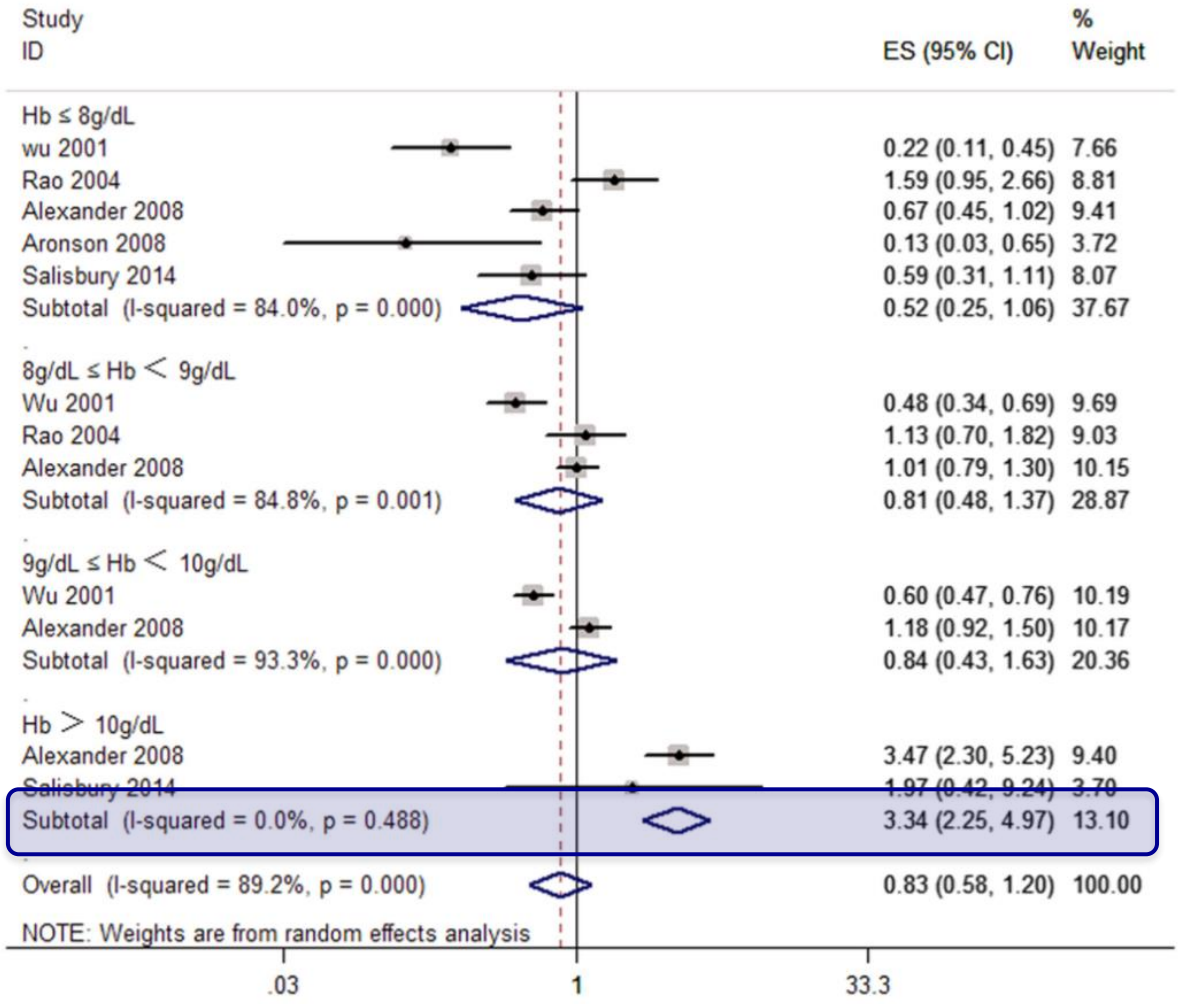
Figure 1. Thirty-day mortality in cardiac surgery, myocardial infarction, and vascular surgery versus all others.

