Перипоперативна Анемија

Н.доц. Марија Јовановски -Срцева

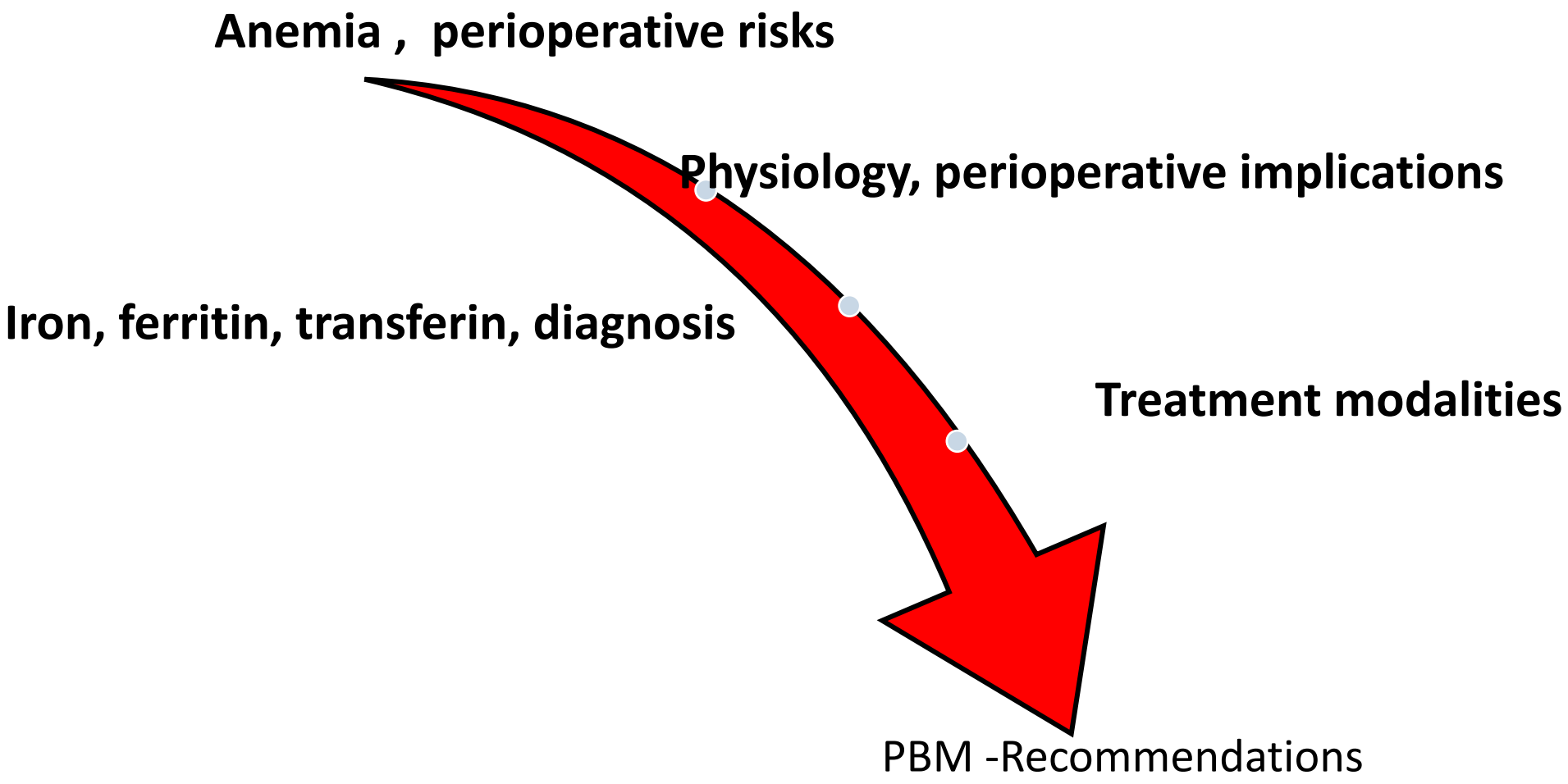
Marija Jovanovski-Srceva MSc, PhD

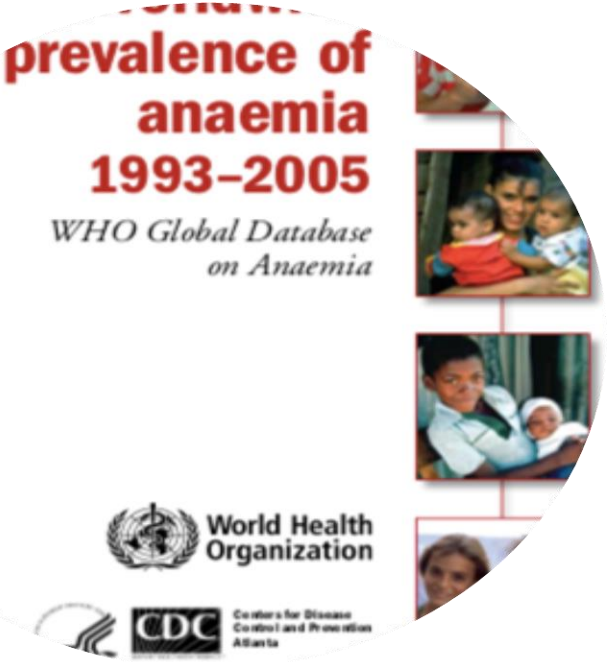
Anemia

Talking anemia is offensive???
Paradigm

- Started a study for Anemia and PBM issues
- In 80 primary care settings
- Not Published, GOING ON

- DEVESTATING

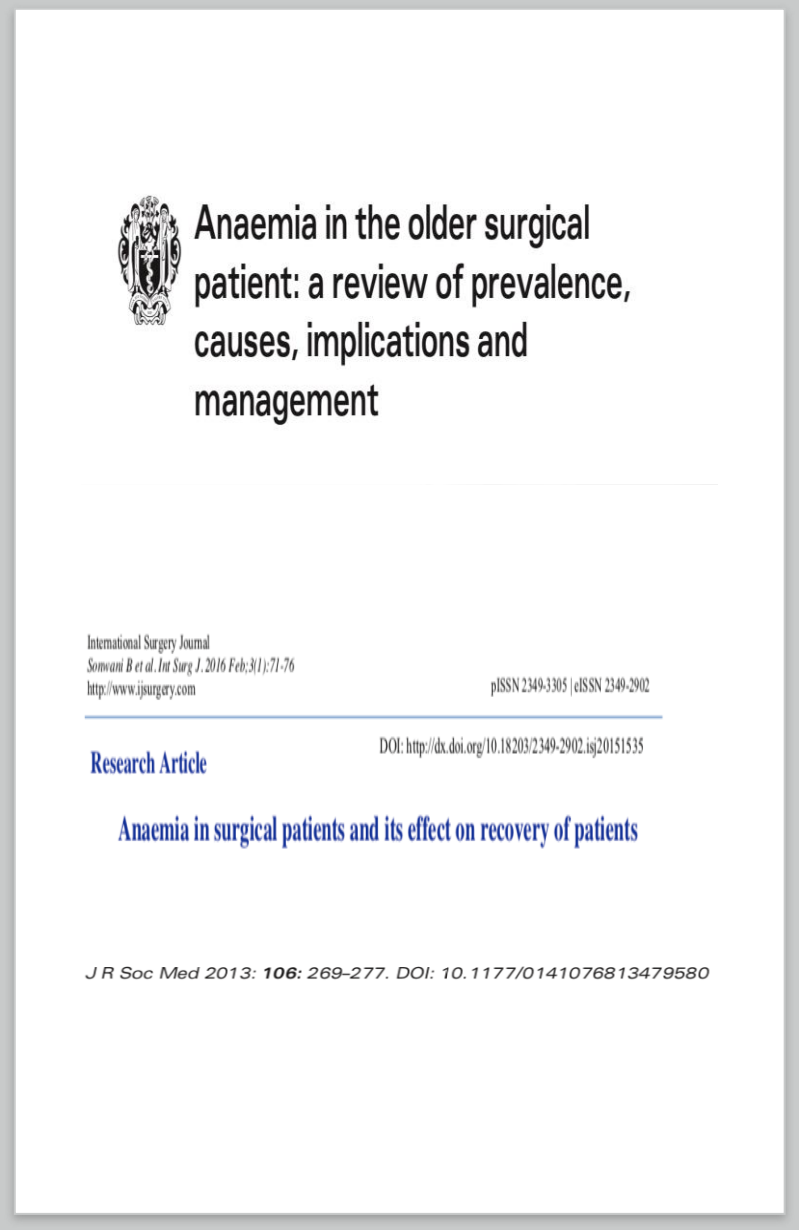

Anemia , perioperative risks
Physiology, perioperative implications
Iron, ferritin, transferin, diagnosis
Treatment modalities
PBM -Recommendations



Facts

- **prevalence 5-75%(*Shander et al.2004)***
- **50% is iron deficiency anemia**

- *de Benoist B et al., eds. Worldwide prevalence of anaemia 1993-2005. WHO Global Database on Anaemia Geneva, World Health Organization, 2008*
- *the global prevalence of anaemia in 2011 - World Health ...*
- *https://apps.who.int › iris › bitstream › handle › 9789241564960_eng*



Anaemia in the older surgical patient: a review of prevalence, causes, implications and management

International Surgery Journal
Sonwani B et al. Int Surg J. 2016 Feb;3(1):71-76
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

Research Article
DOI: http://dx.doi.org/10.18203/2349-2902.isj20151535

Anaemia in surgical patients and its effect on recovery of patients

J R Soc Med 2013; **106**: 269–277. DOI: 10.1177/0141076813479580

Facts -surgery

- >30% have anemia on the day of surgery
- 48 % (>65y)have unexplained anemia
- cardiac surgery (40,4 %), Emergency hip(>45 %)
- **Surgery, age, gender and status**

Steinberg A et al. Anesth Intensivmed 2015;56:64-74

Anemia is harmless- we have weapon for that?

