Patient Blood Management (PBM)

A New Perioperative Transfusion Concept

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Disclosure - Conflicts of Interest

In the past years I received honoraria and travel support for consulting and lecturing from

- Australian Red Cross Blood Service
- Austrian Federal Ministry of Health
- Abbott
- CSL Behring
- Fresenius Kabi
- Haemonetics
- Janssen-Cilag
- Novo Nordisk
- Ortho Biotech
- Pentapharm/TEM
- Vifor Pharma
- Western Australian Department of Health

…

What is patient blood management?

- PBM views a patient‘s own blood as a valuable and unique natural resource that should be conserved and managed appropriately.
- PBM employs a patient-specific **perioperative multidisciplinary, multimodal team approach** to optimising, conserving and managing patients own blood.
- PBM aims to identify patients at risk of transfusion and provide a managed plan aimed at **reducing or eliminating the need for allogeneic transfusion with an acceptable risk of anemia.**

Anesthesiology
The journal of the American Society of Anesthesiologists, Inc
Wolters Kluwer Health | Lippincott Williams & Wilkins
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Anesthesiology:
December 2008 - Volume 109 - Issue 6 - pp 951-953
doi: 10.1097/ALN.0b013e31818e3d75
Editorial Views

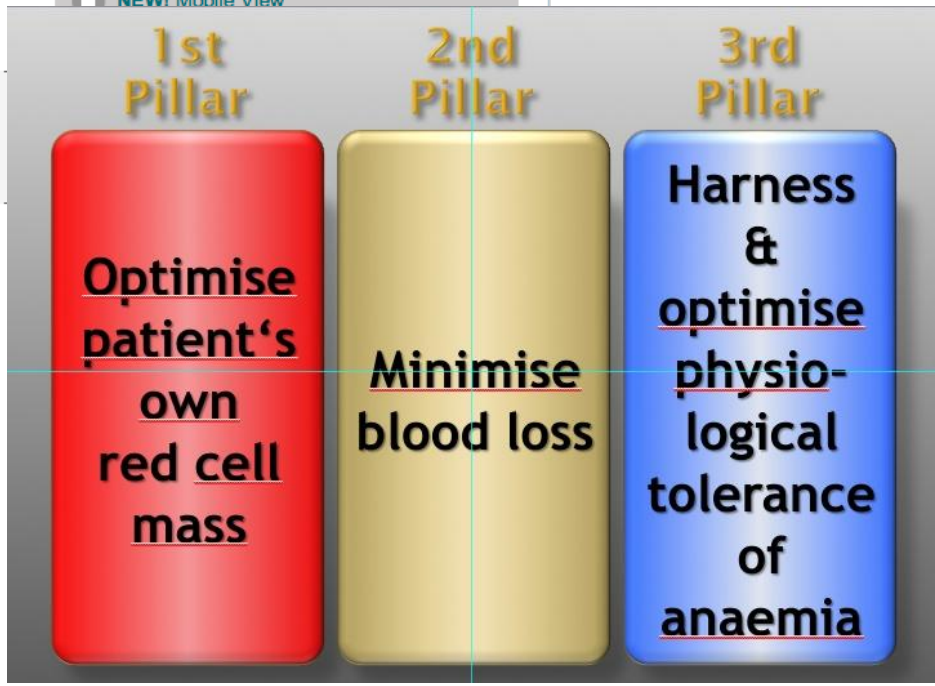
Patient Blood Management: The Pragmatic Solution for the Problems with Blood Transfusions

Spahn, Donat R. M.D., F.R.C.A.; Moch, Holger M.D.; Hofmann, Axel M.E.; Isbister, James P. M.B., F.R.A.C.P.

EDITORIALS

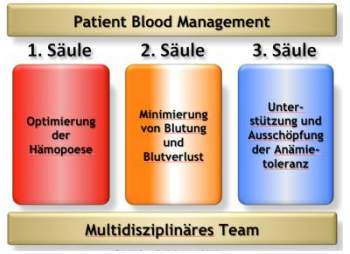
New Blood, Old Blood, or No Blood?

John W. Adamson, M.D.



Patient blood management

Adamson J.W. New Engl J Med (2008) 358: 1225



World Health Organization

Sixty-third World Health Assembly

Date: 17–21 May 2010
Location: Geneva, Switzerland

The Sixty-third session of the World Health Assembly took place in Geneva during 17–21 May 2010. At this session, the Health Assembly discussed a number of public health issues, including:

WHA63.12 adopted by resolution May 21, 2010:

„Bearing in mind that **patient blood management means** that before surgery every reasonable measure should be taken to **optimize the patient's own blood volume, to minimize the patient's blood loss and to harness and optimize the patient-specific physiological tolerance of anaemia** following WHO's guide for optimal clinical use **(three pillars of patient blood management)**"

United States

FEDERAL REGISTER
The Daily Journal of the United States Government

Notice

Meeting of the Advisory Committee on Blood Safety and Availability

A Notice by the Health and Human Services Department on 05/06/2011

On June 8, 2011, the Committee will be asked to review and comment on WHA 63.12 regarding the availability, safety and quality of blood products. *http://apps.who.int/gb/ebwha/pdf_files/WHA63/A63_R12-en.pdf* Specifically the Committee will be asked to review the current status of safe and rational use of blood products in patient blood management and assess the current status in the U.S.

Australia

NHMRC Guidelines Development:

Module 1 - Critical Bleeding/Massive Transfusion
Module 2 - Peri operative
Module 3 – Medical
Module 4 - Intensive Care
Module 5 – Obstetric
Module 6 - Paediatric/Neonates

http://www.nba.gov.au/guidelines/review.html

The Real World

Paradigm Shift

GIVE BLOOD

GIVE LIFE

ANSARA

Rationale for PBM

- Blood supply issues
- Cost of blood
- Transfusion practice variability
- **Transfusion safety and effectiveness**


Source of swine flu discovered!!

Pathogens – Costly Fear

The **AUSTRALIAN RED CROSS discarded 33,600 liters** of donated **blood** as the result of fears that it was contaminated with **dengue** fever following an outbreak of the disease in northern Queensland in late 2009 and 2010, according to a report in the *Sunday Herald Sun*.

That loss ... accounted for about 7% of its overall blood supply.

A Multicenter, Randomized, Controlled Clinical Trial of Transfusion Requirements in Critical Care (Complications during ICU-stay)

	Restrictive (n=418)	Liberal (n=420)	p-value
Cardiac	55 (13.2%)	88 (21.0%)	<0.001
Pulmonary	106 (25.4%)	122 (29.0%)	0.22
Infectious	42 (10.0%)	50 (11.9%)	0.38
Gastrointestinal	13 (3.1%)	19 (4.5%)	0.28
Neurologic	25 (6.0%)	33 (7.9%9	0.28
Shock	67 (16%)	55 (13.1%)	0.23
Any	205 (49.0%	228 (54.3%)	0.12

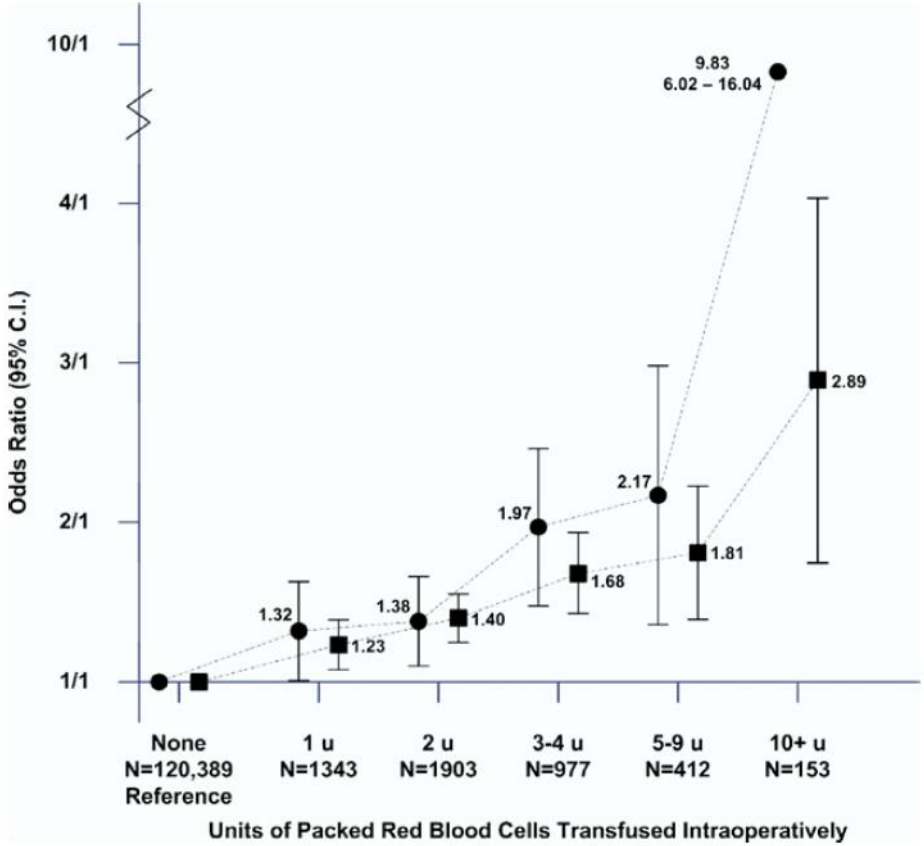
Hebert P.C. et al: NEJM 340, 409-17, 1999

Table 2. Frequencies of Composite Infection and Ischemic Outcomes

	Not Transfused			Transfused		
Outcome	N	n	%	N	n	%
Infection*	3674	. . .	. . .	4842	. . .	. . .
Nadir hematocrit <21	52	1	1.9	982	120	12.2
Nadir hematocrit ≥21 and <24	390	16	4.1	2164	243	11.2
Nadir hematocrit ≥24 and <27	1176	42	3.6	1385	200	14.4
Nadir hematocrit ≥27	2056	82	4.0	311	33	10.6
Ischemia†	3670	. . .	. . .	4848	. . .	. . .
Nadir hematocrit <21	52	1	1.9	982	132	13.4
Nadir hematocrit ≥21 and <24	390	13	3.3	2167	307	14.2
Nadir hematocrit ≥24 and <27	1175	40	3.4	1389	231	16.6
Nadir hematocrit ≥27	2053	72	3.5	310	36	11.6

Murphy G. J. et al. Circulation (2007) 116: 2544

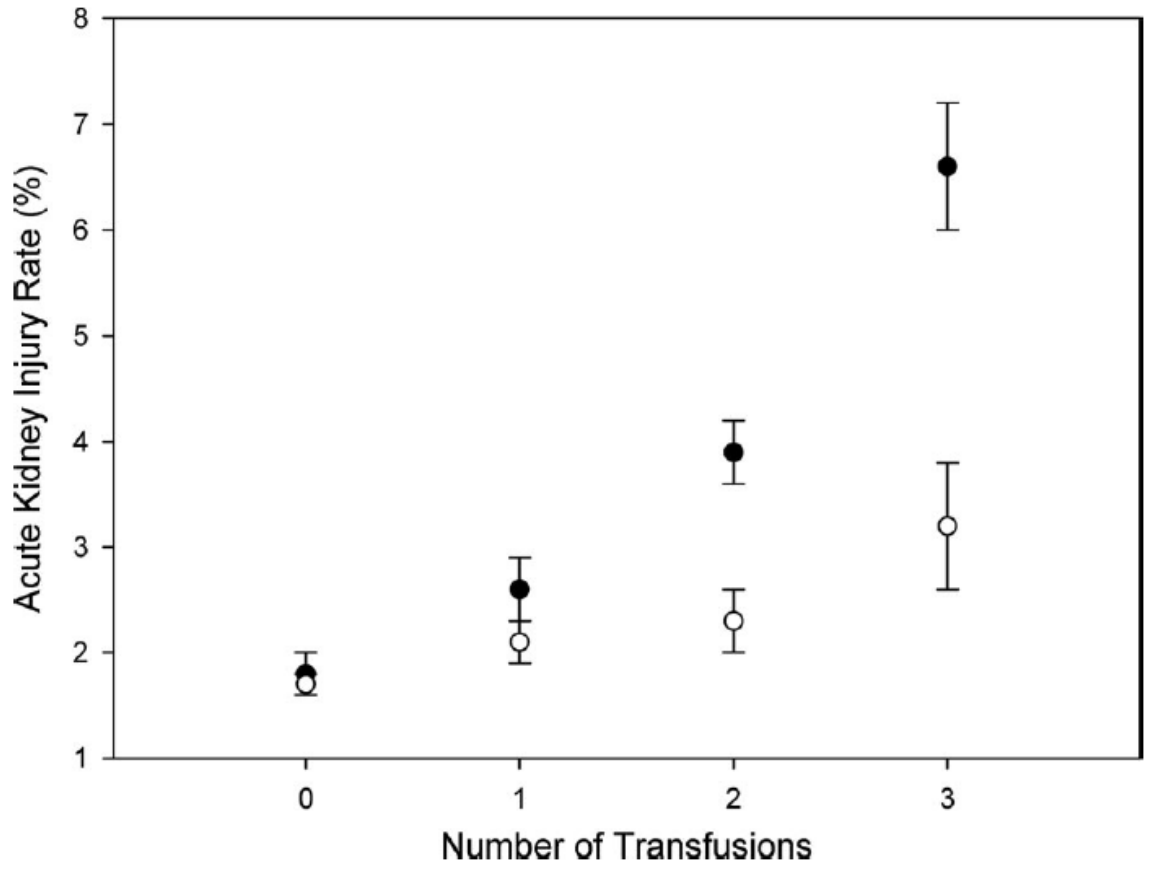
Intraoperative Transfusion of 1 U to 2 U Packed Red Blood Cells Is Associated with Increased 30-Day Mortality, Surgical-Site Infection, Pneumonia, and Sepsis in General Surgery Patients



Propensity and risk adjusted odds ratios (95% CI) for 30-day mortality and morbidity by level of intraoperative transfusion. Both morbidity and mortality risks were substantially increased after only 1 U RBC transfusion intraoperatively and continued to increasewith increasing units. Circles, mortality; squares, morbidity.