Conclusions: New trials in patients undergoing cardiac surgery establish that a restrictive transfusion strategy of 7 to 8 g/dL is safe and decreased red cell use by 24%. Further research is needed to define the optimal transfusion threshold in patients with acute myocardial infarction.

37 études, 19.049 pts

Carson *Am Heart J* 2018

Seuils Transfusionnels & SCA



Blood transfusion and all-cause mortality in hemoglobin-stratified analyses

Métaanalyse
17 études observationnelles
2.525.550 pts

Probablement:
. *Cible 8-9 g/gl*
. *Ne pas dépasser 10 g/dl*

Wang *Ann Intern Med* 2018

Reality study : stratégie restrictive pour SCA aussi!

JAMA Network

QUESTION Is a restrictive strategy of blood transfusion noninferior to a liberal strategy among patients with acute myocardial infarction (MI) and anemia?

CONCLUSION This trial found that a restrictive transfusion strategy vs a liberal one resulted in a noninferior rate of MACE among patients with acute MI and anemia, but the confidence interval included what may be a clinically important harm.

POPULATION

385 Men
281 Women

Adults with MI and anemia (hemoglobin, 7-10 g/dL)

Median age: 77 years

LOCATIONS

35 Hospitals in France and Spain

INTERVENTION

668 Patients randomized
666 Patients analyzed

342
Restrictive transfusion
Transfusion triggered by hemoglobin ≤8 g/dL

324
Liberal transfusion
Transfusion triggered by hemoglobin ≤10 g/dL

PRIMARY OUTCOME

MACE (composite of all-cause death, stroke, recurrent MI, or emergency revascularization prompted by ischemia) at 30 days. (Noninferiority = upper CI of <1.25)

FINDINGS

Occurrence of MACE at 30 days

Restrictive transfusion
36 of 342 patients
(95% CI, 7.5% to 14.6%)

Liberal transfusion
45 of 324 patients
(95% CI, 10.0% to 17.9%)

Between-group difference:
-3.0% (95% CI, -8.4% to 2.4%)

Relative risk for the primary outcome:
0.79 (1-sided 97.5% CI, 0 to 1.19), meeting criteria for noninferiority

Ducrocq G, Gonzalez-Juanatey JR, Puymirat E, et al. Effect of a restrictive vs liberal blood transfusion strategy on major cardiovascular events among patients with acute myocardial infarction and anemia: the REALITY randomized clinical trial. *JAMA*. Published February 9, 2021. doi:10.1001/jama.2021.0135

Augmentation de la morbidité des 1 CG

Table 4 | Surgical subgroup analyses with primary hierarchical logistic regression model for stroke/myocardial infarction. Odds ratios are adjusted for age, sex, race, insurance payor, cardiovascular risk factors,* cerebrovascular disease, coronary artery disease, obesity, smoking status, anemia, and interactions between transfusion and cardiovascular risk factors or cerebrovascular disease, as well as random effects by hospital

Subgroup variable	Colectomy (partial and total)	Small bowel resection	Hip/knee replacement or revision	Spine, including fusion and laminectomy	Hysterectomy
No of patients	37 989	16 179	432 419	196 802	112 960†
No (%) transfused	1748 (4.6)	647 (4.0)	15 516 (3.6)	3903 (2.0)	1747 (1.6)
No (%) with stroke/MI (%)	689 (1.8)	309 (1.9)	1447 (0.33)	670 (0.34)	115 (0.10)
Odds ratio for stroke/myocardial infarction (95% CI)					
pRBC use (units) (reference: 0 units):					
1	2.36 (1.33 to 4.19)	2.05 (0.66 to 6.30)	1.26 (0.78 to 2.03)	1.43 (0.65 to 3.14)	5.21 (1.15 to 23.7)
2	2.21 (1.38 to 3.54)	2.84 (1.32 to 6.11)	1.77 (1.22 to 2.56)	1.73 (0.90 to 3.33)	7.57 (3.33 to 17.2)
3	2.56 (1.06 to 6.17)	1.80 (0.23 to 13.9)	3.29 (1.61 to 6.74)	3.87 (1.46 to 10.3)	4.79 (1.45 to 15.8)
≥4	1.96 (0.84 to 4.54)	4.37 (1.45 to 13.1)	3.05 (1.29 to 7.21)	4.27 (1.73 to 10.5)	9.46 (2.29 to 39.0)