- MOST CLINICANS THINK TRANSFUSION IS THE WEAPON

- ARE WE SURE?

European Society of Anaesthesiology ESA

Eur. J Anesthesiology 2017; 34: 332-395

•Preoperative anemia in adults and children appears to be **a strong predictor** for **perioperative blood transfusion** across various types of conditions and surgeries and may be **associated with adverse events**. **B**

Anemia as a risk

- Anemia is – RISK FACTOR –multi dimensional
  - *Fowler BJM 2015*
- Mild anemia- (colorectal surgery >20 000) (AMI, stroke, death)
  - *Leichete J. Am Coll Surg 2011*
- Independent predictive risk - mortality and death

Beatie et all, 2009;Spahn D, 2010;Musllam et al, 2011

- Preop anemia - Co existing anemia increases health care costs

  Dowling,2007;

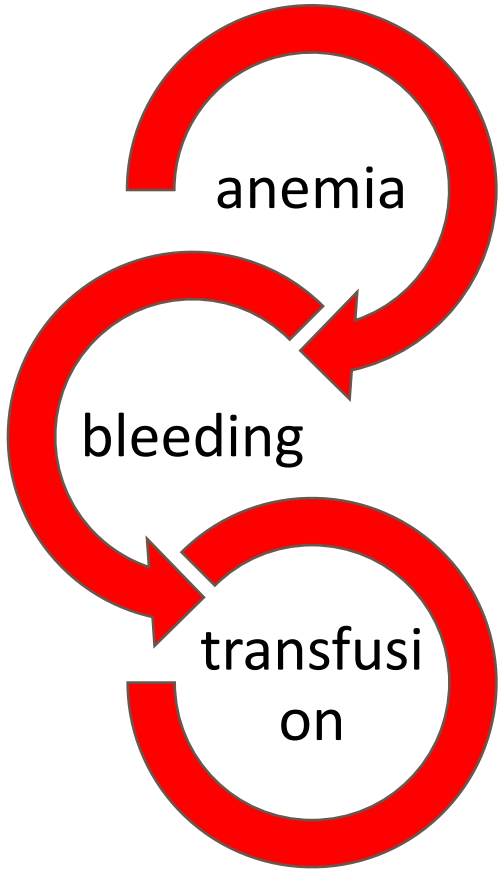
  Kaser et al 2019

- Increases the adverse events

  Fredericke C et al 2019

- Predictor for transfusion, and transfusion costs

  - *Munoz, BJA 2015*
  - Kaser et al 2019

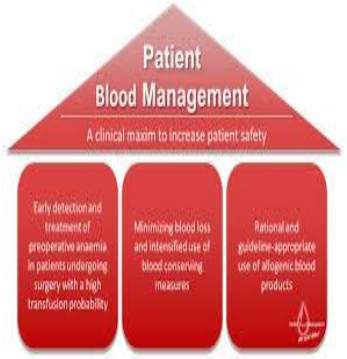


>5 mil pts (24 mil of units blood) yearly

(ANNUAL SUMMARY OF THE REPORTING ADVERESE REACTIONS AND EVENTS 2015, EUROPIAN COMMISION.

- With such numbers, WE HAVE TO CHANGE OUR ATTITUDES
- AWERNESS YES, BUT ADRESSALBNES ALSO is a matter of thing
- DOING SMTH.
- Anemia has influence on every part of the perioperative part

	DETECTION AND MANEGMENT ANEMIA	MINIMISATION OF BLOOD LOOS AND BLEEDING	MANEGMENT ANEMIA AND IMPROVE TOLERANCE
PRE-OP	• Aim for assessment of anaemia 4–6 weeks before surgery • Identify, evaluate and treat anaemia • Treat absolute or functional iron deficiency with oral or i.v. iron • Consider erythropoiesis stimulating agents if nutritional anaemia is ruled out/treated • Refer for further evaluation as necessary	• Identify and manage bleeding risk (past medical and family history) • Review medications (antiplatelet, anticoagulation therapy) • Minimize iatrogenic blood loss • Procedure planning and rehearsal	• Compare estimated blood loss with patient specific tolerable blood loss • Assess and optimize patient's physiologic reserve e.g. pulmonary and cardiac function • Formulate patient-specific management plan using appropriate blood conservation modalities
INTRA-OP	• Schedule surgery with optimization of red cell mass	• Meticulous haemostasis and surgical techniques • Anaesthetic blood sparing techniques e.g. central neuraxial blockade • Balanced physiology to aid optimal coagulation • Patient positioning • Goal directed management using point of care and VET • Antifibrinolysis and cell salvage	• Optimize cardiac output • Optimize oxygenation and ventilation • Evidence based transfusion thresholds
POST-OP	• Stimulate erythropoiesis • Manage nutrition and correctable anaemia (e.g. avoid folate deficiency, iron restricted erythropoiesis)	• Monitor and manage bleeding • Avoid secondary haemorrhage • Maintain normothermia (unless specifically indicated) • Autologous blood salvage • Minimize iatrogenic blood sampling loss • Haemostasis/anticoagulation management	• Maximize oxygen delivery • Minimize oxygen consumption • Avoid/treat infections promptly • Evidence based transfusion thresholds

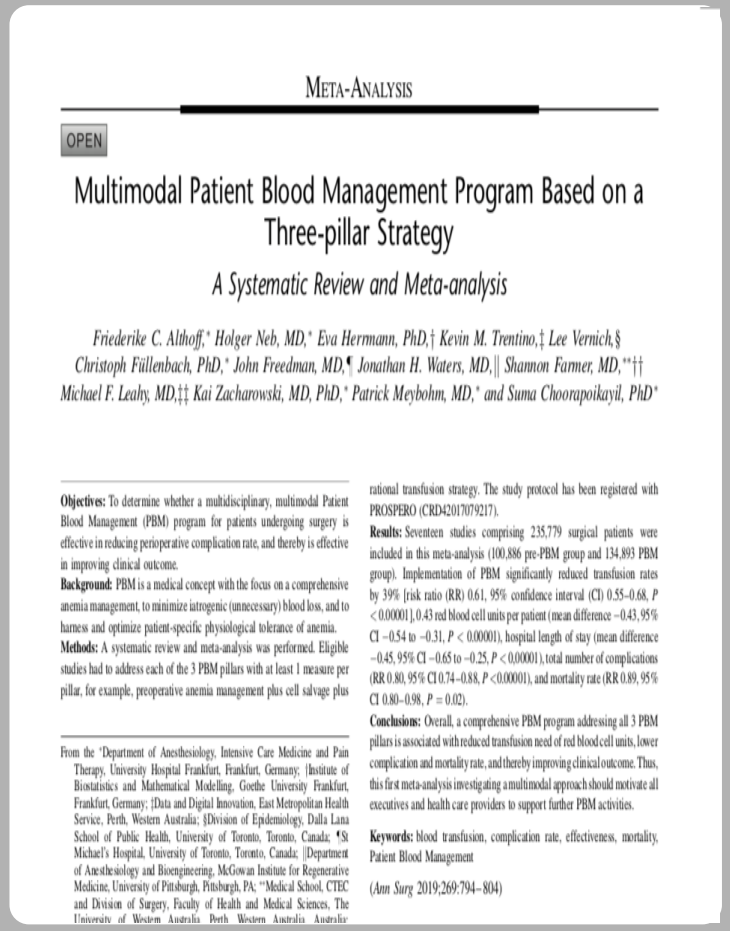


The timely application of EBM concepts designed

to maintain HB concentrations,
optimize hemostasis
minimize blood loss
in a effort to improve patient outcome

WHO ASSEMBLY – PBM – PATIENT SAFTYY
WHA 63.12 RESOLUTION WHO MEMENERS SHOUD IMPLEMENT

PBM organization chart per the Society for the advanced Blood Management



META-ANALYSIS

OPEN

Multimodal Patient Blood Management Program Based on a Three-pillar Strategy

A Systematic Review and Meta-analysis

Friederike C. Althoff, Holger Neb, MD,* Eva Herrmann, PhD,† Kevin M. Trentino,‡ Lee Vernich,§ Christoph Füllenbach, PhD,* John Freedman, MD,¶ Jonathan H. Waters, MD,‖ Shannon Farmer, MD,**†† Michael F. Leahy, MD,‡‡ Kai Zacharowski, MD, PhD,* Patrick Meybohm, MD,* and Suma Choorapoikayil, PhD**

Objectives: To determine whether a multidisciplinary, multimodal Patient Blood Management (PBM) program for patients undergoing surgery is effective in reducing perioperative complication rate, and thereby is effective in improving clinical outcome.