Bernard et al: J Am Coll Surg 2009;208:931–937

Influence of Erythrocyte Transfusion on the Risk of Acute Kidney Injury after Cardiac Surgery Differs in Anemic and Nonanemic Patients



Anemic

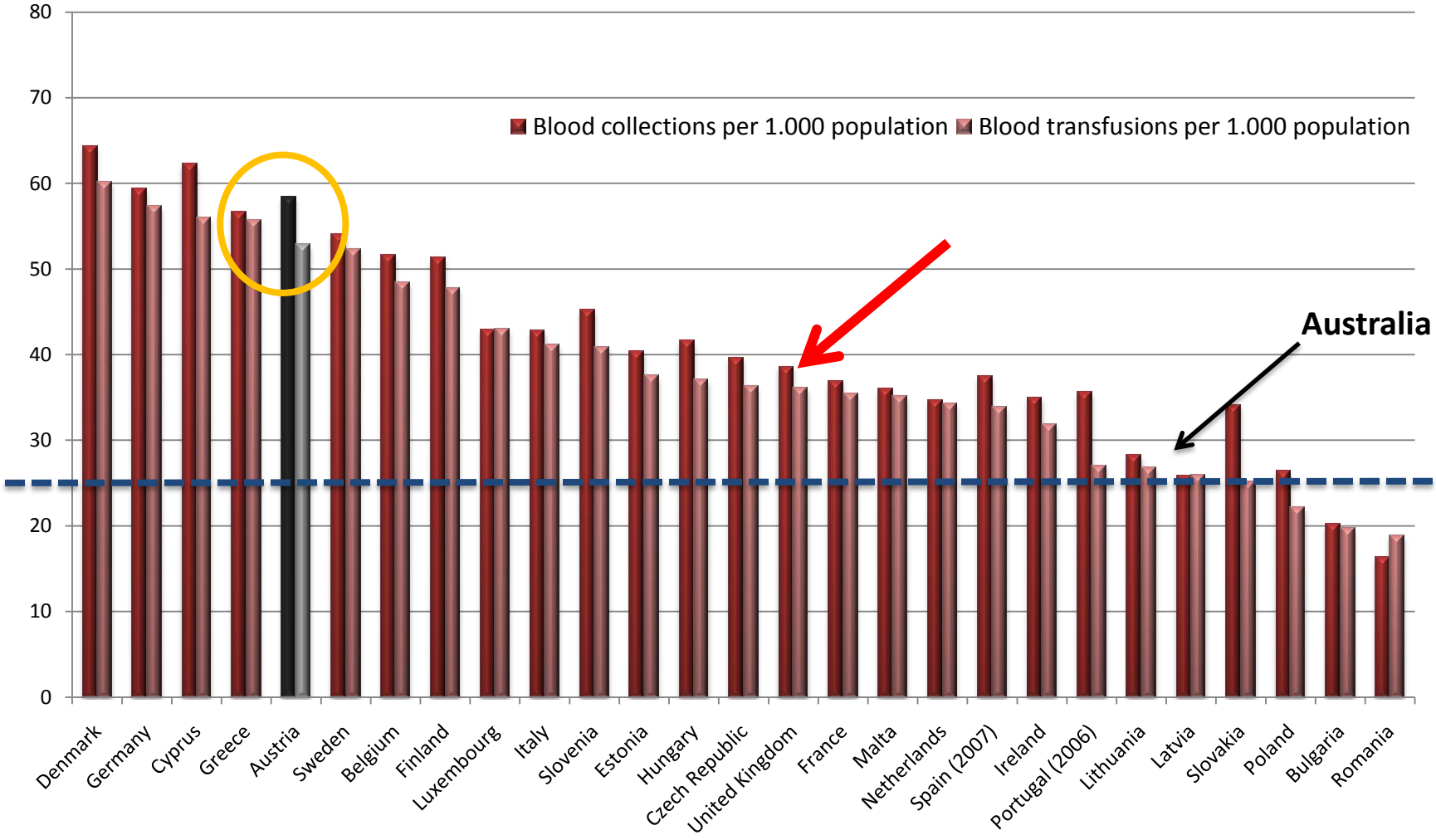
Non-anemic

Karkouti et al: Anesthesiology 2011; 115:523–30

Rationale for PBM

- Blood supply issues
- Cost of blood
- **Transfusion practice variability**
- Transfusion safety and effectiveness

Blood Collection and RBC Transfusions (per 1.000 population) - EU 2008

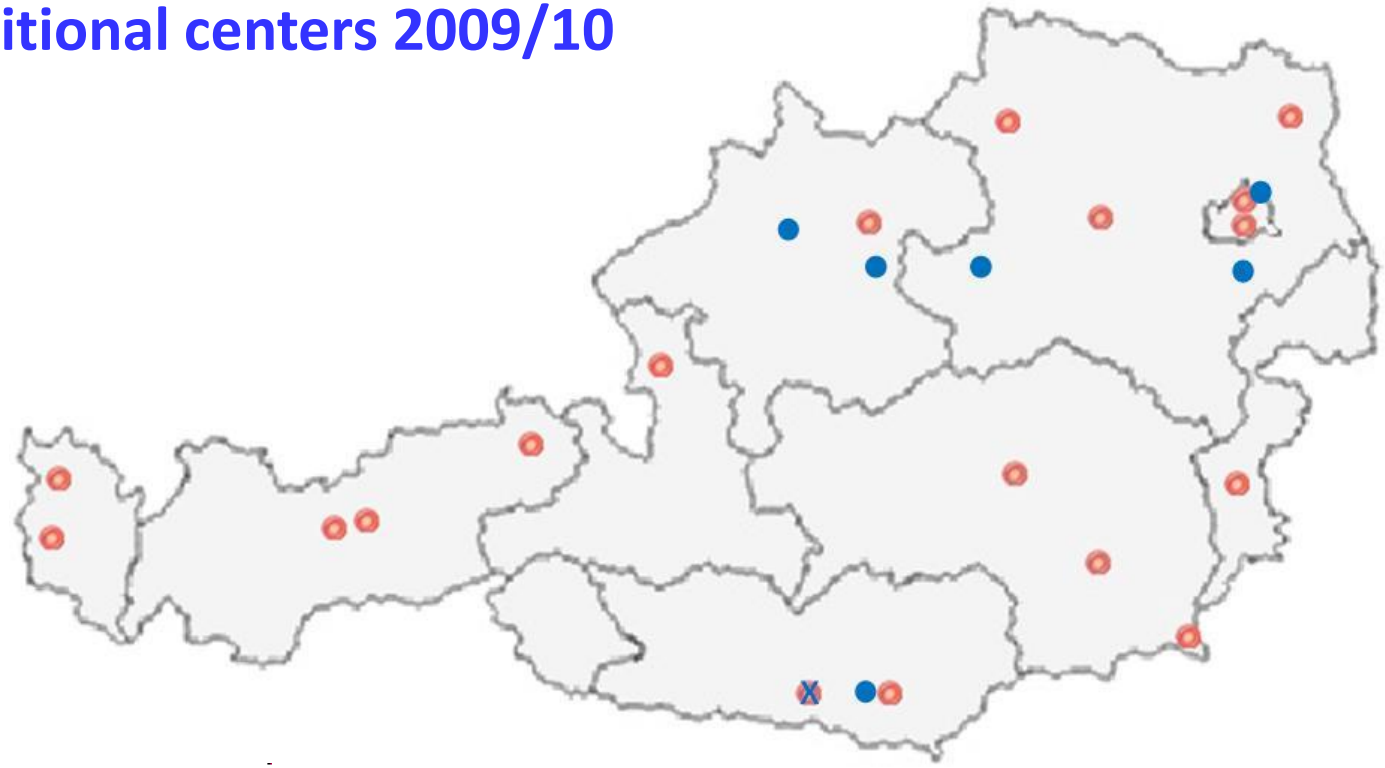


Council of Europe, Final Report: The collection, testing and use of blood and blood products in Europe 2008
EUROSTAT 2008