CHF=congestive heart failure; MI=myocardial infarction; pRBC=packed red blood cells

BMJ 2015;350:h3037

WHAT THIS STUDY ADDS

There is an association between perioperative transfusion of as little as one unit of blood and ischemic stroke or myocardial infarction

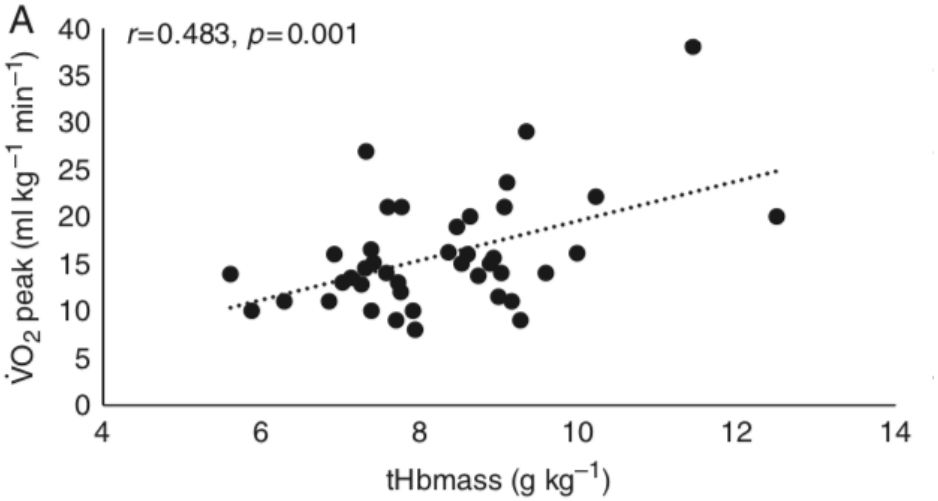
NICE guidelines

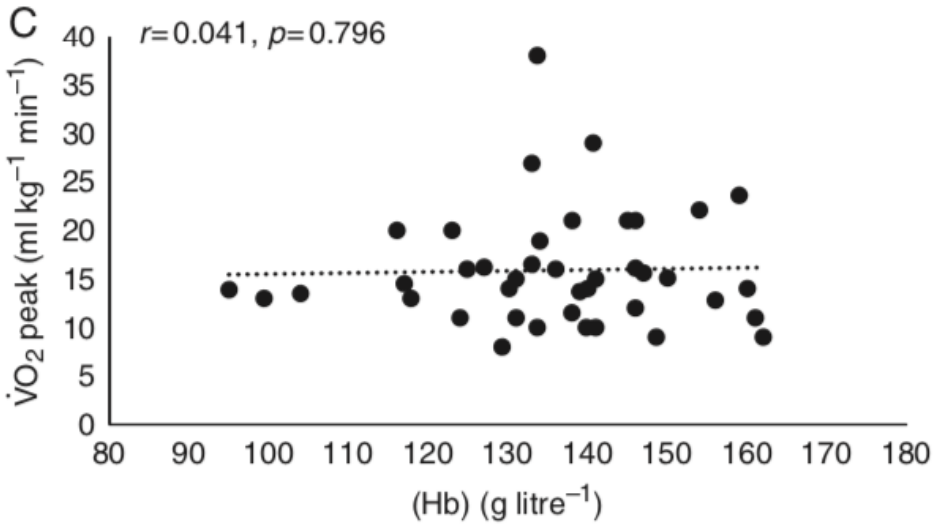
1 Single Unit Policy

Don't give two without review

THINK!

- Is your patient symptomatic?
- Is the transfusion appropriate?
- What is the haemoglobin trigger level?
- What is the patient's target haemoglobin level?