Background: PBM is a medical concept with the focus on a comprehensive anemia management, to minimize iatrogenic (unnecessary) blood loss, and to harness and optimize patient-specific physiological tolerance of anemia.

Methods: A systematic review and meta-analysis was performed. Eligible studies had to address each of the 3 PBM pillars with at least 1 measure per pillar, for example, preoperative anemia management plus cell salvage plus rational transfusion strategy. The study protocol has been registered with PROSPERO (CRD42017079217).

Results: Seventeen studies comprising 235,779 surgical patients were included in this meta-analysis (100,886 pre-PBM group and 134,893 PBM group). Implementation of PBM significantly reduced transfusion rates by 39% [risk ratio (RR) 0.61, 95% confidence interval (CI) 0.55–0.68, $P < 0.00001$], 0.43 red blood cell units per patient (mean difference −0.43, 95% CI −0.54 to −0.31, $P < 0.00001$), hospital length of stay (mean difference −0.45, 95% CI −0.65 to −0.25, $P < 0.00001$), total number of complications (RR 0.80, 95% CI 0.74–0.88, $P < 0.00001$), and mortality rate (RR 0.89, 95% CI 0.80–0.98, $P = 0.02$).

Conclusions: Overall, a comprehensive PBM program addressing all 3 PBM pillars is associated with reduced transfusion need of red blood cell units, lower complication and mortality rate, and thereby improving clinical outcome. Thus, this first meta-analysis investigating a multimodal approach should motivate all executives and health care providers to support further PBM activities.

Keywords: blood transfusion, complication rate, effectiveness, mortality, Patient Blood Management

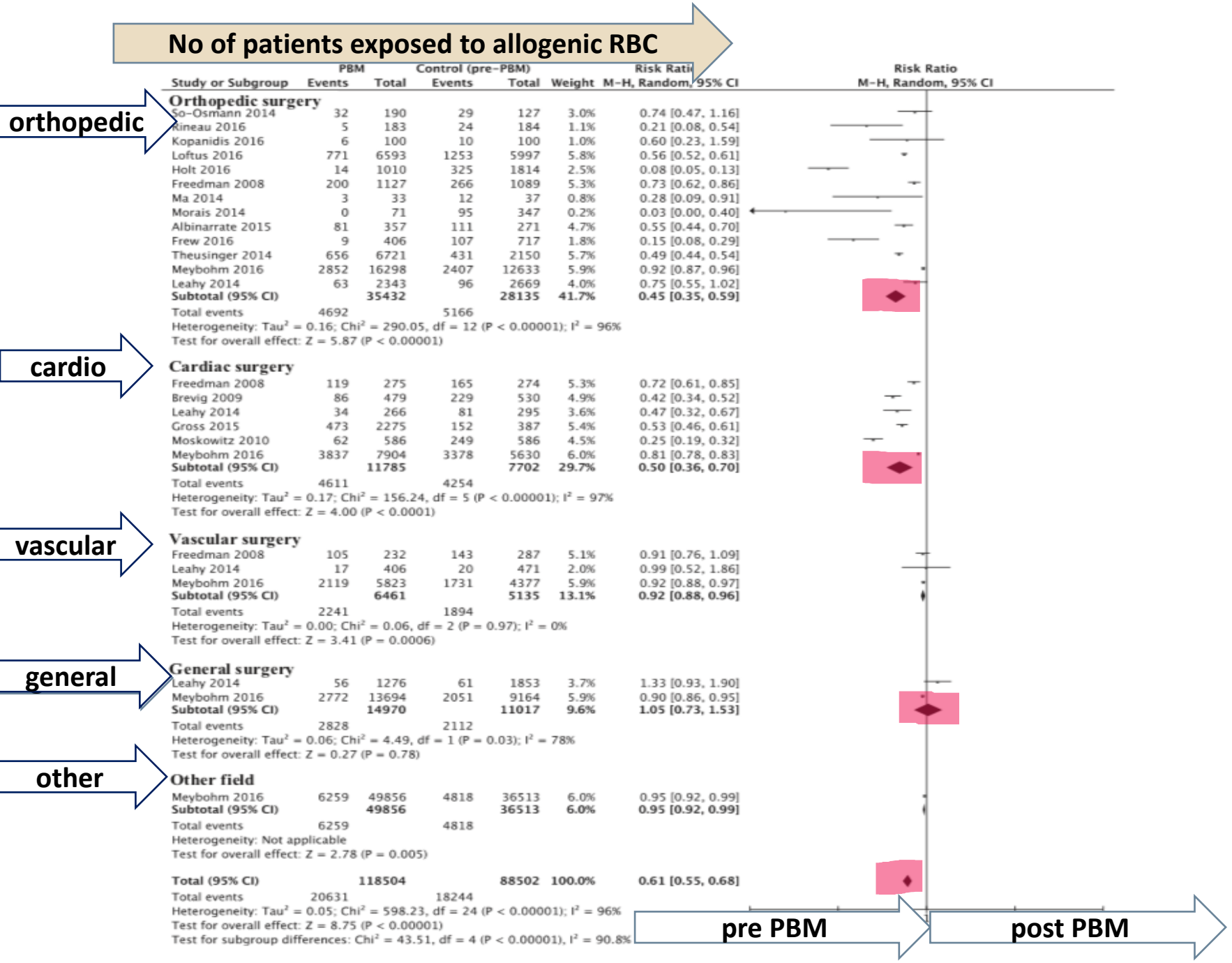
(*Ann Surg* 2019;269:794–804)

From the *Department of Anesthesiology, Intensive Care Medicine and Pain Therapy, University Hospital Frankfurt, Frankfurt, Germany; †Institute of Biostatistics and Mathematical Modelling, Goethe University Frankfurt, Frankfurt, Germany; ‡Data and Digital Innovation, East Metropolitan Health Service, Perth, Western Australia; §Division of Epidemiology, Dalla Lana School of Public Health, University of Toronto, Toronto, Canada; ¶St Michael's Hospital, University of Toronto, Toronto, Canada; ‖Department of Anesthesiology and Bioengineering, McGowan Institute for Regenerative Medicine, University of Pittsburgh, Pittsburgh, PA; **Medical School, CTEC and Division of Surgery, Faculty of Health and Medical Sciences, The University of Western Australia, Perth, Western Australia, Australia;