Centers – Both Evaluations

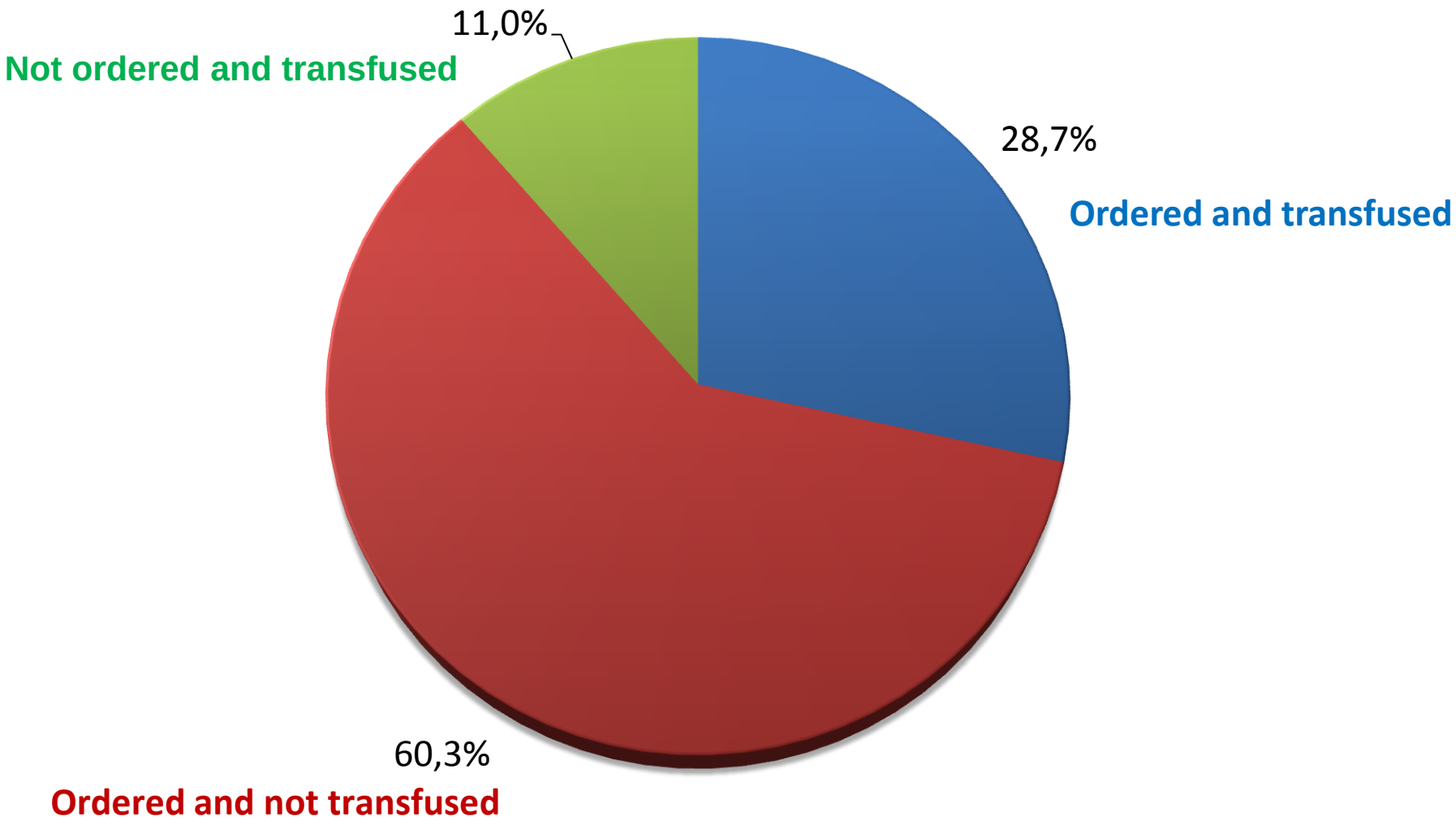
Centers 2004/5

Additional centers 2009/10

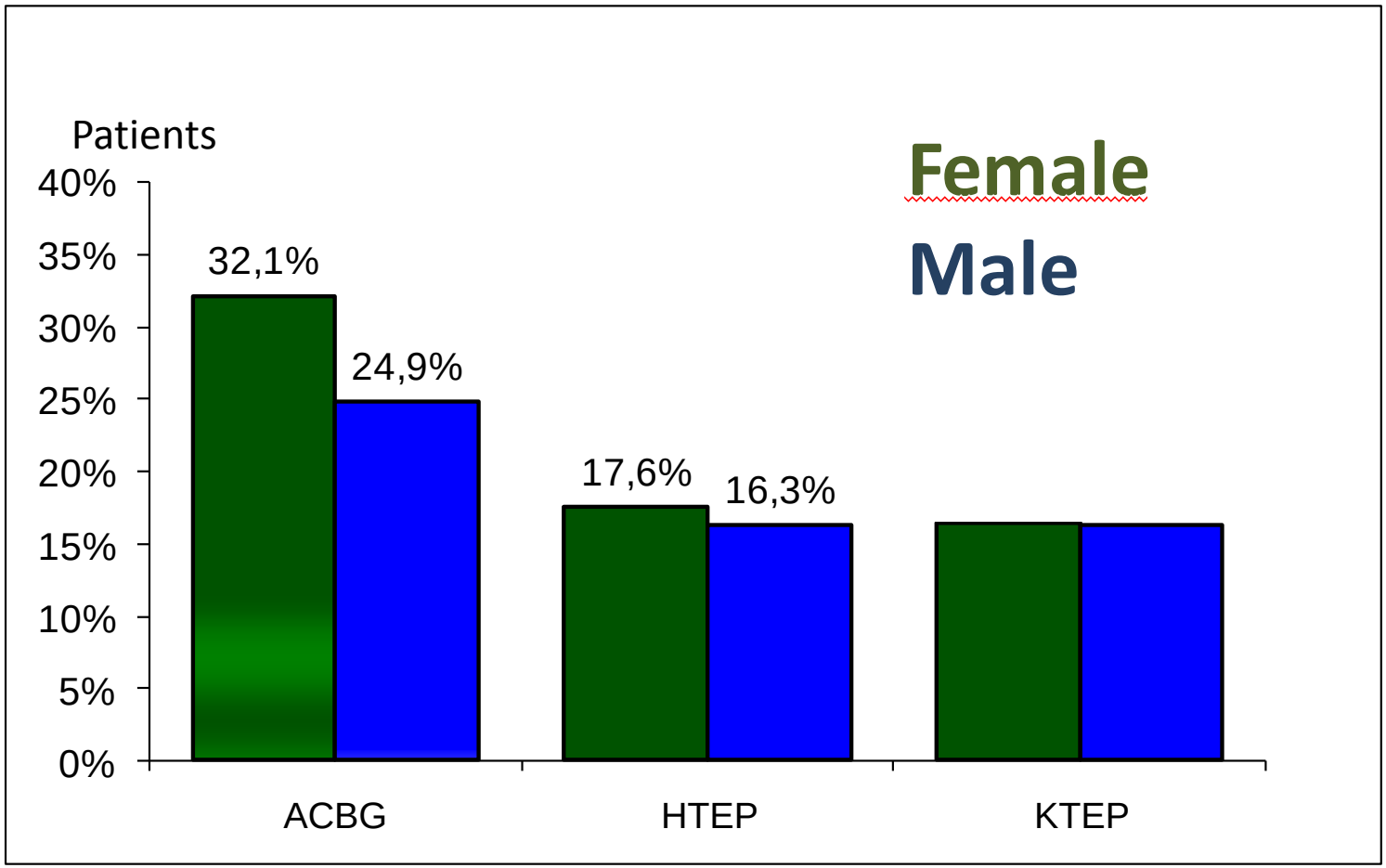


BUNDESMINISTERIUM
FÜR GESUNDHEIT

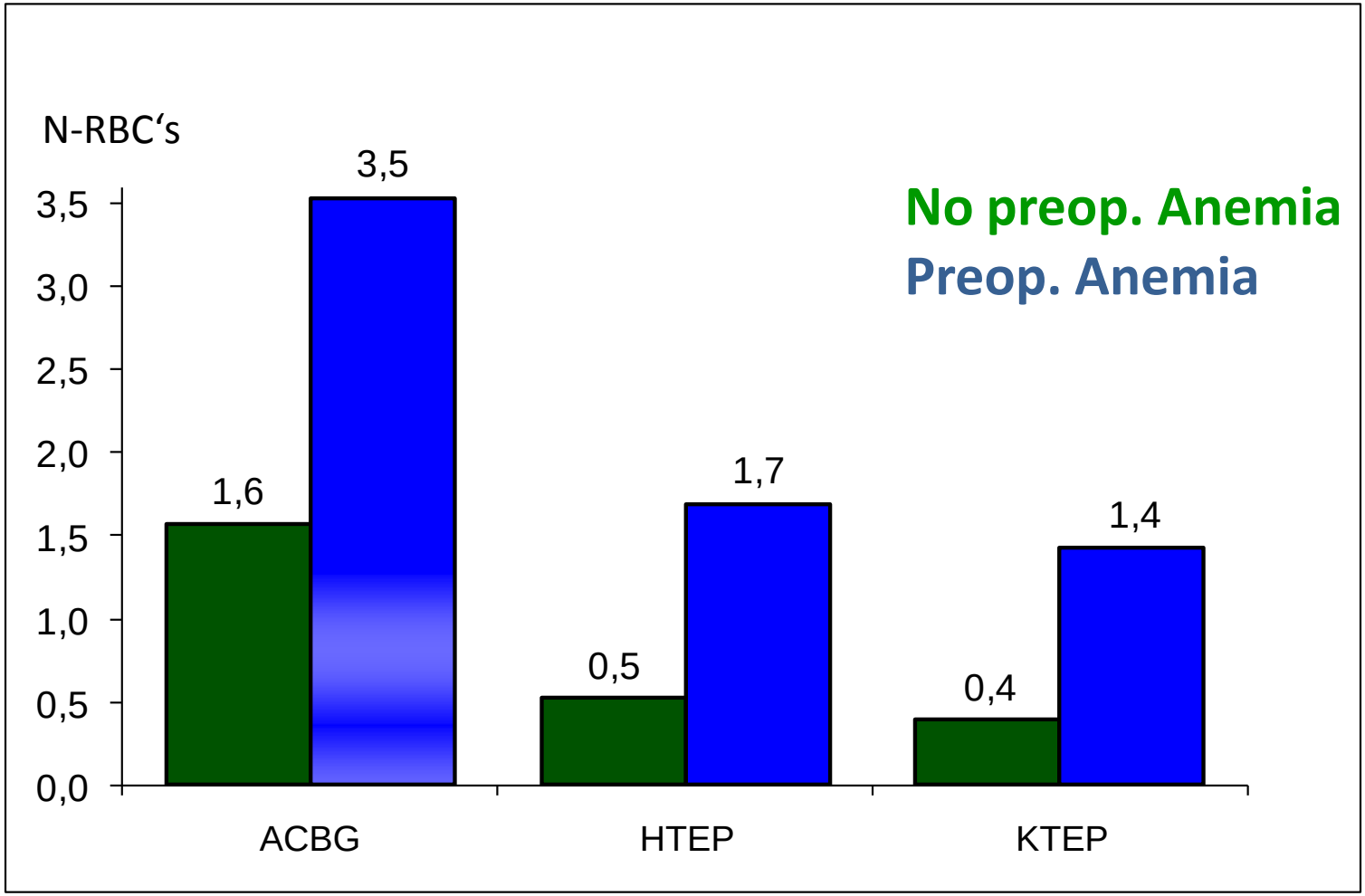
Pre-operative blood request



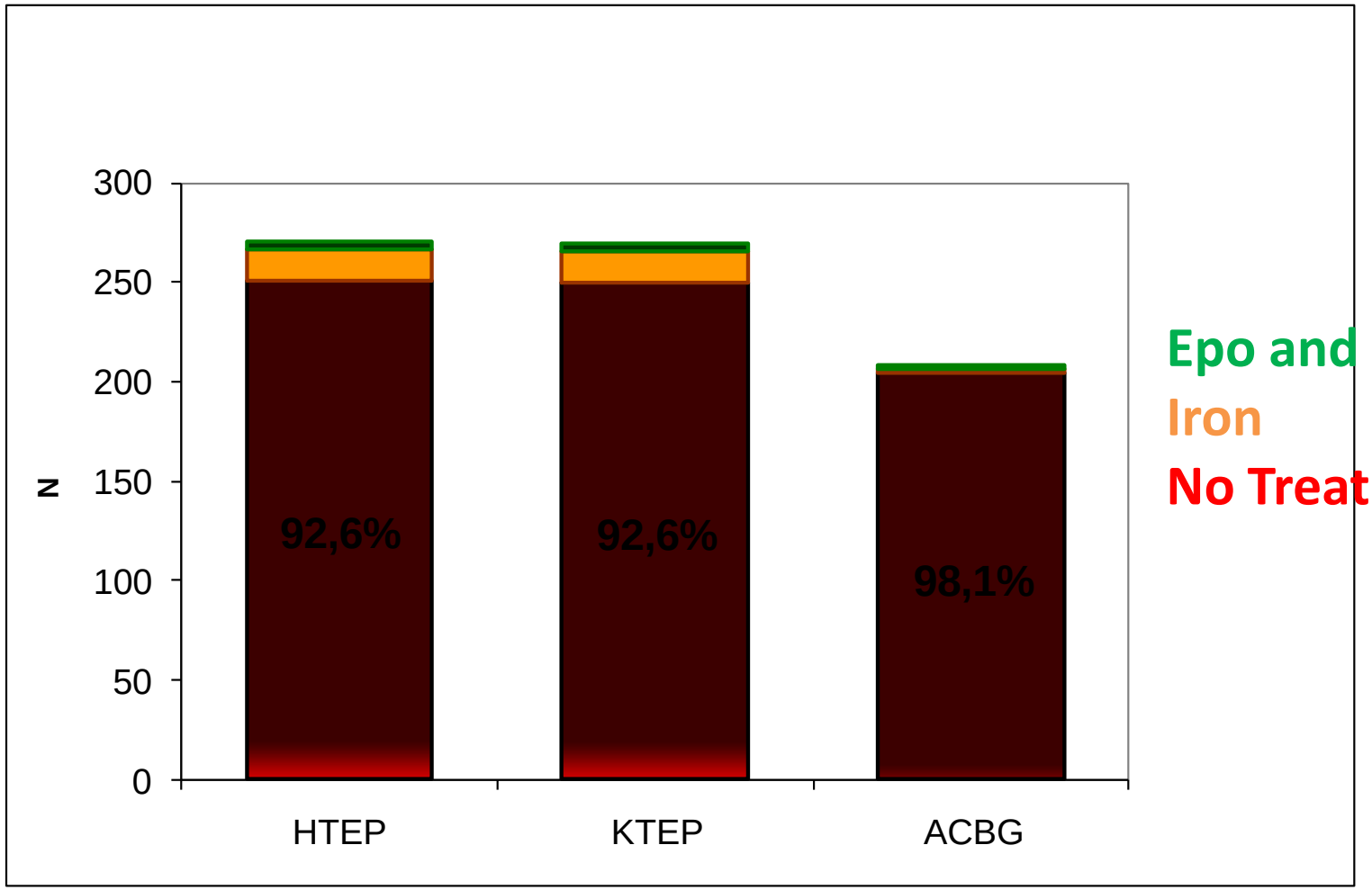
Prevalence of Preoperative Anemia



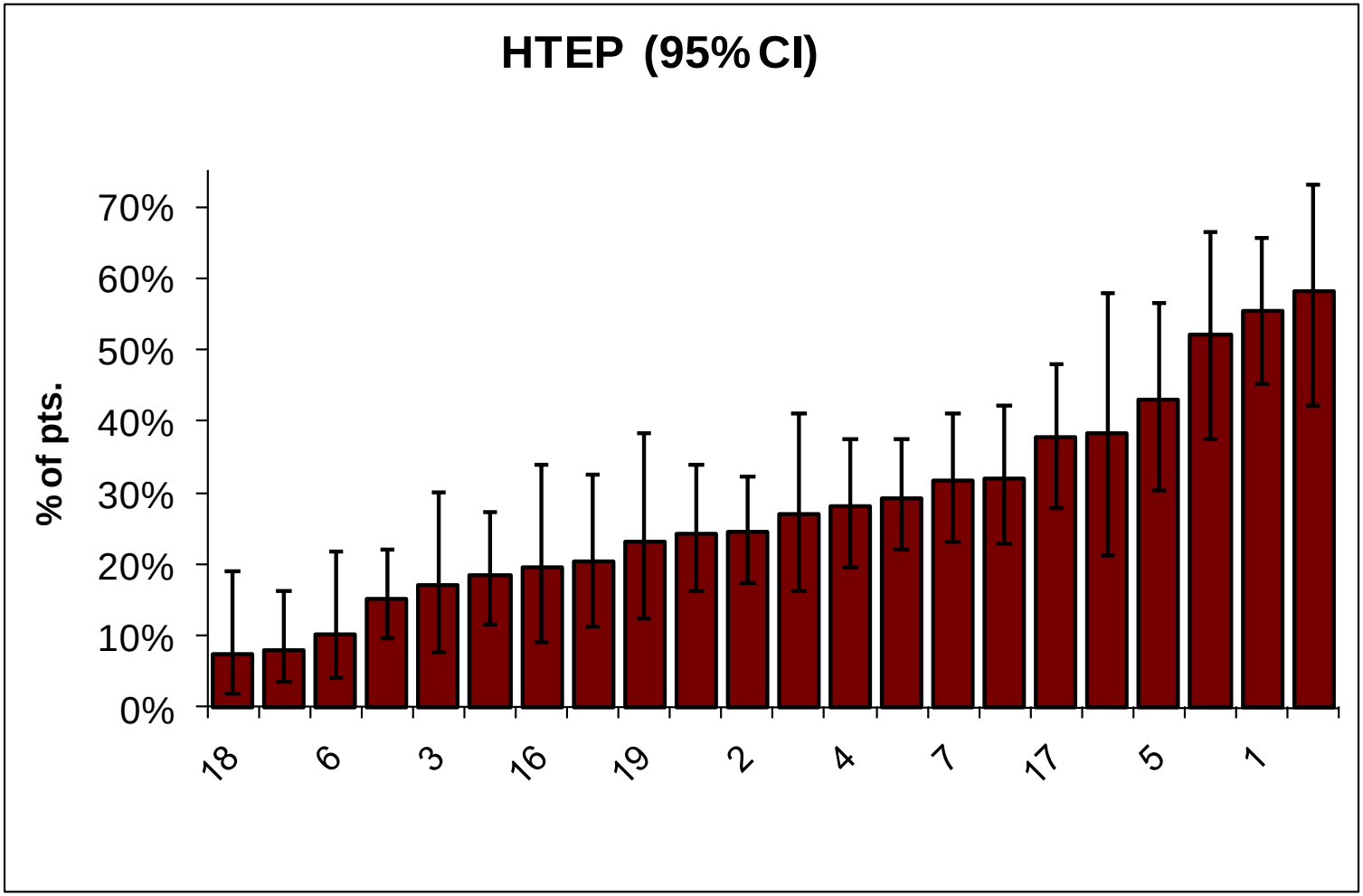
RBC Transfusion in Patients with Preoperative Anemia