La masse d'Hb est associée à la VO2

- La masse d'Hb est plus importante que la concentration
- Explique **44%** de la variance de la VO2

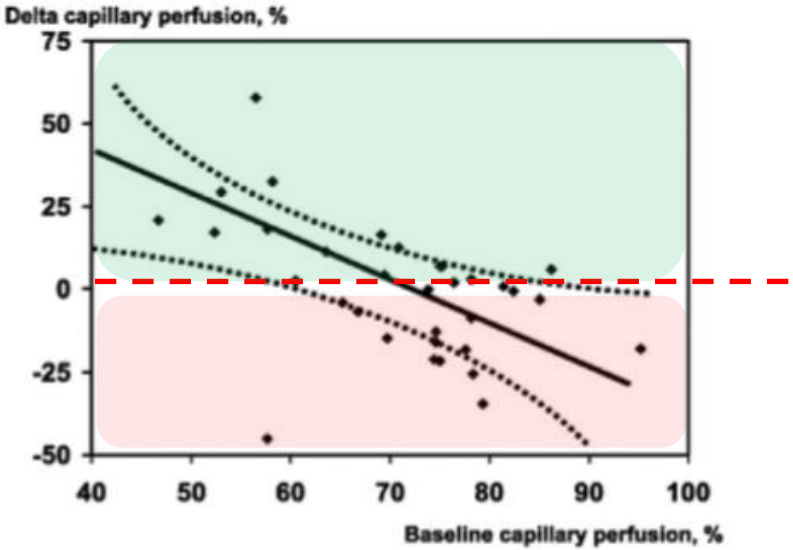
Attention à l'hémodilution

n=42 pts, VO2 pre-op
Mesure masse Hb (oCOR)

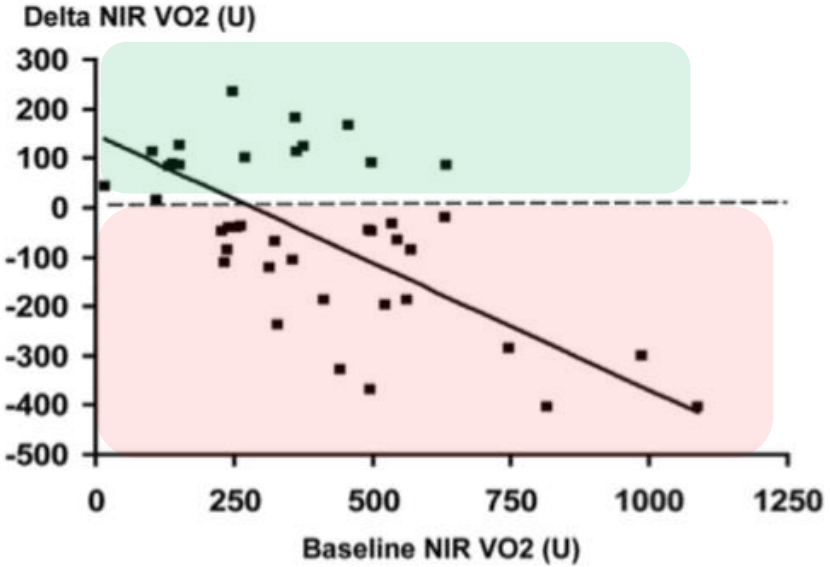
Otto *BJA* 2017

La transfusion n'améliore pas toujours le transport en O2

Perfusion capillaires



Oxygénation tissulaire

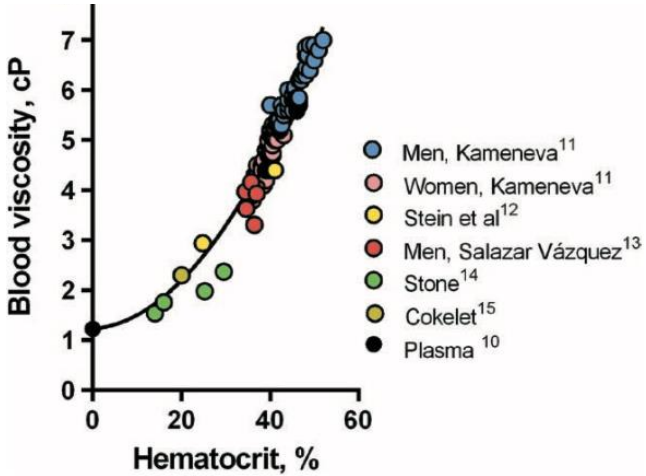


Weinberg *Best Pract Res Clin Anaesth* 2016

Posttransfusion Increase of Hematocrit per se Does Not Improve Circulatory Oxygen Delivery due to Increased Blood Viscosity