- 200 000 patients with or without PBM
- Different types of surgery

- Risk for transfusion
- Transfusion rates per patients
- LOHS
- Mortality rate

No of patients exposed to allogenic RBC



orthopedic

cardio

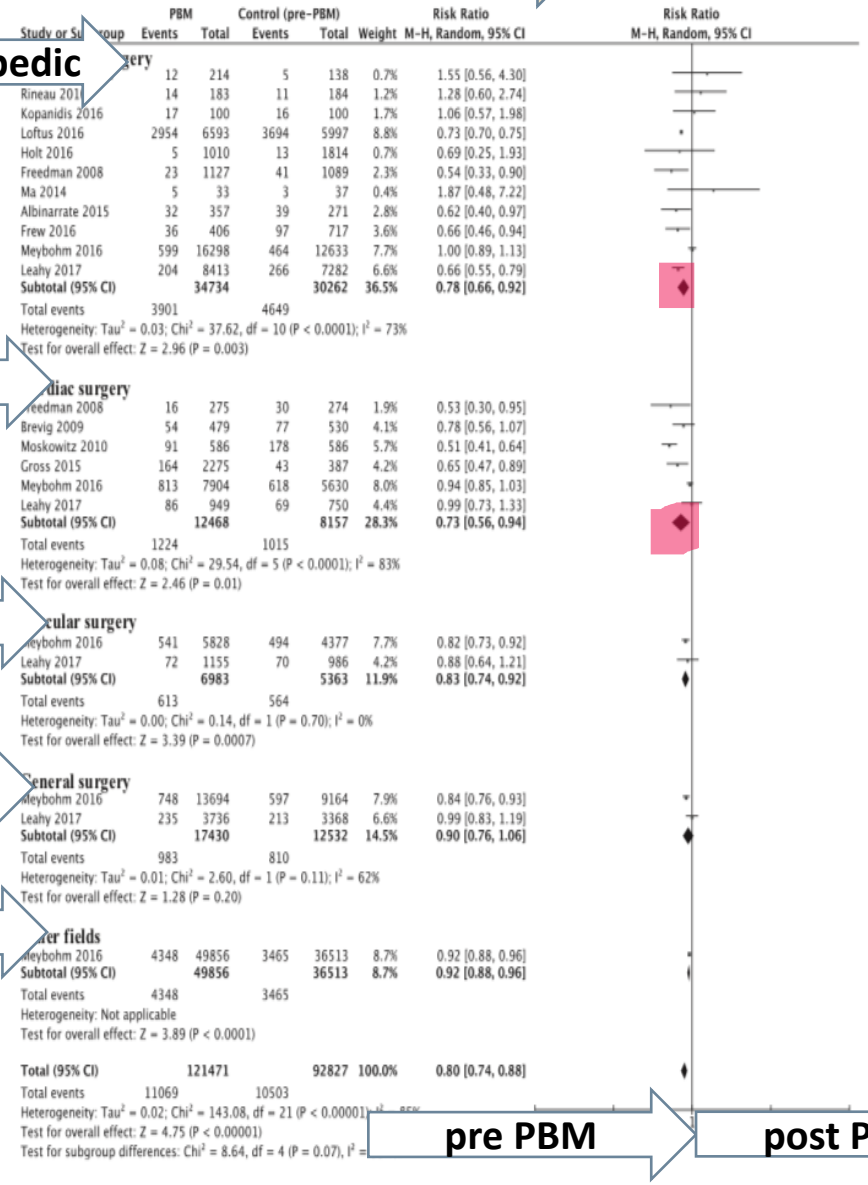
vascular

general

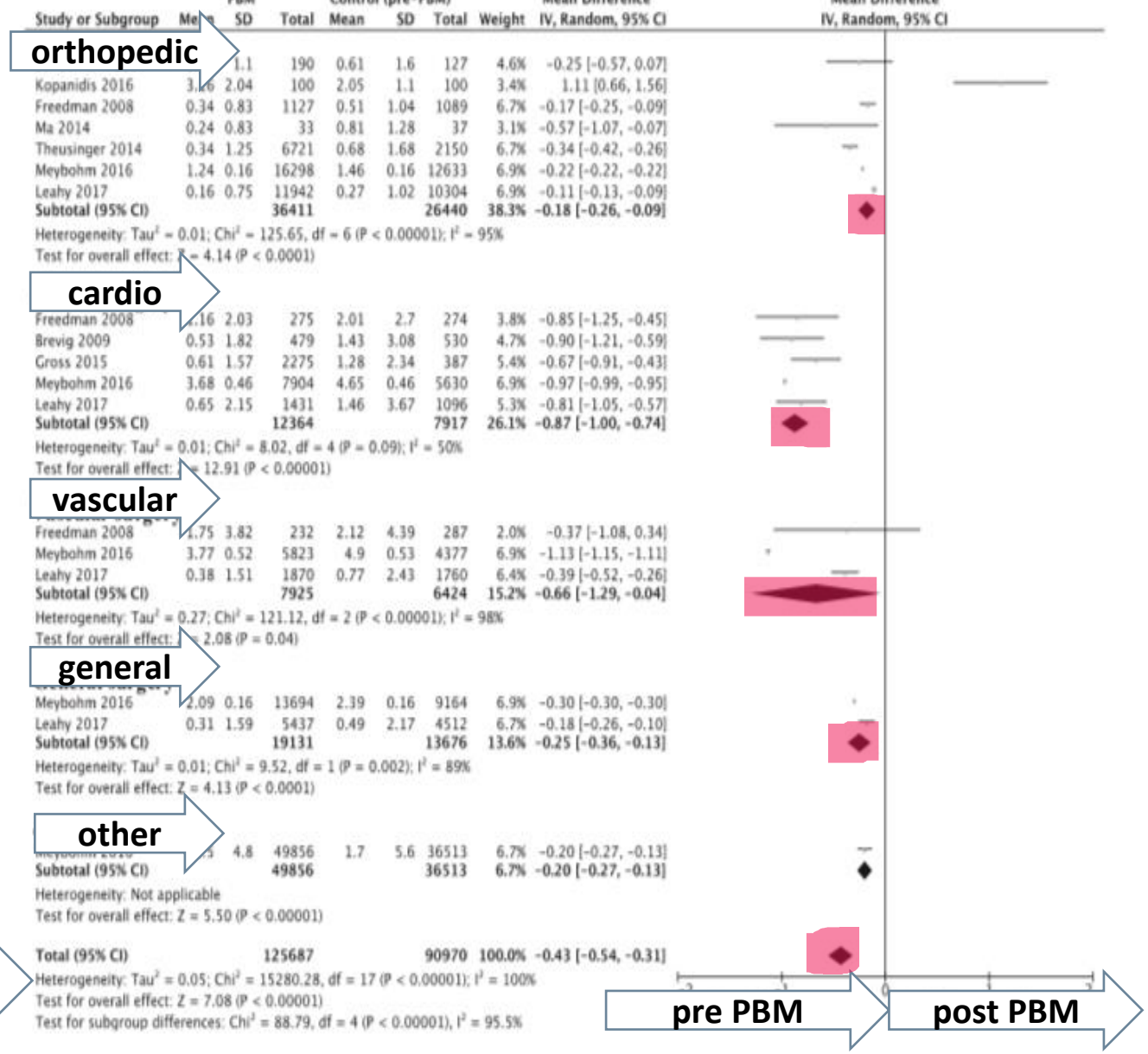
other

Abdominal(
Pediatric,
obstetrics

Total no. of complications



Number of units per patients



Length of hospital stay

orthopedic

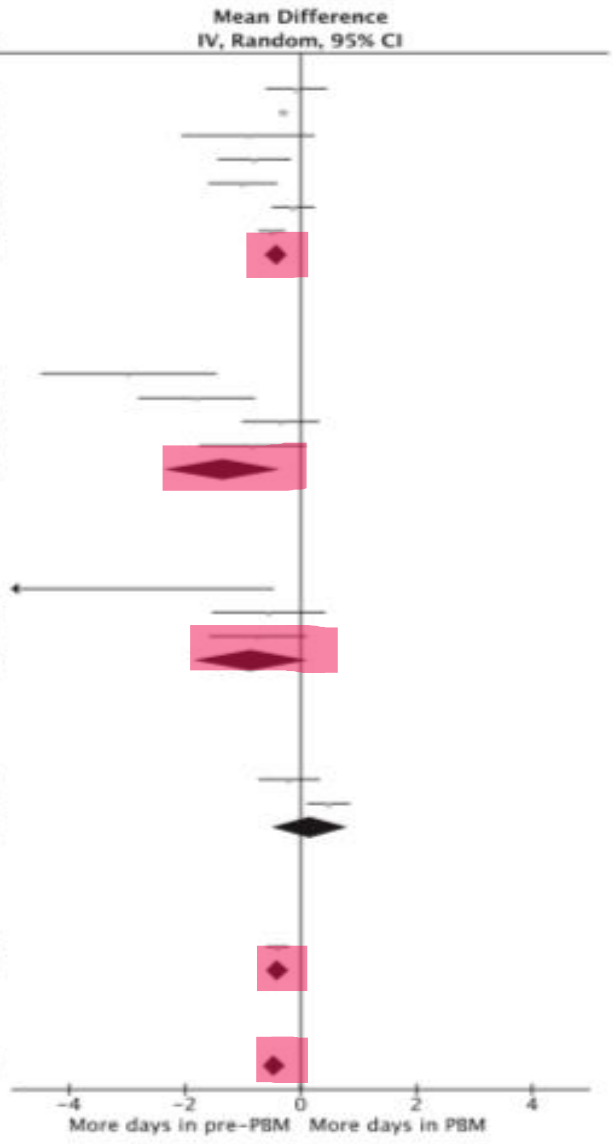
cardio

vascular

general

other

Study or Subgroup	PBM Mean	PBM SD	PBM Total	Control (pre-PBM) Mean	Control (pre-PBM) SD	Control (pre-PBM) Total	Weight	Mean Difference IV, Random, 95% CI
Orthopedic surgery								
Rineau 2016	9.28	2.7	183	9.35	2.5	184	6.7%	-0.07 [-0.60, 0.46]
Loftus 2016	3.02	1.76	6593	3.32	1.91	5997	12.7%	-0.30 [-0.36, -0.24]
Freedman 2008	6.25	18.2	1127	7.16	7.51	1089	2.4%	-0.91 [-2.06, 0.24]
Ma 2014	12.4	1.2	33	13.2	1.5	37	5.6%	-0.80 [-1.43, -0.17]
Albinarrate 2015	9.1	3.8	357	10.1	3.8	271	5.9%	-1.00 [-1.60, -0.40]
Meybohm 2016	12.85	16.3	16298	12.98	16.03	12633	8.8%	-0.13 [-0.51, 0.25]
Leahy 2017	5.89	8.74	11942	6.39	8.86	10304	10.9%	-0.50 [-0.73, -0.27]
Subtotal (95% CI)			**36533**			**30515**	**52.9%**	**-0.41 [-0.60, -0.22]**
Heterogeneity: $Tau^2 = 0.03$; $Chi^2 = 12.66$, df = 6 (P = 0.05); $I^2 = 53\%$								
Test for overall effect: Z = 4.16 (P < 0.0001)								
Cardiac surgery								
Freedman 2008	7.81	7.55	275	10.78	10.4	274	1.5%	-2.97 [-4.49, -1.45]
Gross 2015	10.4	8	2275	12.2	9.6	387	3.0%	-1.80 [-2.81, -0.79]
Meybohm 2016	16.6	19.4	7904	16.95	19.8	5630	5.2%	-0.35 [-1.02, 0.32]
Leahy 2017	11.07	11.64	1431	11.9	11.74	1096	3.4%	-0.83 [-1.75, 0.09]
Subtotal (95% CI)			**11885**			**7387**	**13.1%**	**-1.34 [-2.34, -0.34]**
Heterogeneity: $Tau^2 = 0.77$; $Chi^2 = 12.58$, df = 3 (P = 0.006); $I^2 = 76\%$								
Test for overall effect: Z = 2.63 (P = 0.009)								
Vascular surgery								
Freedman 2008	8.07	23.4	232	12.91	27.5	287	0.2%	-4.84 [-9.22, -0.46]
Meybohm 2016	18.13	25.1	5828	18.68	24.98	4377	3.1%	-0.55 [-1.53, 0.43]
Leahy 2017	9.16	12.91	1870	9.9	13.02	1760	3.9%	-0.74 [-1.58, 0.10]
Subtotal (95% CI)			**7930**			**6424**	**7.2%**	**-0.85 [-1.83, 0.13]**
Heterogeneity: $Tau^2 = 0.31$; $Chi^2 = 3.51$, df = 2 (P = 0.17); $I^2 = 43\%$								
Test for overall effect: Z = 1.70 (P = 0.09)								
General surgery								
Meybohm 2016	14.38	21.33	13694	14.58	19.58	9164	6.6%	-0.20 [-0.74, 0.34]
Leahy 2017	6.97	10.06	5437	6.49	8.79	4512	8.9%	0.48 [0.11, 0.85]
Subtotal (95% CI)			**19131**			**13676**	**15.5%**	**0.17 [-0.50, 0.83]**
Heterogeneity: $Tau^2 = 0.18$; $Chi^2 = 4.17$, df = 1 (P = 0.04); $I^2 = 76\%$								
Test for overall effect: Z = 0.50 (P = 0.62)								
Other fields								
Meybohm 2016	10.7	14.1	49856	11.1	14.6	36513	11.4%	-0.40 [-0.59, -0.21]
Subtotal (95% CI)			**49856**			**36513**	**11.4%**	**-0.40 [-0.59, -0.21]**
Heterogeneity: Not applicable								
Test for overall effect: Z = 4.04 (P < 0.0001)								
Total (95% CI)			**125335**			**94515**	**100.0%**	**-0.45 [-0.65, -0.25]**
Heterogeneity: $Tau^2 = 0.08$; $Chi^2 = 57.74$, df = 16 (P < 0.00001); $I^2 = 72\%$								
Test for overall effect: Z = 4.45 (P < 0.00001)								
Test for subgroup differences: $Chi^2 = 7.02$, df = 4 (P = 0.13), $I^2 = 43.0\%$								