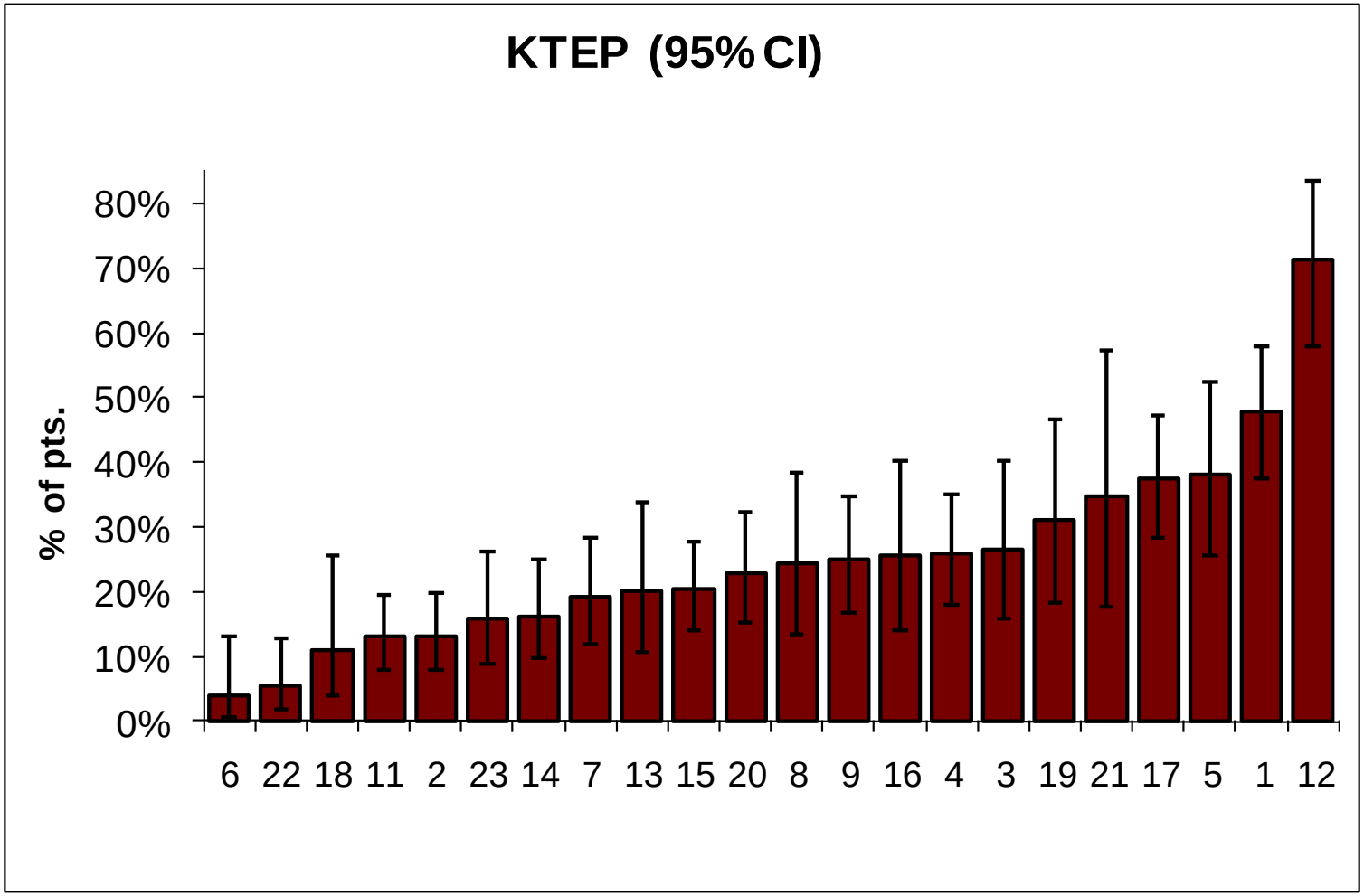
Treatment of Preoperative Anemia



Percentage of Patients Transfused in Different Centers (HTEP)



Percentage of Patients Transfused in Different Centers (KTEP)



Rationale for PBM

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Impact of the Ageing Population on Blood Demand

BLOOD DONORS AND BLOOD COLLECTION

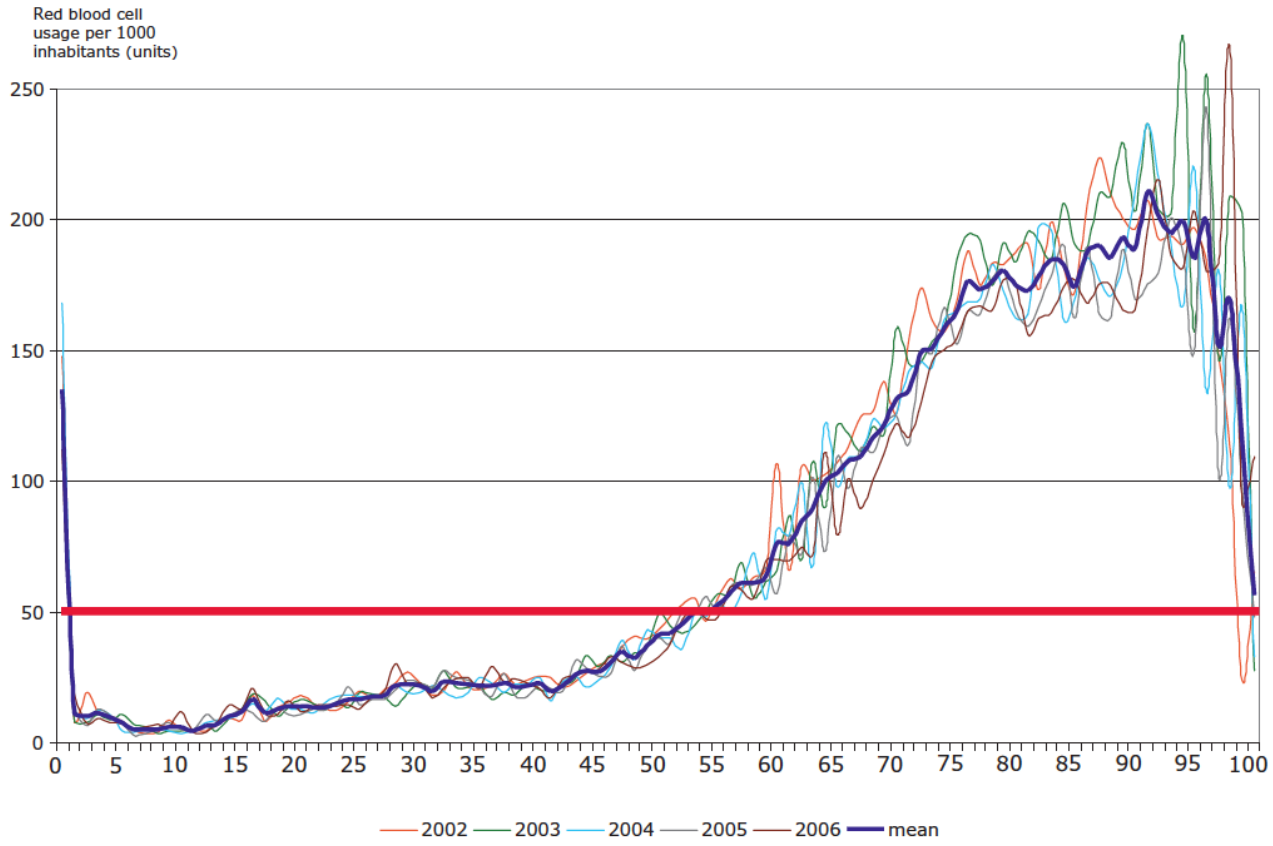
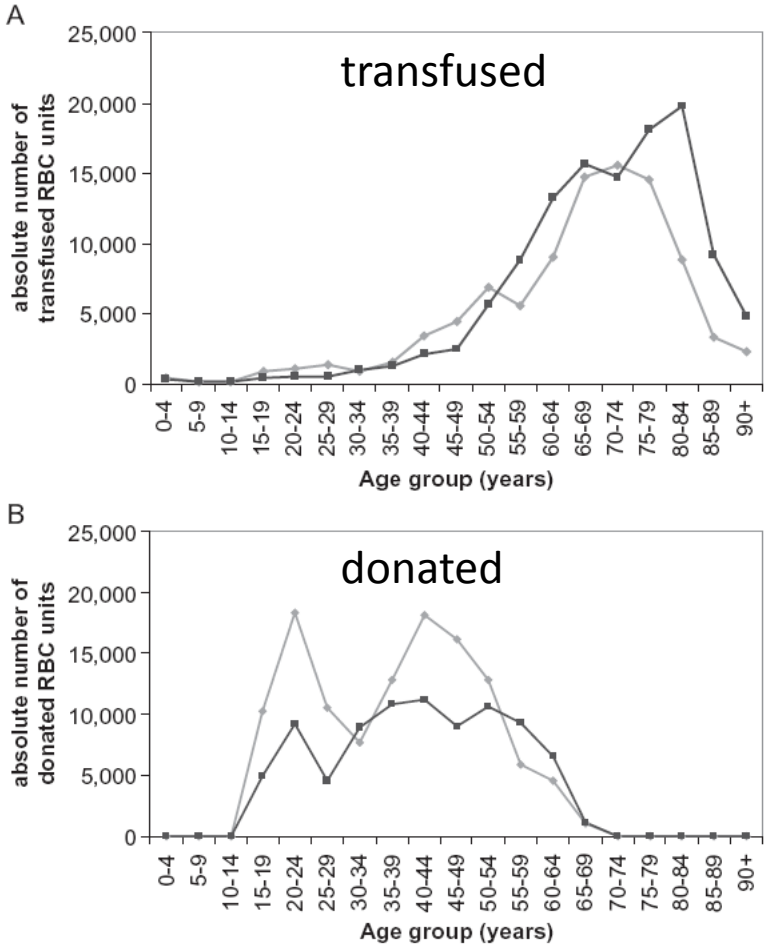
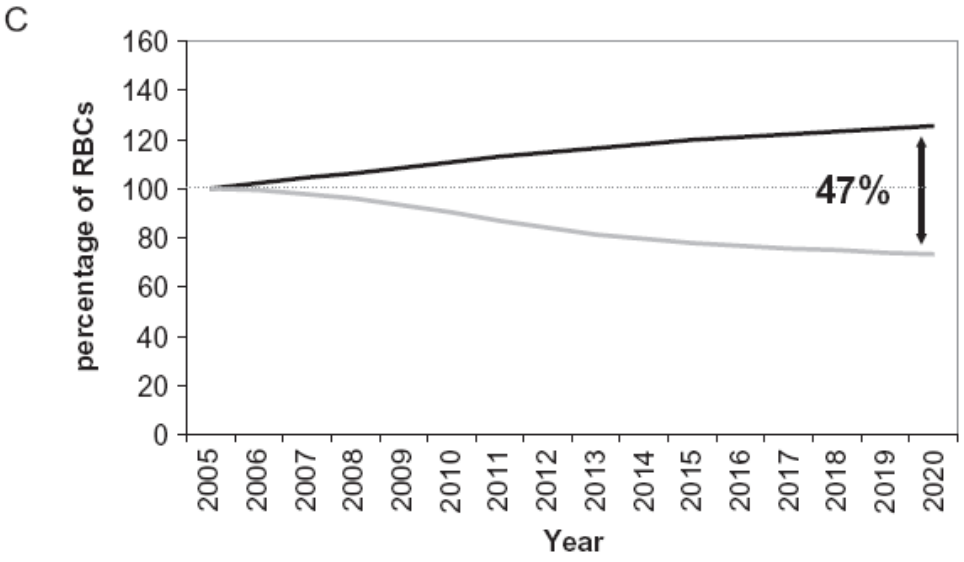


Fig. 2. RBC usage per capita by age in Finland 2002 to 2006. Current annual RBC usage in Finland is 50 units per 1000 inhabitants.