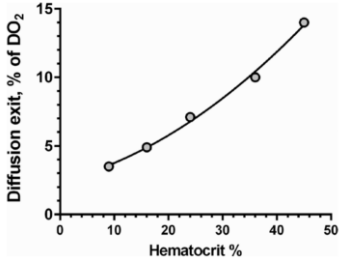
(Anesth Analg 2017;XXX:00–00)

Robert Zimmerman, MS,* Amy G. Tsai, PhD,† Beatriz Y. Salazar Vázquez, MD, PhD,†‡§ Pedro Cabrales, PhD,† Axel Hofmann, ME, PhD,‖ Jens Meier, MD, PhD,# Aryeh Shander, MD,** Donat R. Spahn, MD,¶ Joel M. Friedman, MD, PhD,†† Daniel M. Tartakovsky, PhD,* and Marcos Intaglietta, PhD†



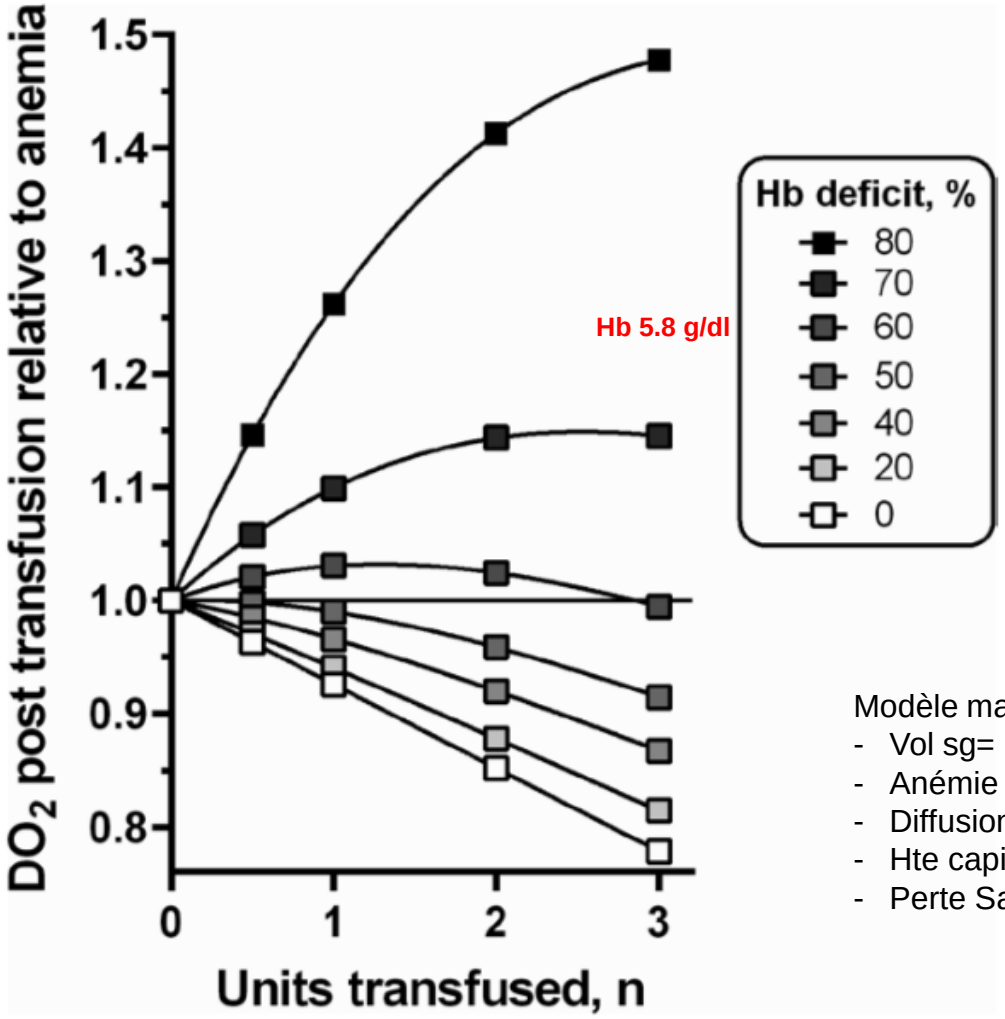
$$DO_2 = CO \times CaO_2 (\text{or } Hct),$$

$$CO = \frac{\Delta P}{R} = \frac{\pi \times r^4}{8 \times \mu(Hct)} \qquad DO_2 = \frac{k}{\mu(Hct)} Hct\ .$$