What is anemia?

- Hgb < 130g/L m
- Hgb <120 g/| F*

- Mild to moderate: 100-129 g/L
- Moderate to severe: <100 g/L

- **ANEMIA means – low O_2 carrying capacity AND inability to meet body physiological needs for quantity of O_2 of the tissues**
- WHO (1968-2011)

European Society of Anaesthesiology ESA

Eur. J Anesthesiology 2017; 34: 332-395

- If anemia is present, we recommend identifying the cause. **1C**

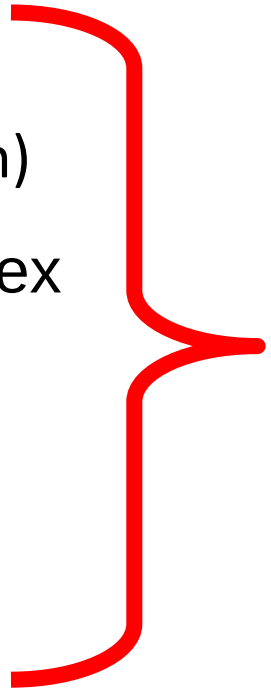
holly trinity of anemia

- **Iron deficiency**
- **Renal disease**
- **Chronic inflammation**

PREOPERATIVE : SCREENING OF ANEMIA

Laboratory Tests

- Complete Blood Cell Count
- Iron Status (Iron, **Ferritin**, Transferrin saturation)
- Serum sol transferrin receptors –ferritin index (<1>2)
- Inflamation Marker
- Vitamin B12, Folic Acid (>65 years old)

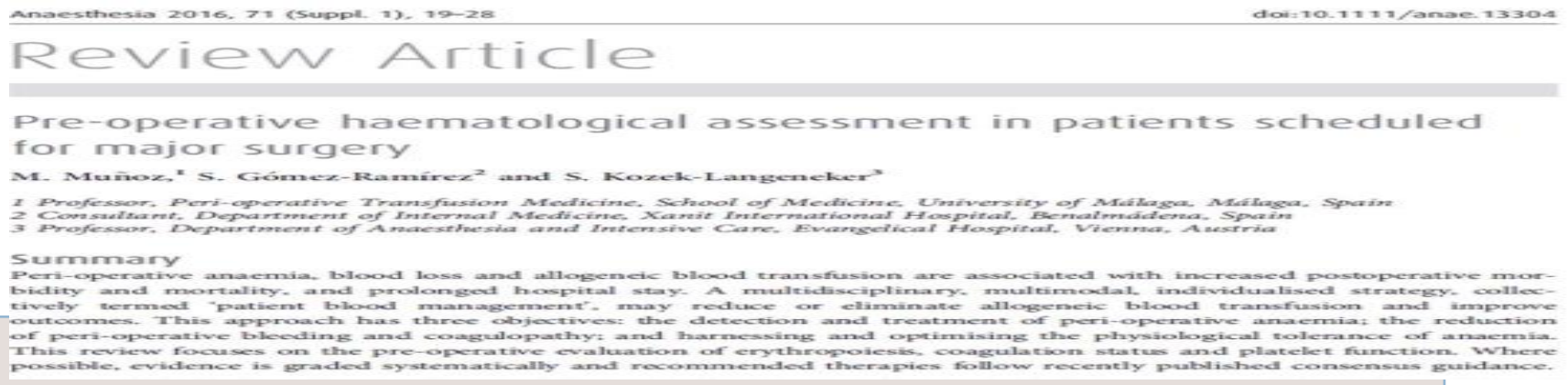


30 days before scheduled operation

Society of Thoracic Surgeons Blood Conservation Guideline Task ForceFerraris VA, Ferraris SP, Saha SP, et al. Perioperative blood transfusion and blood conservation in cardiac surgery: the Society of Thoracic Surgeons and The Society of Cardiovascular Anesthesiologists clinical practice guideline. Ann Thorac Surg 2007; 83(5Suppl): S27–86

4th edition SABM ADMINISTRATIVE AND CLINICAL STANDARDS FOR PATIENT BLOOD MANAGEMENT PROGRAMS, 2018.Society for the Advancement of Blood Management, Inc

Diagnosis



Anaesthesia 2016, 71 (Suppl. 1), 19–28 doi:10.1111/anae.13304

Review Article

Pre-operative haematological assessment in patients scheduled for major surgery

M. Muñoz,[1] S. Gómez-Ramírez[2] and S. Kozek-Langenecker[3]

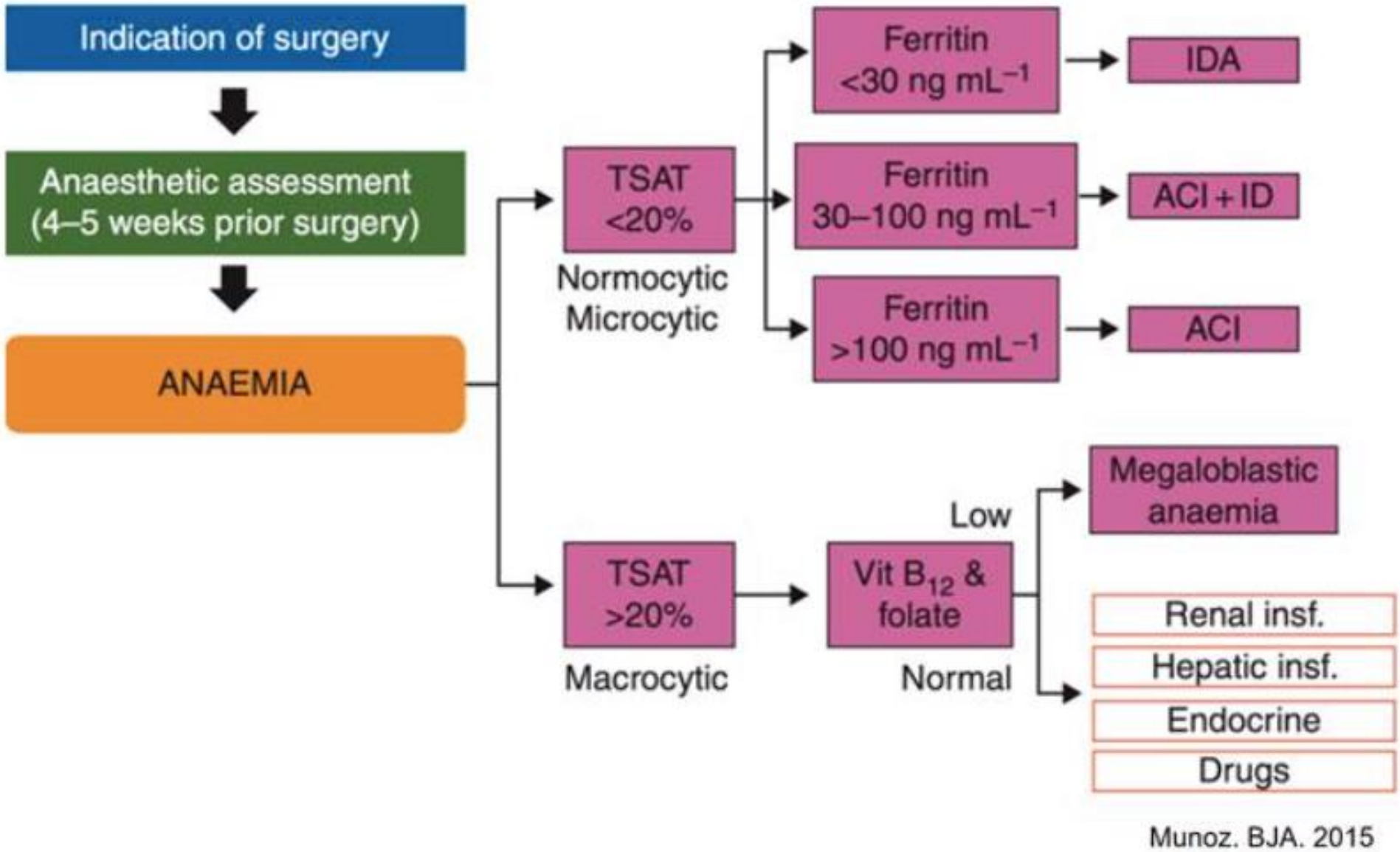
1 Professor, Peri-operative Transfusion Medicine, School of Medicine, University of Málaga, Málaga, Spain
2 Consultant, Department of Internal Medicine, Xanit International Hospital, Benalmádena, Spain
3 Professor, Department of Anaesthesia and Intensive Care, Evangelical Hospital, Vienna, Austria