- r-

Implications of demographics on future blood supply: a population-based cross-sectional study





Absolute numbers in 2005 and projection for 2020

Greinacher et al: TRANSFUSION **;:**-**.**

Rationale for PBM

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- **Cost of blood**
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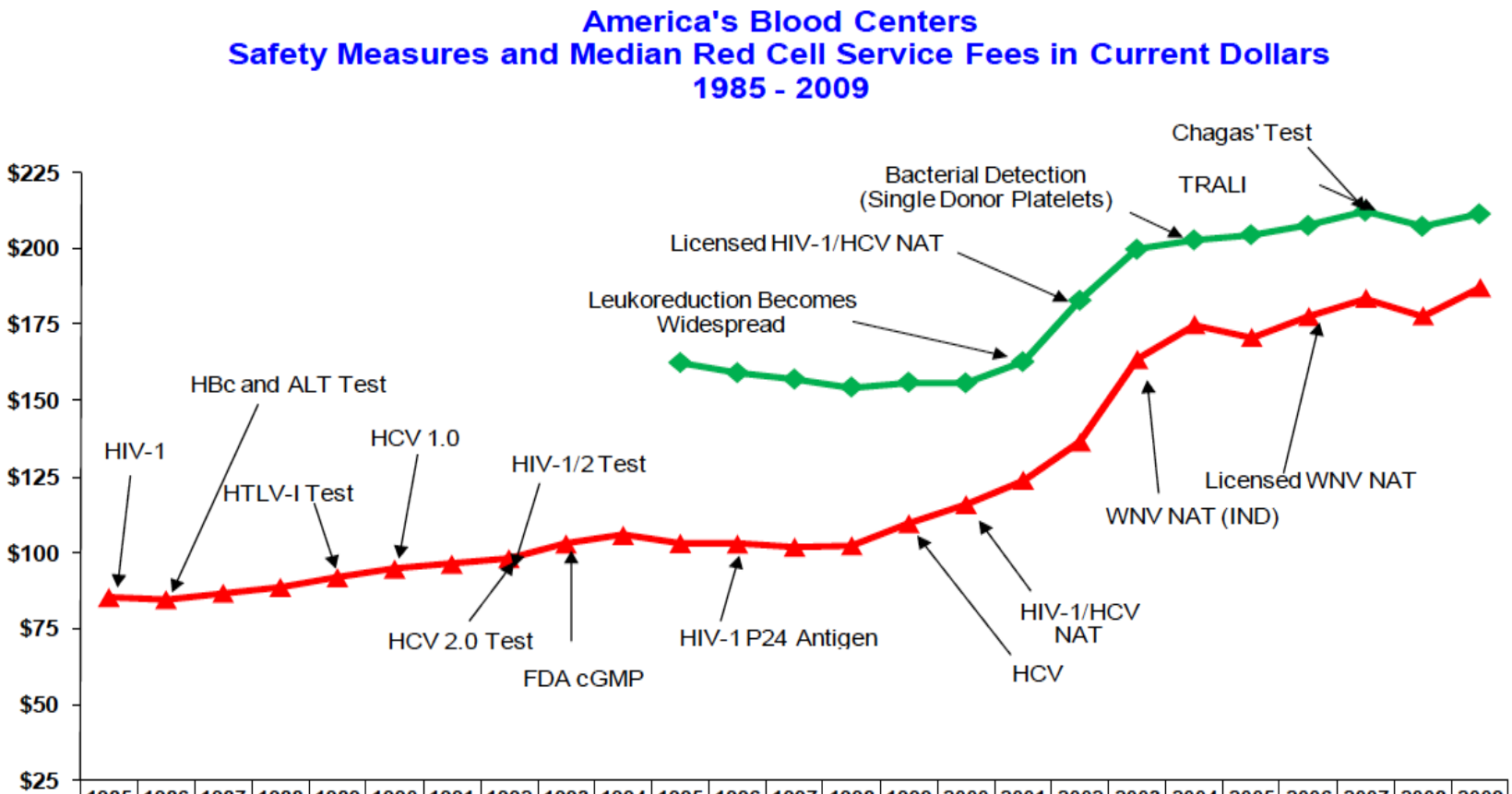
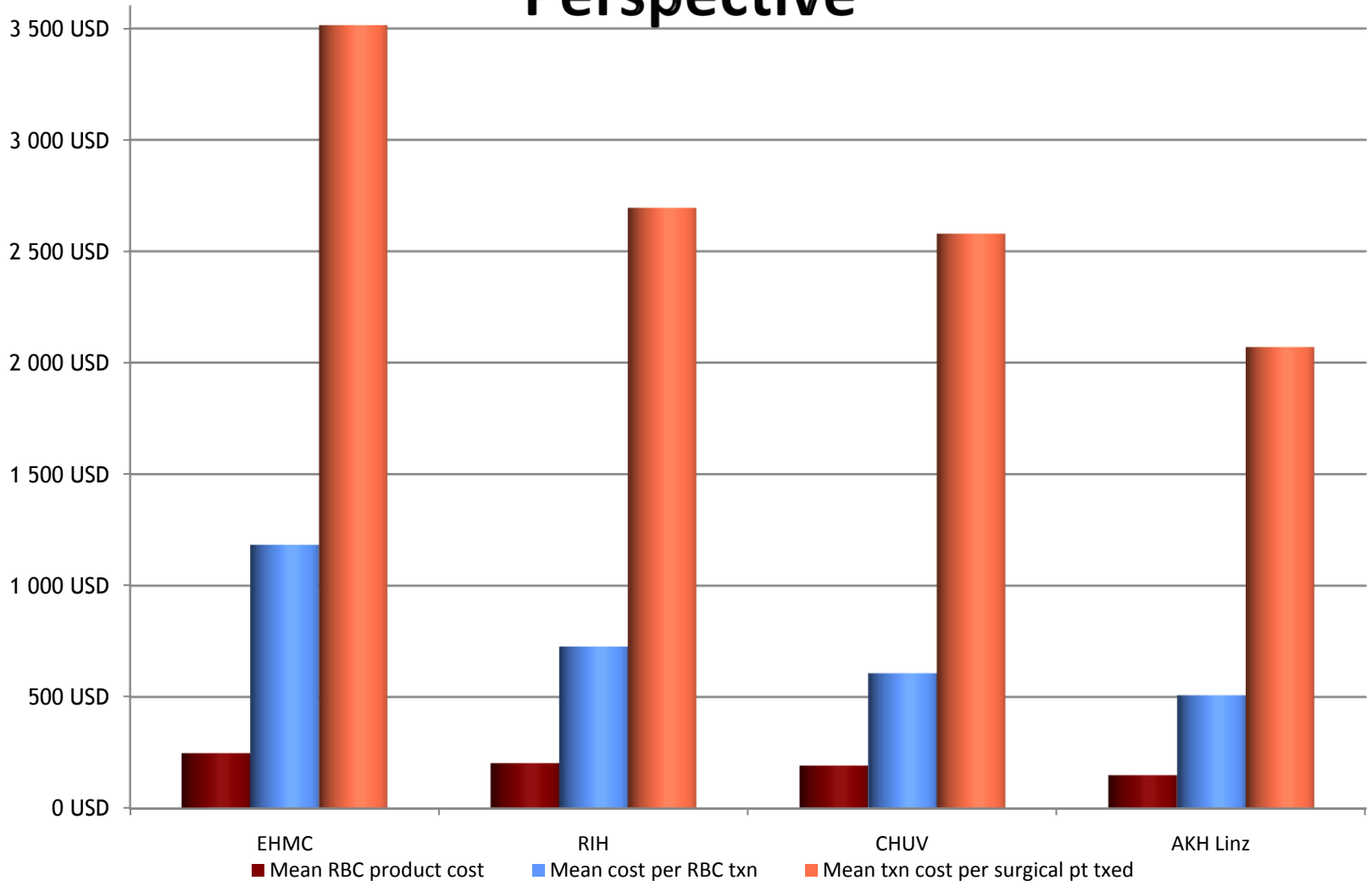
Blood Safety Measures – Another Cost Driver



	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
RBC	85	85	87	89	92	95	96	98	103	106	103	103	102	102	110	116	124	136	163	175	171	178	184	178	187
RBCLR											162	159	157	154	156	156	163	183	200	203	205	208	212	207	212

Activity Based Cost of Transfusion from a Provider's Perspective



Shander A, Hofmann A, Ozawa S, Theusinger O, Gombotz H, Spahn D. Activity-Based Costs of Blood Transfusions in Surgical Patients at Four Hospitals. Transfusion Vol. 50, April 2010

Cost of transfusion outcome

Frequency and outcomes of blood products transfusion across procedures and clinical conditions warranting inpatient care: an analysis of the 2004 healthcare cost and utilization project nationwide inpatient sample database.

- Retrospective cohort study of all hospitalisations in the US in 2004 (n=38.66 million) to assess in-hospital outcomes associated with blood transfusion.
- 5.8% (2.33 million) transfused
- After adjustment for age, gender, comorbidities, admission type or DRG transfusion associated with:

  - 1.7 increased odds of death (P<0.0001)
  - 1.9 increased odds of infection (P<0.0001)
  - 2.5 days longer LOS
  - $17,194 higher charges (P<0.0001)

→ $40.1 billion more charges for txed pts!

Morton et al: **Am J Med Qual. 2010 Jul-Aug;25(4):289-96. Epub 2010 Jun 7,2010**

Implementing Patient Blood Management

Clinician's Transfusion-Trigger Hb

Pre-op Hb Patient 1

Expected Nadir Hb Patient 1

Blood loss 1,800ml

Scenario 1 – Patient treated w/o PBM

0 2,0 4,0 6,0 8,0 10,0 12,0 14,0

Hb g/dL

Clinician's Transfusion-Trigger Hb

Pre-op Hb Patient 1

Expected Nadir Hb Patient 1

Blood loss 1,800ml

1st Pillar

Optimise haemo-poiesis

- Fe
- B_{12}
- Folic Acid
- ESAs

Scenario 2 – Patient treated w/ PBM

0 2,0 4,0 6,0 8,0 10,0 12,0 14,0

Hb g/dL

Clinician's Transfusion-Trigger Hb

Pre-op Hb Patient 1

Expected Nadir Hb Patient 1

Blood 1,800

Blood loss 1,000ml

2nd Pillar

Minimise blood loss & bleeding

- Meticulous surgical hemostasis,
- Topical hemostatic agents
- Systemic hemostatic agents
- Anesthesiological techniques
- Normothermia
- Induced hypotension
- etc.

Scenario 2 – Patient treated w/ PBM

0 2,0 4,0 6,0 8,0 10,0 12,0 14,0

Hb g/dL

Clinician's Transfusion-Trigger Hb

Pre-op Hb Patient 1

Expected Nadir Hb Patient 1

Blood loss 1,000ml

3rd Pillar

Harness & optimise physio-logical tolerance of anaemia

- Keep pt. normovolemic
- FiO_2 100%
- Minimising metabolic demand

Scenario 2 – Patient treated w/ PBM

0 2,0 4,0 6,0 8,0 10,0 12,0 14,0

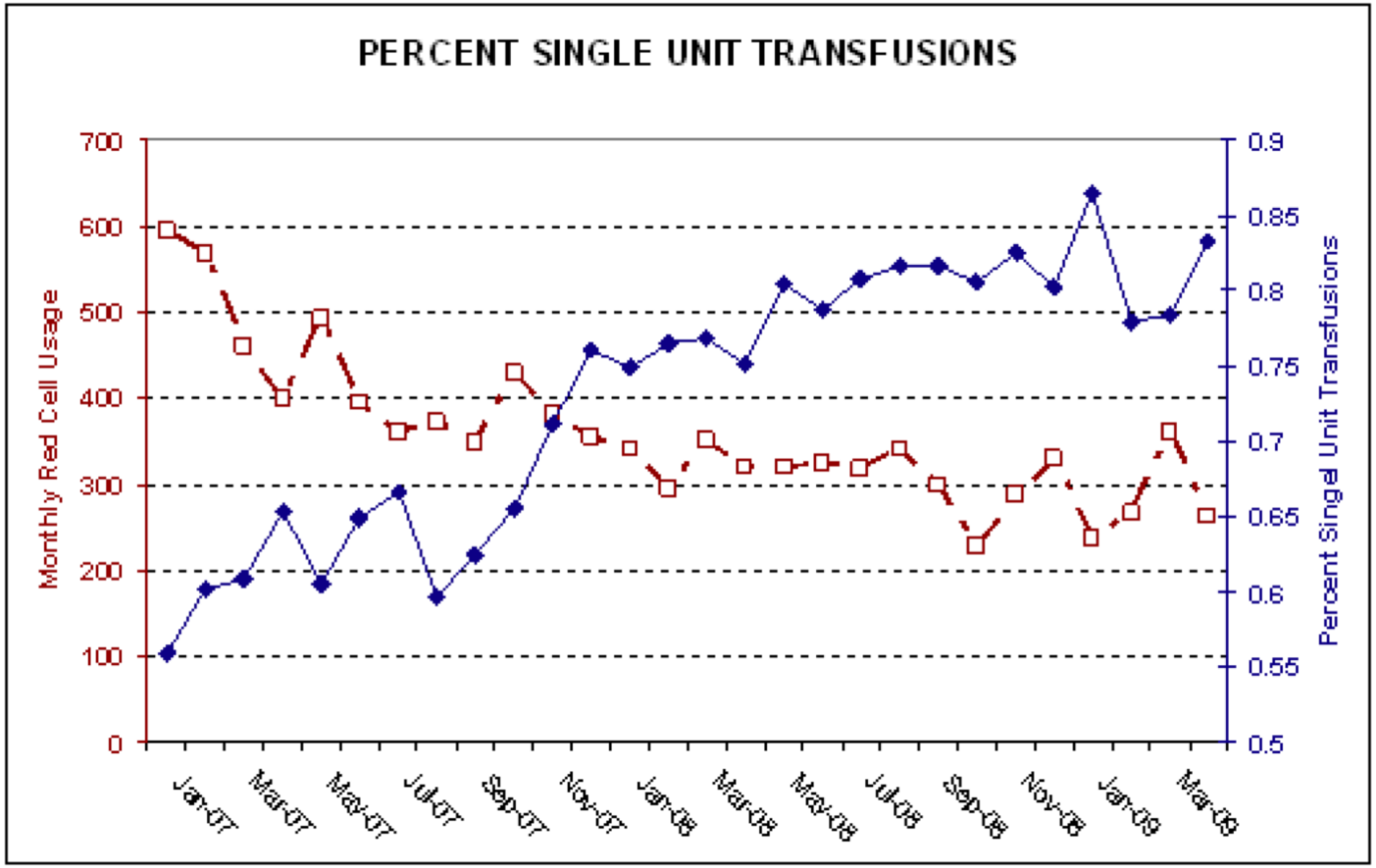
Hb g/dL

Components of PBM

- Evaluation of the actual blood usage (data management)
- Optimising blood ordering schedules
- Increasing tolerance of anemia
- 3 pillar strategy
  - Optimising preoperative red cell mass
  - Minimising perioperative blood loss
  - Reducing transfusion trigger