Blood Flow ↓ → D02 ↓

Zimmerman *Anesth Anal* 2017



Le transport en O2 peut diminuer avec la transfusion!

(par augmentation de la viscosité)

$$R_{T,a} = \frac{DO_{2,\,posttrans(T)}}{DO_{2,\,anemic\ state(a)}} = \frac{Hct_T}{Hct_a} \times \frac{\mu_a}{\mu_T}.$$

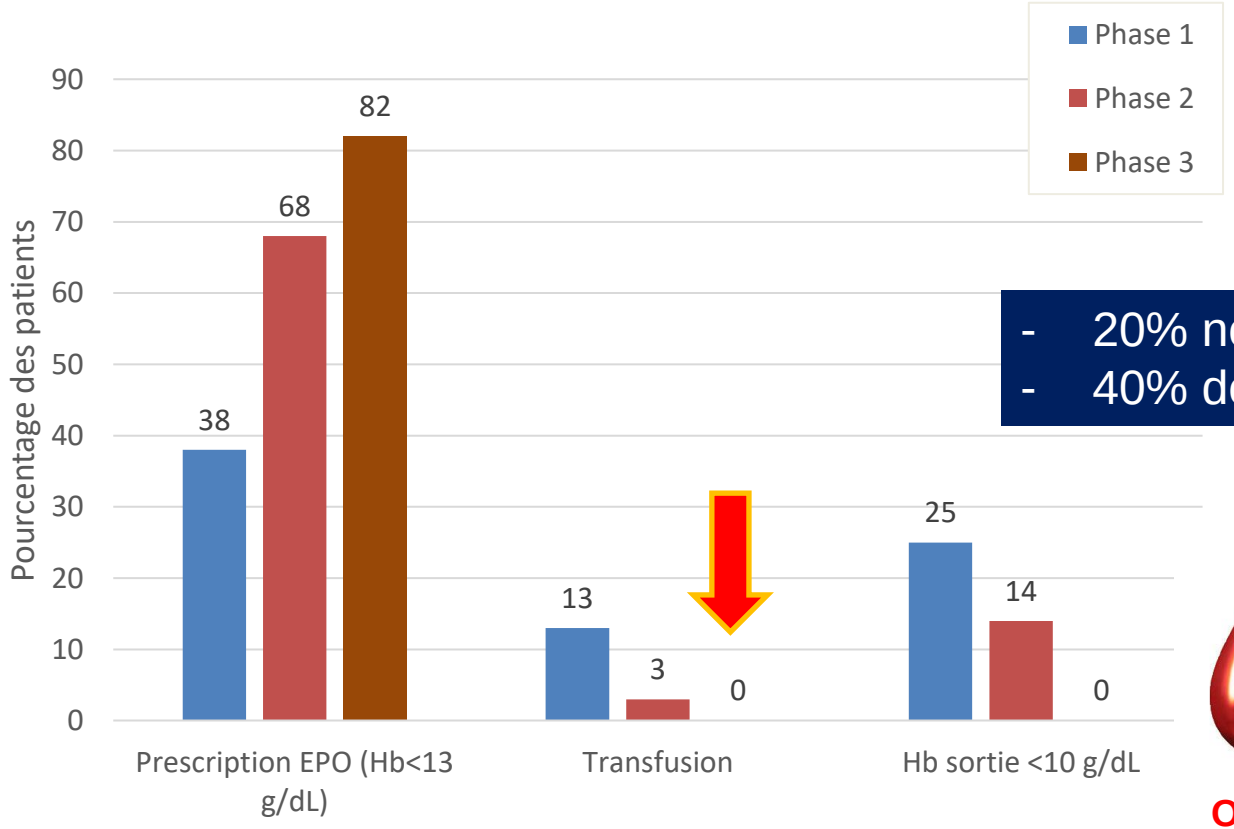
Modèle mathématique

- Vol sg= 5l, Hte= 45%, DC= 5 $l.min^{-1}$, SaO2 100%
- Anémie à volume constant
- Diffusion O_2 capillaire selon temps transit
- Hte capil ≃ ½ Hte V
- Perte Sat O_2: central Blood – Capil (A3) ≃ -14%.

Zimmerman *Anesth Anal* 2017

EST-CE QUE ÇA MARCHE ?

Evaluation PBM Angers 2014-2020: EPO+FER
ZERO transfusion!

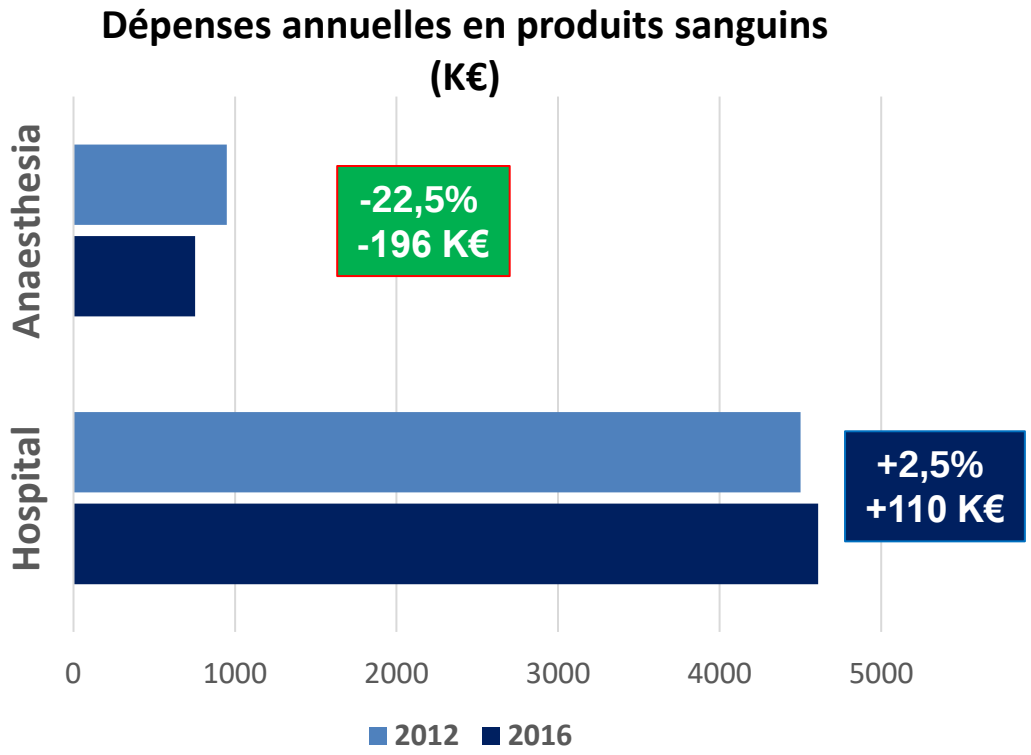


- 20% non traités en pré-op
- 40% de CM non traité

ZET

Objectif Zero Transfusion !

Le PBM c'est rentable !



Les économies réalisées compensent l'augmentation des dépenses du CHU

Perfusions de FER = **RECETTES !**

Année	Valorisation
M12 2015	54 235,38
M12 2016	47 123,21
M3 2017	12 684,26
Total	**114 042,85 €**

Conclusions

Le PBM est un **must** *(amélioration devenir des patients!)*

- Multiples recos

Besoin d'une bonne coordination / **travail d'équipe**

- *Bilan avant CS*
- *Simplification traitement: EPO+FER*
- *Possibilité de rattrapage*

Voir le positif !

- Bénéfices pour le patient traité !

- Bénéfices pour institution et collectivité