Summary

Peri-operative anaemia, blood loss and allogeneic blood transfusion are associated with increased postoperative morbidity and mortality, and prolonged hospital stay. A multidisciplinary, multimodal, individualised strategy, collectively termed 'patient blood management', may reduce or eliminate allogeneic blood transfusion and improve outcomes. This approach has three objectives: the detection and treatment of peri-operative anaemia; the reduction of peri-operative bleeding and coagulopathy; and harnessing and optimising the physiological tolerance of anaemia. This review focuses on the pre-operative evaluation of erythropoiesis, coagulation status and platelet function. Where possible, evidence is graded systematically and recommended therapies follow recently published consensus guidance.

- HgB, MCV
- Serum iron-TIBC
- **Serum ferritin (30-100micg/L)- most specific**
- Transferrin saturation(TSAT) (20 %)
- Serum soluble transferrin receptors (sTRF)(<2,4,5)
- (not affected by inflammation)
- Serum sol transferrin receptpors –ferritin index (<1>2)
- Ferritin (Inflamat <100; CHF <300; CKD<500, cancer <800) Tsat <20%

Munoz M,. Anesthesiology 2016,71 (supl 1), 19-28



Munoz. BJA. 2015

FE Metabolism basics

Iron, transferrin should be bounded

Fe, from nutrition or recycled

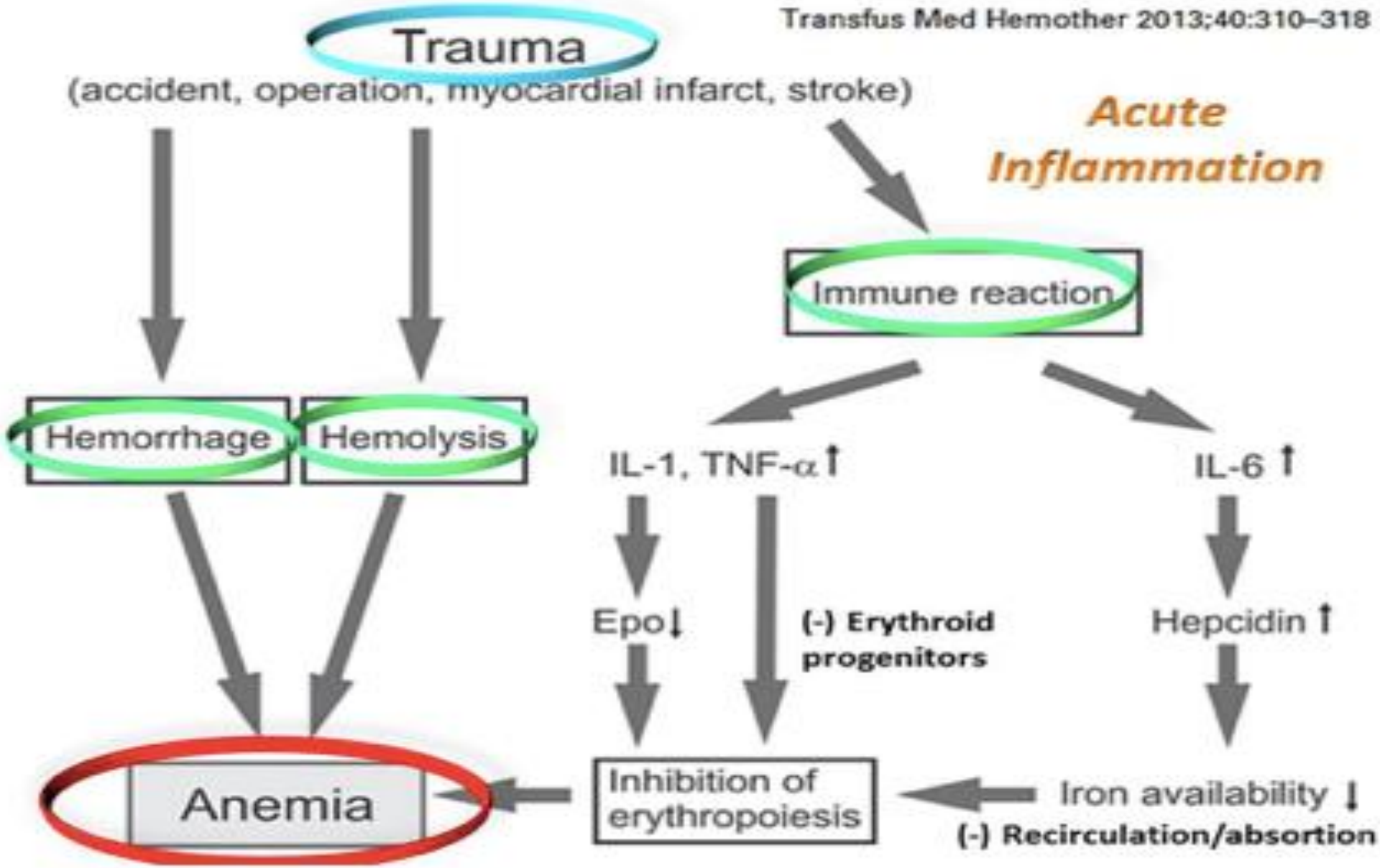
functional pool (heart, muscles- non erythroid, bone marrow, RBC);storage pool (liver)

Fe, needed for RBC renewal 20-30 mg,1-2 mg absorbed- lost

Fe, Ferrous form transported through FEROPORTIN

HEPCIDIN- PEPTIDE (HEPATOCITES – IN RESPONSE OF INLTAMATION) DYSREGULATES IRON

Anand IS. Circulation 2018;138:80-98


Transfus Med Hemother 2013;40:310–318
Trauma
(accident, operation, myocardial infarct, stroke)
Acute Inflammation
Immune reaction
Hemorrhage
Hemolysis
IL-1, TNF-α ↑
IL-6 ↑
Epo ↓
(-) Erythroid progenitors
Hepcidin ↑
Anemia
Inhibition of erythropoiesis
Iron availability ↓
(-) Recirculation/absortion

Challenge is to implement anemia management pathways

BJA

British Journal of Anaesthesia 115 (1): 15–24 (2015)

doi: 10.1093/bja/aev165
Review Articles

REVIEW ARTICLES

'Fit to fly': overcoming barriers to preoperative haemoglobin optimization in surgical patients†

M. Muñoz[1,*], S. Gómez-Ramírez[3], S. Kozek-Langeneker[4], A. Shander[5], T. Richards[6], J. Pavía[2], H. Kehlet[7], A. G. Acheson[8], C. Evans[9], R. Raobaikady[10], M. Javidroozi[5] and M. Auerbach[11]