Data Management

Single RBC unit txns vs total units txd



Example from EMMC USA

MSBOS

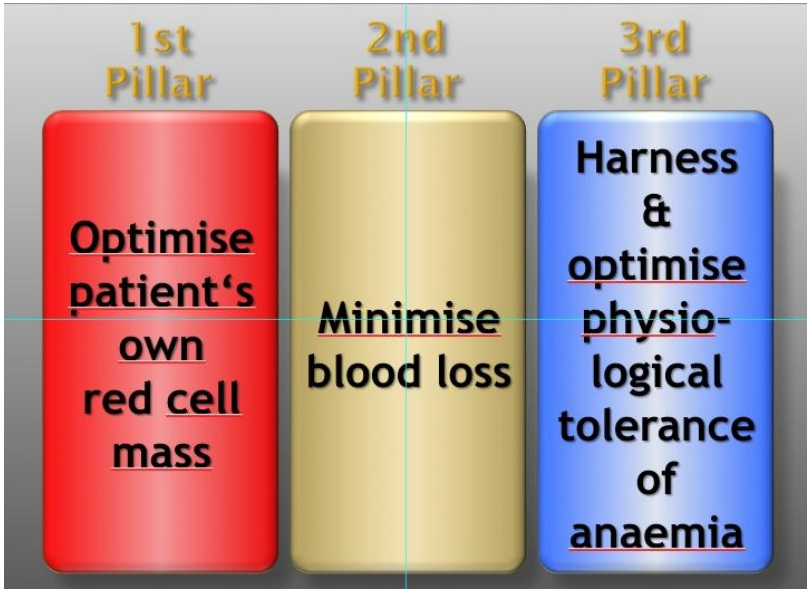
Maximum Blood Ordering Schedule

Authors	Type of surgery	CTR before	CTR after
Rogers et al. 2006	Orthopedics	3.21 : 1	1.62 : 1
Mehra et al. 2004	Knee replacement	4.90 : 1	1.70 : 1
Foley et al. 2003	Gynecology	2.25 : 1	1.71 : 1
Richardson et al. 1998	Various	1.80 : 1	1.80 : 1

1.7: 1 = reduction of ....€

Components of PBM

- ✓ Evaluation of the actual blood usage (data management)
- ✓ Optimising blood ordering schedules
- ✓ Increasing tolerance of anemia
- 3 pillar strategy
  - Optimising preoperative red cell mass
  - Minimising perioperative blood loss
  - Reducing transfusion trigger



	1st Pillar Optimise patient's own red cell mass	2nd Pillar Minimise blood loss	3rd Pillar Harness & optimise physiological tolerance of anaemia
Preoperative	• Detect anaemia • Identify underlying disorder(s) causing anaemia • Manage disorder(s) • Refer for further evaluation if necessary • Treat iron deficiency/anaemia of chronic disease/iron-restricted erythropoiesis • Note: Anaemia is a contraindication for elective surgery	• Identify and manage bleeding risk • Minimising iatrogenic blood loss • Procedure planning and rehearsal • Preoperative autologous blood donation (in selected cases or when patient choice) • Other	• Assess/optimise patient's physiological reserve and risk factors • Compare estimated blood loss with patient-specific tolerable blood loss • Formulate patient-specific management plan using appropriate blood conservation modalities to minimise blood loss, optimise red cell mass and manage anaemia • Restrictive transfusion strategies
Intraoperative	• Timing surgery with haematological optimisation	• Meticulous haemostasis and surgical techniques • Blood-sparing surgical techniques • Anaesthetic blood conserving strategies • Autologous blood options • Pharmacological/haemostatic agents	• Optimise cardiac output • Optimise ventilation and oxygenation • Restrictive transfusion strategies
Postoperative	• Stimulate erythropoiesis • Be aware of drug interactions that can increase anaemia	• Vigilant monitoring and management of post-operative bleeding • Avoid secondary haemorrhage • Rapid warming / maintain normothermia (unless hypothermia specifically indicated) • Autologous blood salvage • Minimising iatrogenic blood loss • Haemostasis/anticoagulation management • Prophylaxis of upper GI haemorrhage • Avoid/treat infections promptly • Be aware of adverse effects of medication	• Optimise tolerance of anaemia • Maximise oxygen delivery • Minimise oxygen consumption • Avoid/treat infections promptly • Restrictive transfusion strategies

	1st Pillar Optimise patient's own red cell mass	2nd Pillar Minimise blood loss	3rd Pillar Harness & optimise physiological tolerance of anaemia
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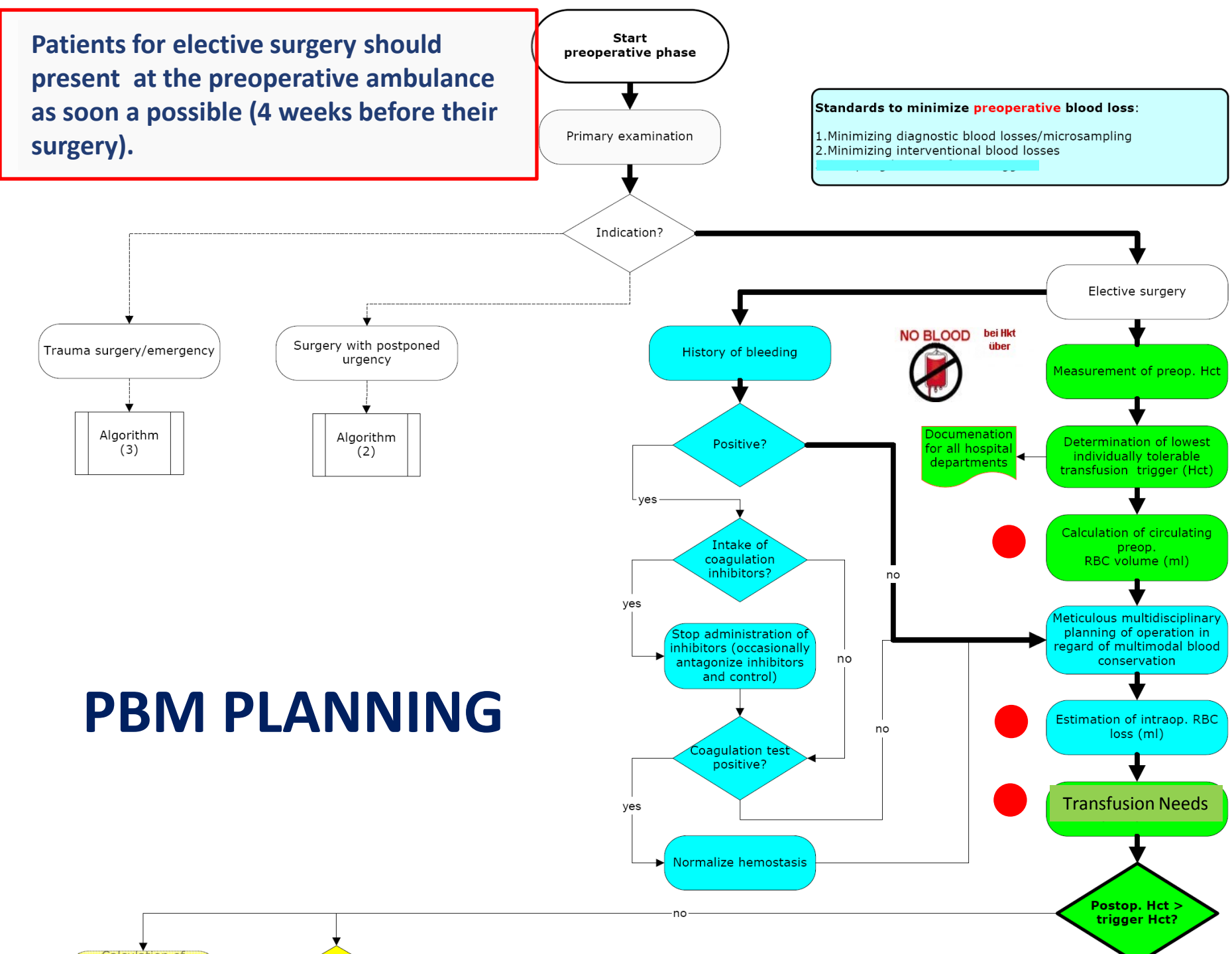
Patients for elective surgery should present at the preoperative ambulance as soon a possible (4 weeks before their surgery).



Standards to minimize preoperative blood loss:

1. Minimizing diagnostic blood losses/microsampling
2. Minimizing interventional blood losses

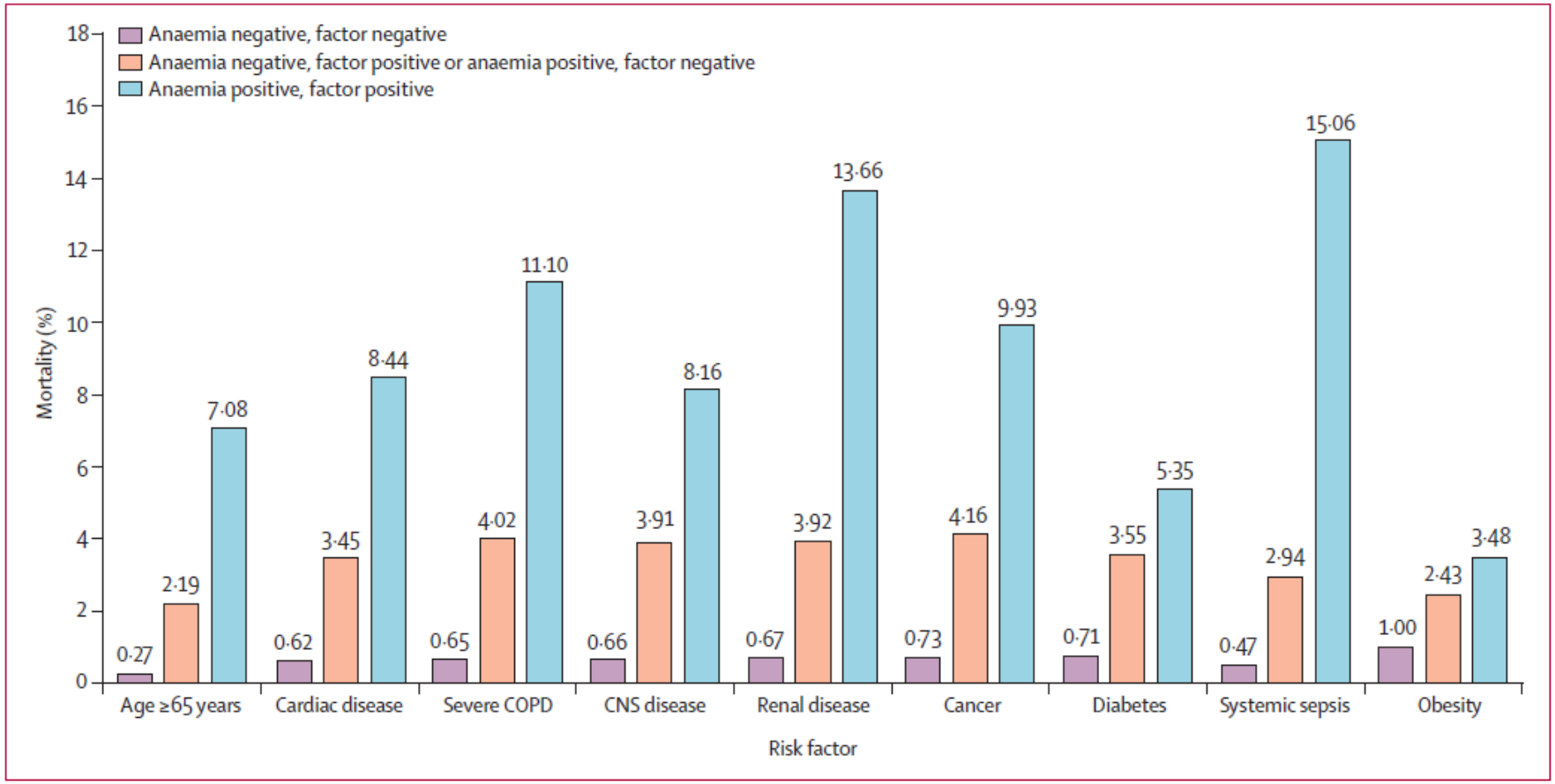
PBM PLANNING

Prävalenz der (präoperativen) Anämie

Nach Grunderkrankung	
Diabetes	14 - 15 %
Herzinsuffizienz	10 - 80 %
Akuter Myokardinfarkt	6 - 18 %
Infektionen	bis zu 95%
Tumorerkrankungen	bis zu 77%
Autoimmunerkrankung	bis zu 71%
Nierenerkrankungen	bis zu 50%
COPD	23%
Präoperativ	
ASA I und ASA II	1 %
Knie- und Hüftoperation	20 - 35 %
Allgemeinchirurgische Eingriffe	bis zu 40 %
Colonchirurgie	25 - 70 %
Herz- und Gefäßoperationen	16 - 40 %