BJA

British Journal of Anaesthesia 115 (1): 15–24 (2015)

doi: 10.1093/bja/aev165
Review Articles

REVIEW ARTICLES

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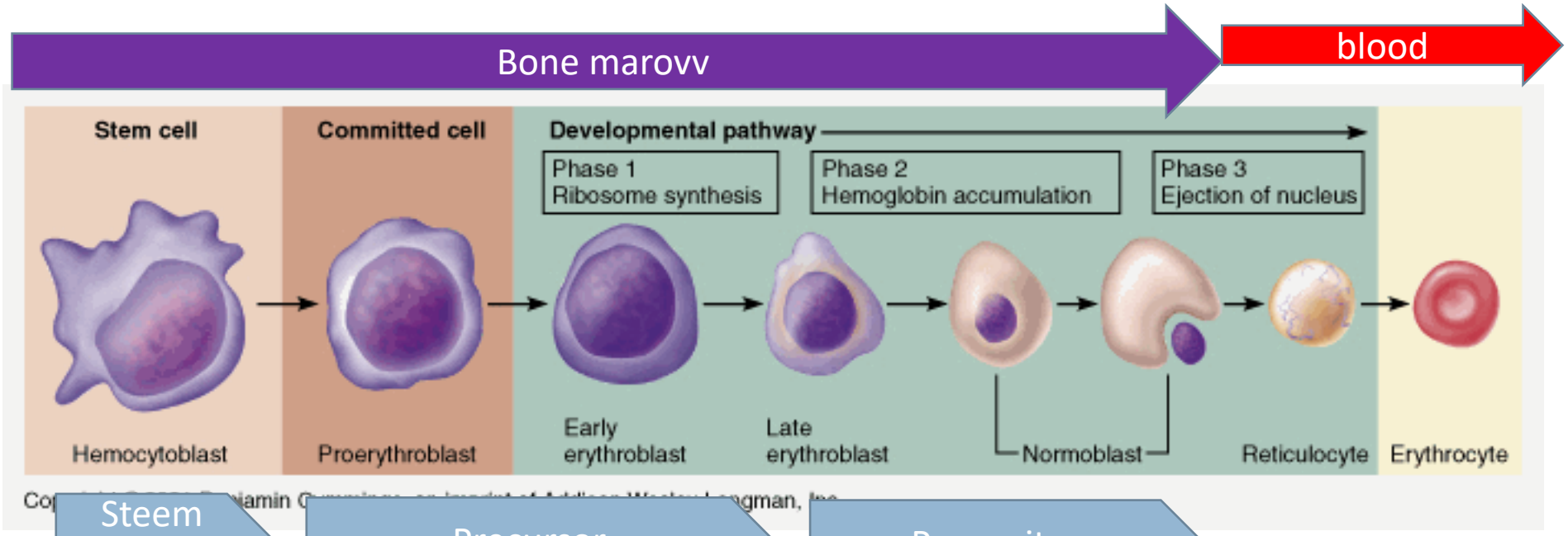
European Society of Anaesthesiology ESA

Eur. J Anesthesiology 2017; 34: 332-395

- We recommend that patients at risk of bleeding are assessed for anemia 3 to 8 weeks before surgery. **1C**
- In non-cancer patients with preoperative anemia scheduled for elective major surgery, we recommend **postponing surgery until anemia has been** corrected. **1C**
- **Time Supporting hematopoiesis (iron, folic ESAS)**

Red cell maturation



Steem cell

Precursor

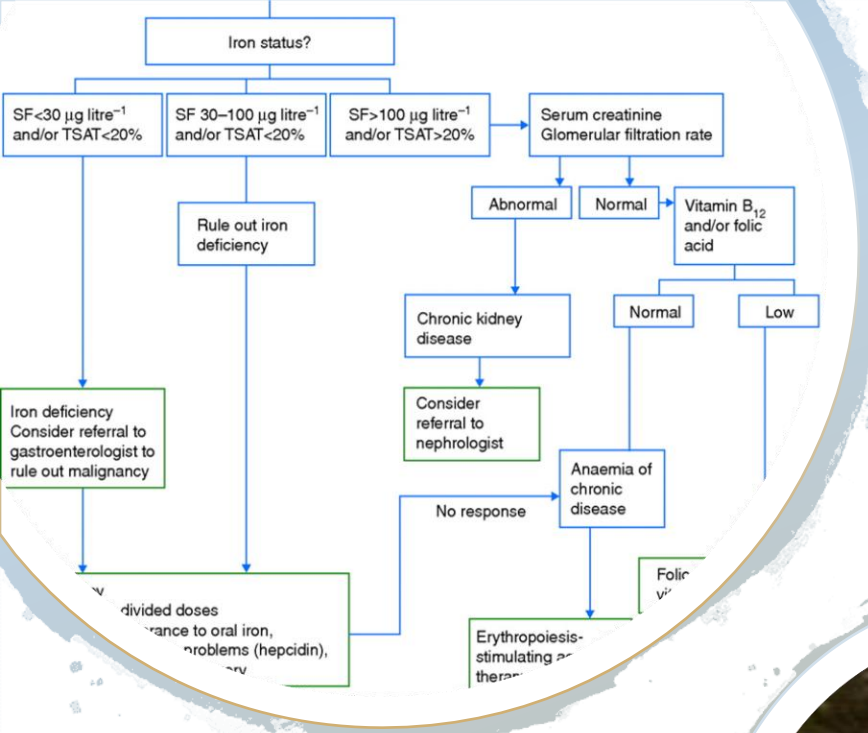
Progenitor

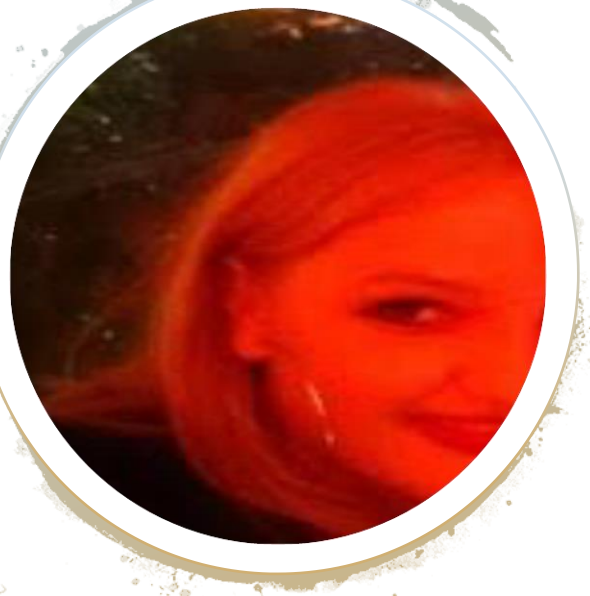
Erythropoietin receptor
10-14 days

Rapid fe uptake
5-7days

1-2 days

Maturation on average 3 week cycle





HELP us Celebrities

- Venus wiliams
- Selena Gomez
- Angelina Jolie
- Brittany Murphy

European Society of Anaesthesiology ESA

- **Esa is in line with NATA**

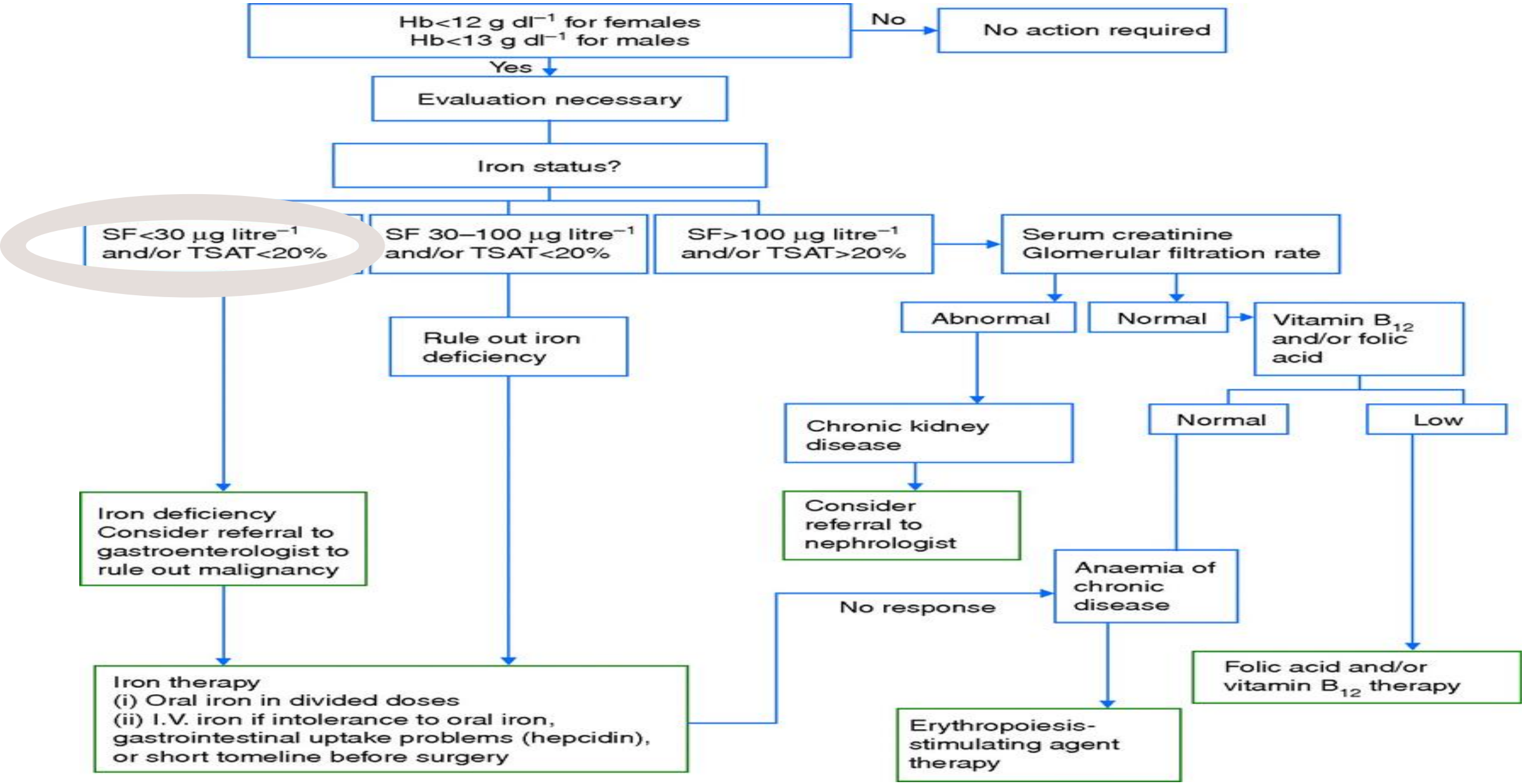
Eur. J Anesthesiology 2017; 34: 332-395

- We recommend treating iron deficiency with iron supplementation. **1B-**

- We recommend the use of intravenous iron in preference to oral iron. **1C-**

Munoz M Manegment of Preoperative anemia :NATA consensus statement ISBP Sci Ser 2012;7:283-287

Bruce et all Practical recommendation for patient blood manegment to reduce of perioperative transfusion in joint replacement



	Ferumoxytol	Iron Carboxymaltose	Iron Isomaltoside 1000	Low Molecular Weight Iron Dextran	Iron Sucrose	Iron Gluconate
Brand name	Feraheme®	Ferinject®	Monofer®	Cosmofer®	Venofer®	Ferlixit®
Maximum single dose	510 mg	1000 mg	20 mg/kg	20 mg/kg	200 mg	125 mg
Minimum administration time (minutes)	15	15	15	60	30	30–60
Replacement dose possible in a single infusion	No	Yes	Yes	Yes	No	No

Oral Iron therapy

Is cheep, takes >8 weeks

Pitfalls: not predictable, GI side effects, bioavailability is changed (H. Pillory)

Doses 40-60 mg /day, without food, interfered with drugs and minerals

Fe, Ferrous form- HAEM for is better choice

Hepcidin levels block it, controversies : does it rise its levels

Blood 2015: 126:1981-1989

Cochrane Library: database of systemic rewieves 2016

IV IRON THERAPY

EXPENCIVE , BUT MORE EFFECTIVE

Decrease the need for ABT and mortality rates
increases Hbg, degreases postop anemia

Novel preparations -without high molecular dextran's ,less- adverse effects

Benefits overcome risks

Recommended where time to surgery is short, no other treatment has results 1 B

Lancer Haematol 2018;5:310-20
PLOS ONE 2015: 1O:E011783
Vox Sanguinis 2015;257-266
Transfusion 2014;54:113-1145

Pragmatic approach „global correction"

1 g isomaltosid IV
+ 40.000 U erythropoietin alpha s.c.
+ 1 mg/day vitamin B12 p.o.
+ 5 mg/day folate p.o.

pharmaceuticals

MDPI

Review

Intravenous Irons: From Basic Science to Clinical Practice

Sunil Bhandari [1], Dora I. A. Pereira [2,3], Helen F. Chappell [4] and Hal Drakesmith [5,6,*]

Pharmaceuticals 2018;11:82-89

European Society of Anaesthesiology ESA

Eur. J Anesthesiology 2017; 34: 332-395

- If other causes of anemia have been excluded or treated

we suggest erythropoiesis stimulating agents .

2C

Erythropoiesis stimulating agents

WHO list of essential medicines, in patient ACD (>500 ml blood lost), Hgb <13

Epoetin alpha, Darbeopetin, Erythropoietin biosimilars

Increases red cell mass

Reduces ABT, not in hypertensive , increases the risk for DVT, cancer

Controversies for to much still going on

Lancer Haematol 2018;5:310-20
Vox Sanguinis 2015;257-266

European Society of Anaesthesiology ESA

Eur. J Anesthesiology 2017; 34: 332-395

- In patients with preoperative anemia, **we recommend the use of combined therapy with intravenous iron and erythropoietin along with a restrictive transfusion policy. 1C**

- **If autologous blood donation** is performed suggest treatment with **Iv iron, ESA to avoid preoperative anemia and transfusion rates**. **2C**

Anemia Treatment
Safely increase Hgb 0.5-1 gm/week

- Treatment Options: IV iron, enteric iron, Erythropoietin stimulating agents (ESA's), Vitamin B-12, folate, treat co-morbidities, delay and defer

- IV iron, effect at 1 week, max effect at 2 weeks,
- several doses needed (1 gram divided dose common)
- ESA action onset 4-6 days, max at 10 days, must
- give with iron
- Pre- OP-One week treatment "lead time" needed, Post-OP start ASAP.

Ultra short combination treatment, IV iron, B12, ESA

- Single dose intravenous iron for iron deficcency: new paradigm

Haemathology 2016

Fast track anemia clinic in the Emergency department

Blood Transfusions 2016;14;126-133

Effect of ultra short term treatment of patients with iron deficiency anemia or anemia undergoing cardiac surgery a prospective trial

Lancet 2019 393;2201-2212

- Perioperative

- *Fluid management*
- *T*
- *Ph*
- *Prolene*
- *Cell salvage*
- Antifibrinolytics

- Postoperative anemia

European Society of Anaesthesiology ESA

Eur. J Anesthesiology 2017; 34: 332-395

- If patients are anemic following surgery we suggest use of intravenous iron post op. **2C**

- Postoperative anemia

Eur. J Anesthesiology 2017; 34: 332-395

- Hemolysis,
- Blood loss, low EPO stores,
- Hepcidin levels,
- Nutritional or
- Hemodilution

- Postoperative anemia

EBM reccomendation

- Ferritin levels
- Insufficient Iron stores and Ferritin <100

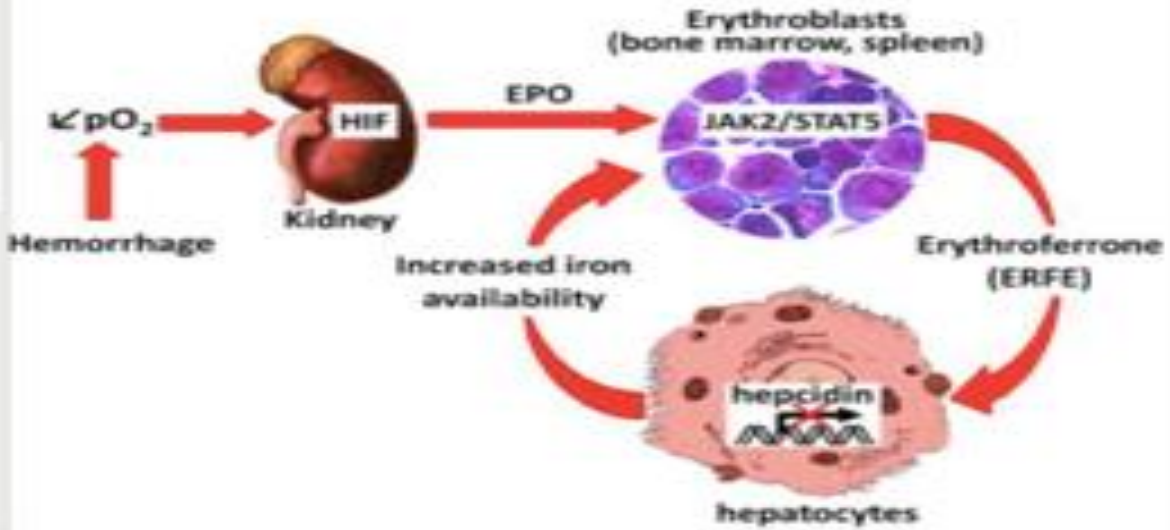
- We recommend a target Hb of 7-9 g/dl during active bleeding.**1C**

Restrictive transfusion criteria's for postoperative bleeding

Hb level (g/dl)	Clinical criteria: • ability to compensate anaemia? signs of hypoxia? • risk factors: comorbidity? • relevant postOP bleeding?	Decision for pRBC transfusion
< 6		yes (1-2 pRBCs)
6 - 8	compensation adequate no risk factors no relevant postOP bleeding	no
	compensation recuded e.g. ST-segment dynamics, tachycardia > 80 bpm, hypotension, lactate acidosis risk factors present: e.g.. CHD, cardiac failure, stroke, renal dysfunction	yes
8 - 10	compensation adequate	no
	compensation reduced: e.g. ST-segment dynamics, tachycardia > 80 bpm, hypotension, lactate acidosis	yes
> 10		no

Proposed mechanism of action of the erythroid regulator ERFE

BLOOD, 24 JULY 2014 • VOLUME 124, NUMBER 4



Hemodialysis International

Supplement Article

Role of hepcidin-ferroportin axis in the pathophysiology, diagnosis, and treatment in anemia of chronic inflammation

Arielle L. Langer, Yelena Z. Ginzburg

First published: 22 March 2017

DOI: 10.1111/hdi.12543

Early View


Iron man could cure
anemia.
yourecards
someecards.com

- **Total iron-binding capacity**. The transferrin molecule binds free **iron** and transports it in the blood. **Total iron-binding capacity** (TIBC) or sometimes transferrin **iron-binding capacity** is a medical laboratory test that measures the blood's **capacity** to **bind iron** with transferrin.

- **Transferrin saturation**, measured as a percentage, is a medical laboratory value. It is the value of serum **iron** divided by the total **iron**-binding capacity. ... For instance, a value of 15% means that 15% of **iron**-binding sites of **transferrin** are being occupied by **iron**. The three results are usually reported together.

Blood transfusion overuse

- World health Organisation resolution in 2012 identified patient blood management as one of the most important issues in the care of surgical patients worldwide
- WHO 2010 RECOGNIZED PBM AS A MEANS TO promotethe avialiabillity of transfusion alternatives
- Htttp??apps.who.int ebwha