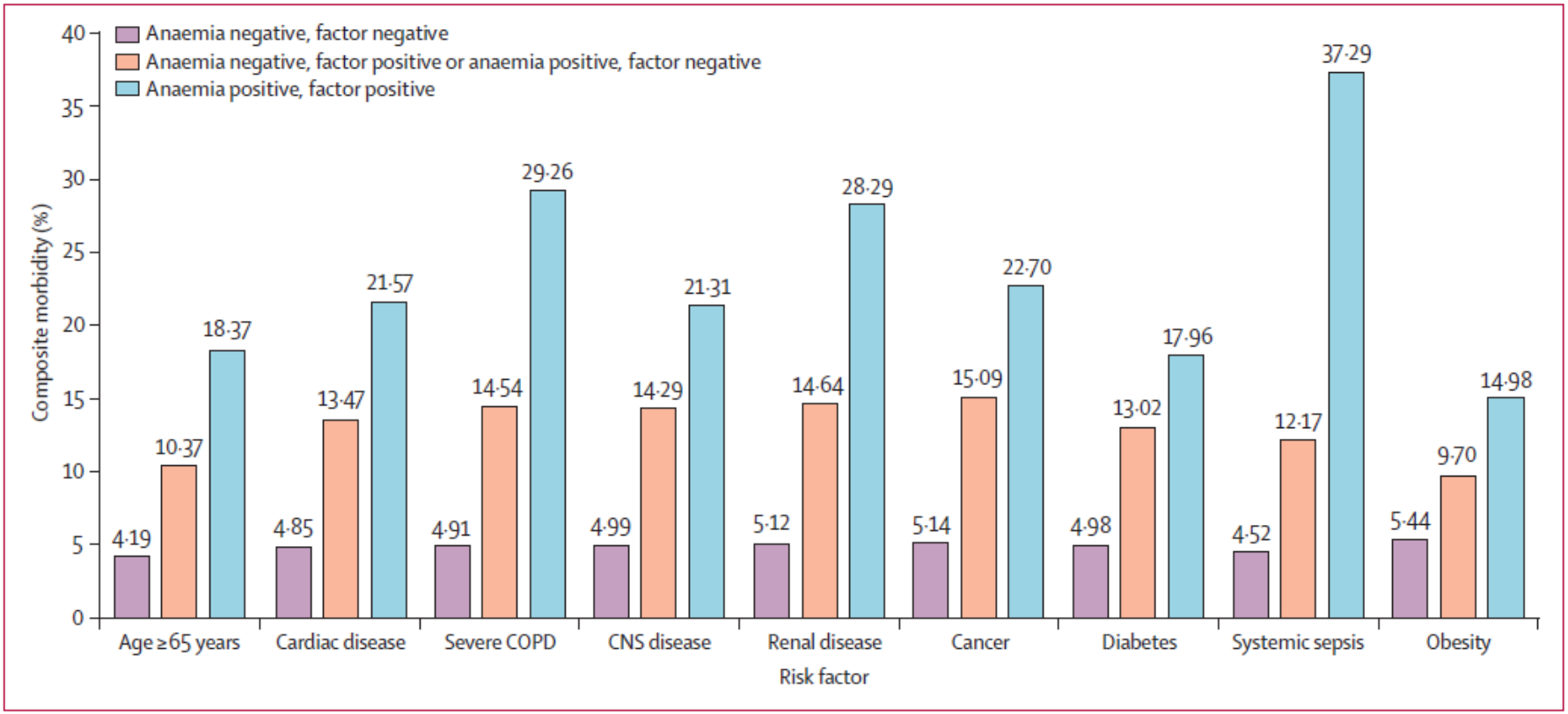
Gombotz et al: AINS 2011 Jul;46(7-8):466-74

30-day mortality, by anaemia and risk factor status



Mussallam et al: www.thelancet.com Published online October 6, 2011 DOI:10.1016/S0140-6736(11)61381-0

30-day composite morbidity, by anaemia and risk factor status



Mussallam et al: www.thelancet.com Published online October 6, 2011 DOI:10.1016/S0140-6736(11)61381-0

Patient blood management is key before elective surgery

Published Online
October 6, 2011
DOI:10.1016/S0140-6736(11)61552-3

See Online/Articles
DOI:10.1016/S0140-6736(11)61381-0

Writing in *The Lancet*, Khaled Musallam and colleagues address an important topic through their analysis of the American College of Surgeons' National Surgical Quality Improvement Program database;[1] namely, what is the prevalence of preoperative anaemia in patients undergoing major non-cardiac surgery and what are the implications? Moreover, by removal of data for allogeneic red-blood-cell transfusions in their analysis (and thus in the absence of treatment for anaemia) the independent and natural course of preoperative anaemia is shown. The main finding of their study[1] was that preoperative anaemia—even to a mild degree—was significantly and independently associated with increased postoperative morbidity and mortality. This association might be aggravated by concomitant perisurgical blood loss[2] and (frequently unnecessary) allogeneic transfusions.[3] I believe that Musallam and colleagues' findings could have an enormous effect on health-care systems worldwide because preoperative diagnosis and treatment of anaemia (apart from transfusions of red blood cells) has almost never been undertaken routinely before surgery.[3]

Anaemia is a serious but easily treatable condition. Treatment is less costly than is transfusion and would possibly improve outcomes, not only by increased tolerance of perioperative blood loss and avoidance of allogeneic transfusions but also through elimination of the risk of anaemia by maintaining increased physiological haemoglobin values throughout the perioperative period.[4]

Because of the nature of Musallam and colleagues' retrospective observational study,[1] the cause of anaemia was not assessed. However, about a third of patients with anaemia probably would have had nutritional deficiencies, a third probably would have had chronic disease, and a third would have had anaemia from an unknown cause.[5] Moreover, diagnostic and interventional blood loss might have had an additional role in the rates of anaemia reported.

Because of the prevalence, treatability, and negative outcomes of preoperative anaemia, preservation and improvement of preoperative red-blood-cell mass is essential as one of the three pillars of the new patient blood management strategy,[6] which lasts for the entire perioperative period and has a patient-specific perioperative multidisciplinary and multifaceted team approach. Implementation of the patient blood management strategy not only reduces transfusion requirements but also improves postoperative outcome, at least in patients undergoing orthopaedic and cardiac surgery.[7,8]

However, some drawbacks of preoperative anaemia treatment need to be considered. Diagnosis and treatment of preoperative anaemia is time consuming and therefore detection and assessment of anaemia should be undertaken close to 28 days before a scheduled surgery to enable adequate treatment.[9] Furthermore, in case of unexplained anaemia a planned surgery with substantial predicted blood loss should be rescheduled.[9] In some populations of patients, treatment with iron or erythropoiesis-stimulating drugs might be ineffective, have serious side-effects, and therefore not be indicated.[10,11] Moreover, at least in patients with chronic disease, anaemia might be regarded as an adaptive mechanism. For such patients, treatment of mild-to-moderate anaemia with iron or erythropoiesis-stimulating drugs might increase mortality despite an improvement in functional capacity and wellbeing.[12]

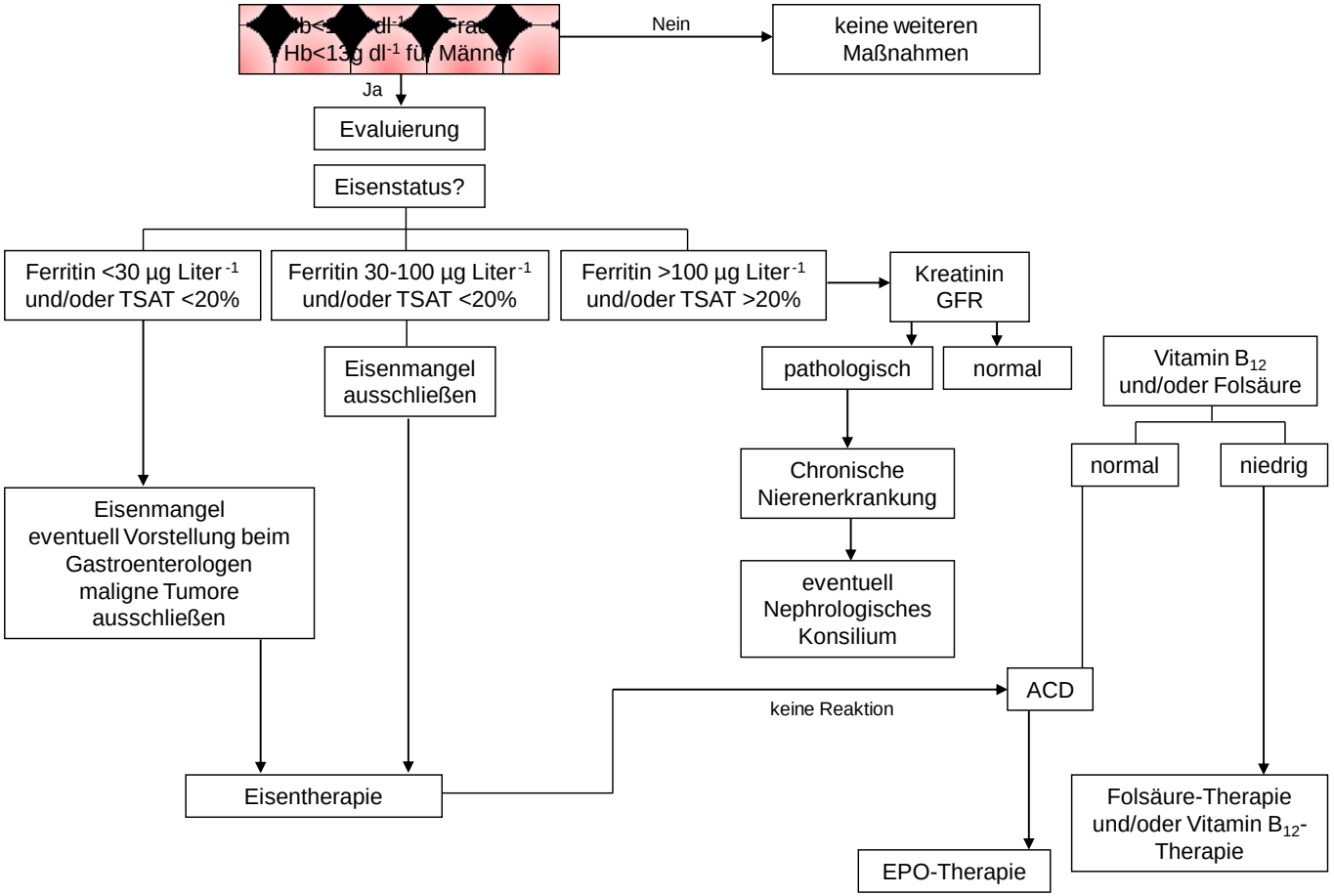
Nonetheless, Musallam and colleagues' study[1] strongly suggests that implementation of treatment of anaemia as part of a universal patient blood management strategy should become standard of care in patients undergoing elective surgical procedures, particularly in those where substantial blood loss is expected. However, additional studies are urgently needed to secure the efficacy and safety of preoperative treatment of anaemia.

Hasan Jamali/AP/Press Association Images

Gombotz H: www.thelancet.com
Published online October 6, 2011 DOI:10.1016/xxxx

Invited comment

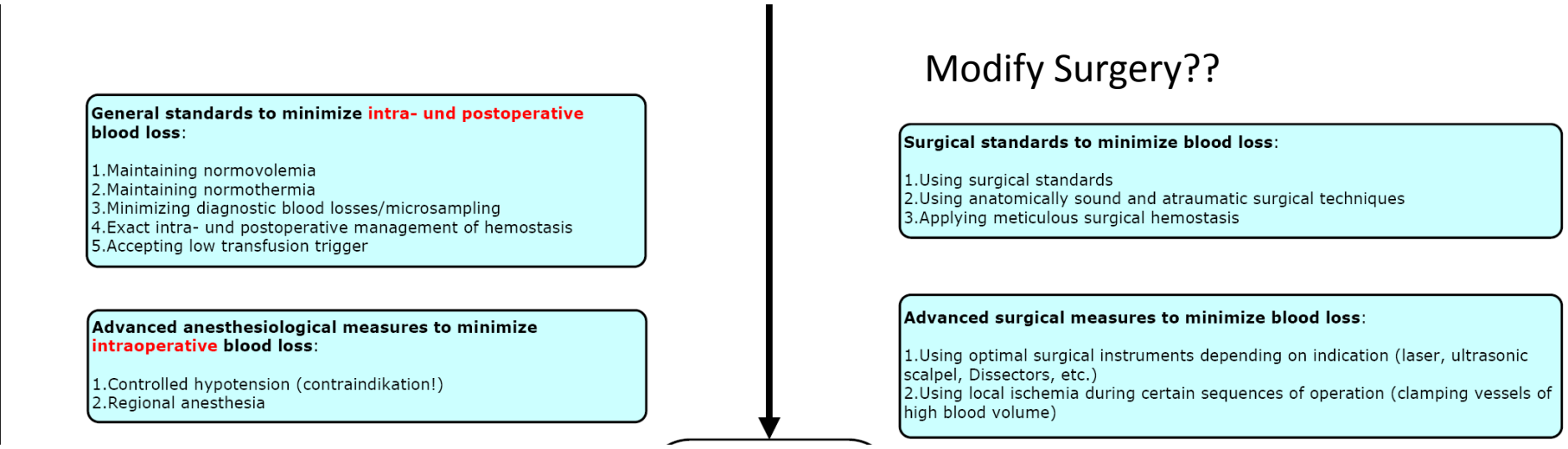
Detection, evaluation, and management of preoperative anaemia in the elective orthopaedic surgical patient: NATA guidelines.

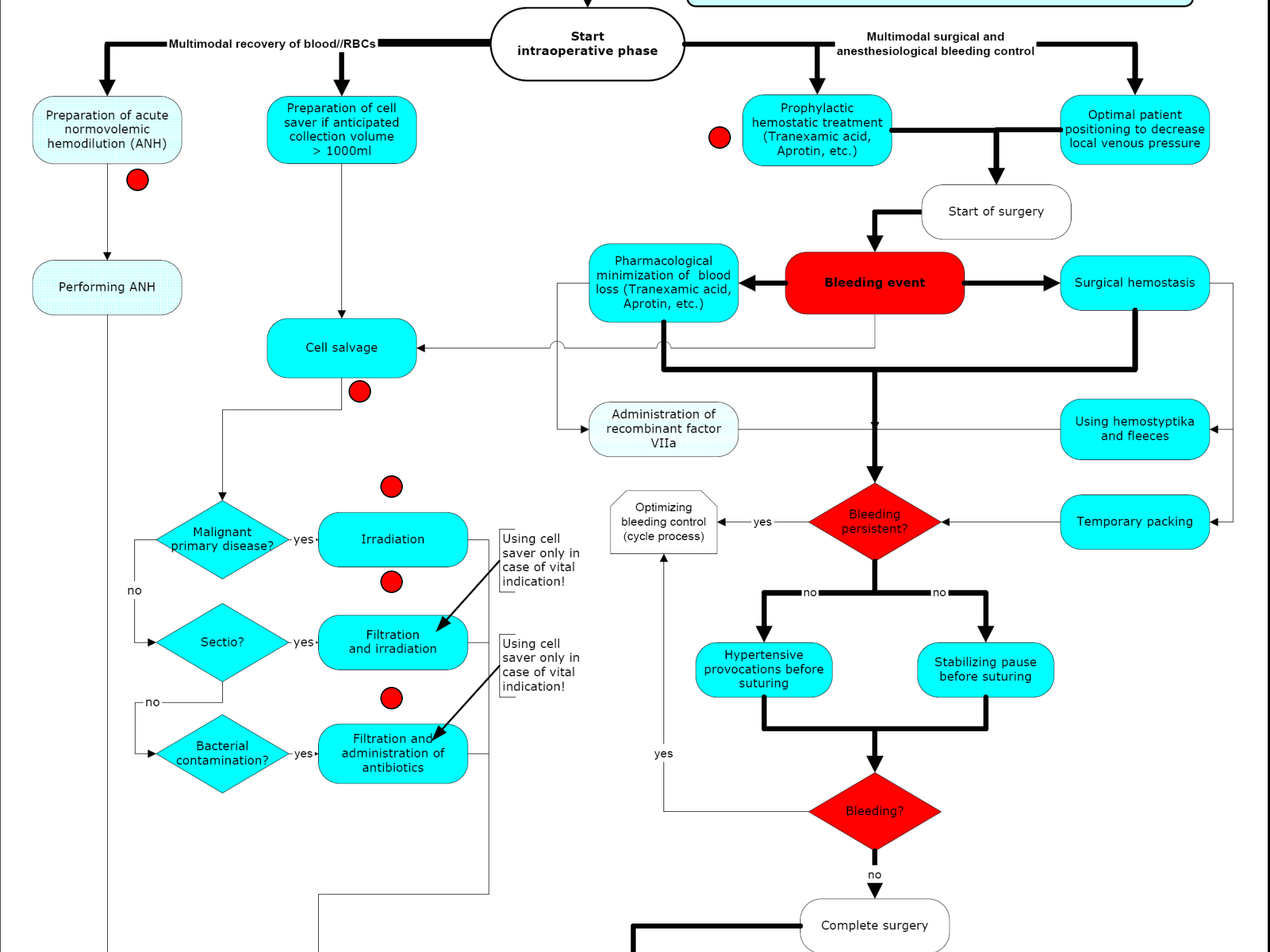


Goodnough et al: Br J Anaesth 2011; 106(1):13-22

	1st Pillar Optimise patient's own red cell mass	2nd Pillar Minimise blood loss	3rd Pillar Harness & optimise physiological tolerance of anaemia
Preoperative	• Detect anaemia • Identify underlying disorder(s) causing anaemia • Manage disorder(s) • Refer for further evaluation if necessary • Treat iron deficiency/anaemia of chronic disease/iron-restricted erythropoiesis • Note: Anaemia is a contraindication for elective surgery	• Identify and manage bleeding risk • Minimising iatrogenic blood loss • Procedure planning and rehearsal • Preoperative autologous blood donation (in selected cases or when patient choice) • Other	• Assess/optimise patient's physiological reserve and risk factors • Compare estimated blood loss with patient-specific tolerable blood loss • Formulate patient-specific management plan using appropriate blood conservation modalities to minimise blood loss, optimise red cell mass and manage anaemia • Restrictive transfusion strategies
Intraoperative	• Timing surgery with haematological optimisation	• Meticulous haemostasis and surgical techniques • Blood-sparing surgical techniques • Anaesthetic blood conserving strategies • Autologous blood options • Pharmacological/haemostatic agents	• Optimise cardiac output • Optimise ventilation and oxygenation • Restrictive transfusion strategies
Postoperative	• Stimulate erythropoiesis • Be aware of drug interactions that can increase anaemia	• Vigilant monitoring and management of post-operative bleeding • Avoid secondary haemorrhage • Rapid warming / maintain normothermia (unless hypothermia specifically indicated) • Autologous blood salvage • Minimising iatrogenic blood loss • Haemostasis/anticoagulation management • Prophylaxis of upper GI haemorrhage • Avoid/treat infections promptly • Be aware of adverse effects of medication	• Optimise tolerance of anaemia • Maximise oxygen delivery • Minimise oxygen consumption • Avoid/treat infections promptly • Restrictive transfusion strategies

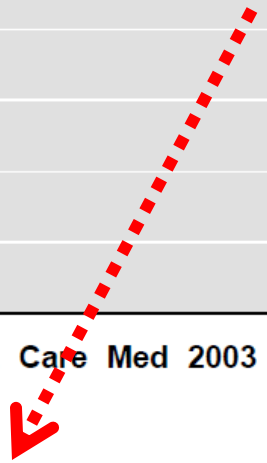
General standards and advanced measures




Start intraoperative phase
Multimodal recovery of blood//RBCs
Multimodal surgical and anesthesiological bleeding control
Preparation of acute normovolemic hemodilution (ANH)
Preparation of cell saver if anticipated collection volume > 1000ml
Prophylactic hemostatic treatment (Tranexamic acid, Aprotin, etc.)
Optimal patient positioning to decrease local venous pressure
Start of surgery
Performing ANH
Pharmacological minimization of blood loss (Tranexamic acid, Aprotin, etc.)
Bleeding event
Surgical hemostasis
Cell salvage
Administration of recombinant factor VIIa
Using hemostyptika and fleeces
Malignant primary disease?
yes
Irradiation
Optimizing bleeding control (cycle process)
Bleeding persistent?
Temporary packing
Using cell saver only in case of vital indication!
no
Sectio?
Filtration and irradiation
Hypertensive provocations before suturing
Stabilizing pause before suturing
Using cell saver only in case of vital indication!
Bacterial contamination?
Filtration and administration of antibiotics
Bleeding?
Complete surgery

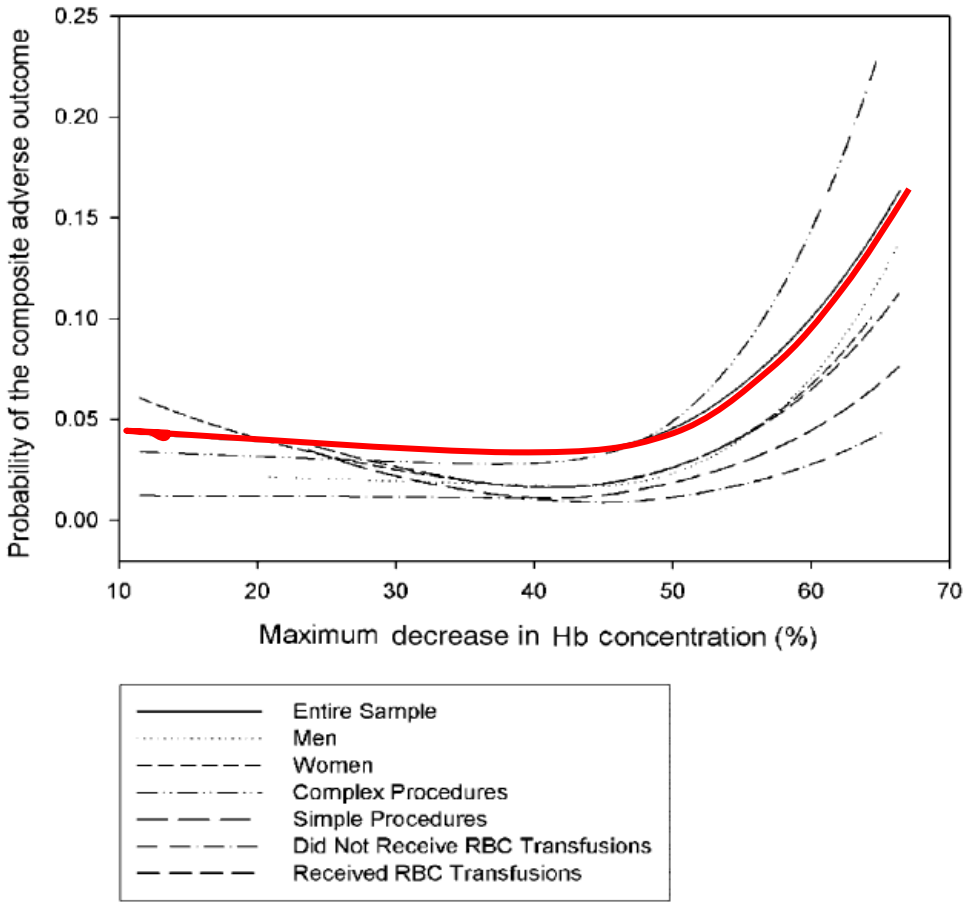
Approximate contributions of selected PBM modalities in the surgical patient	Number of RBC units saved
Perioperative	
Harnessing patient's tolerance of anaemia (restrictive transfusion trigger)	1-2[146]
Restricted phlebotomy	1[128]
Pre-operative	
Optimisation of RBC mass (perioperative anaemia management)	2[184, 185]
Intra-operative	
Meticulous haemostasis & surgical technique	1 or more[186]
Acute normovolaemic haemodilution (ANH)	1 or more[89, 187]
Autologous cell salvage	1or more[188]
Post-operative	
Autologous blood salvage	1[189]

Adapted with author consent from Shander A. Surgery without blood. Crit Care Med 2003 Dec;31(12 Suppl):S708-S714.



Up to 50% reduction of blood loss!!!

The influence of baseline hb concentration on tolerance of anemia in cardiac surgery



The relationship between maximum decrease in Hb concentration and adverse outcomes was independently associated with increased risk!!

Karkouti et al: TRANSFUSION 2008;48:666-672.

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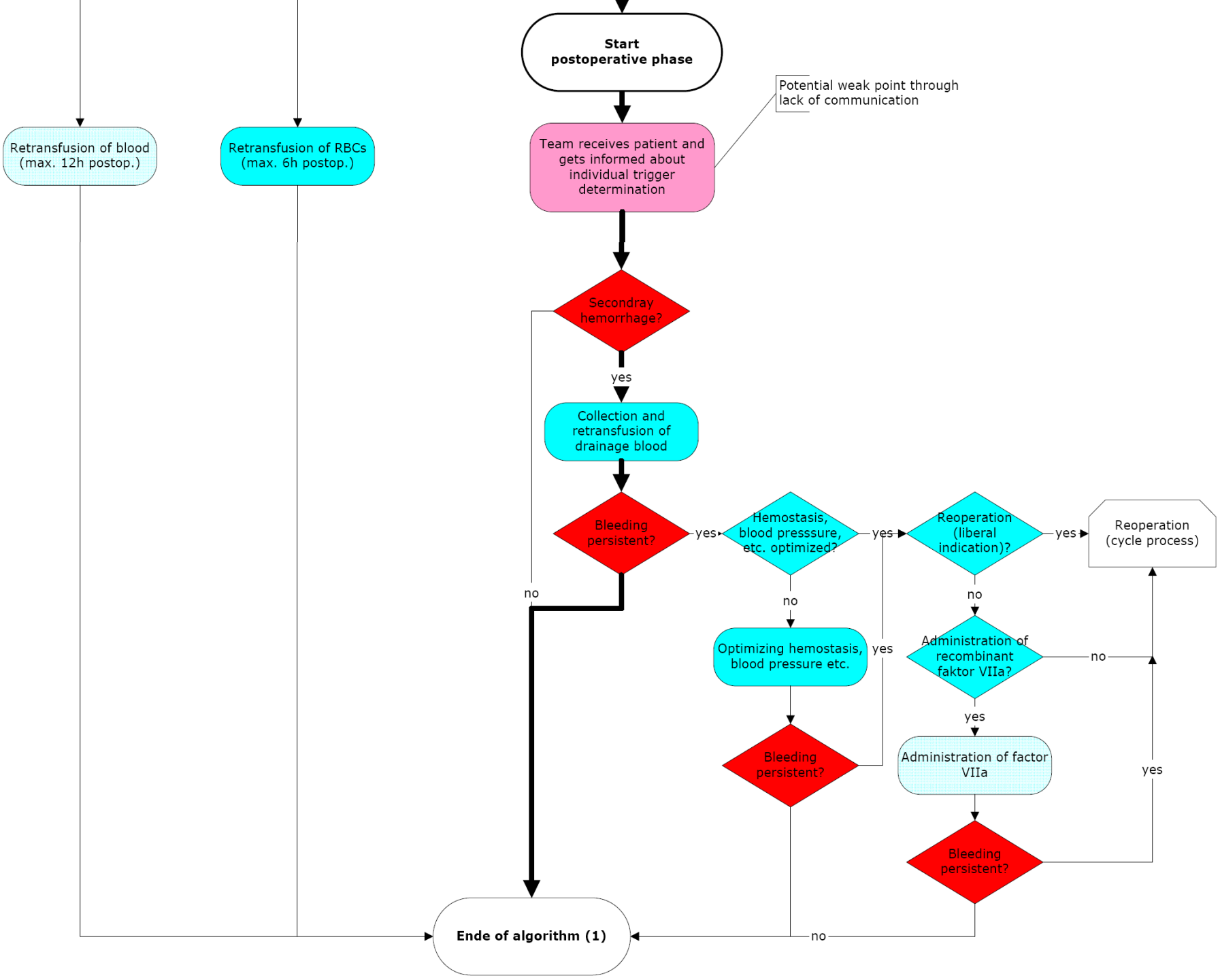
Start postoperative phase
Potential weak point through lack of communication
Team receives patient and gets informed about individual trigger determination
Retransfusion of blood (max. 12h postop.)
Retransfusion of RBCs (max. 6h postop.)
Secondray hemorrhage?
yes
no
Collection and retransfusion of drainage blood
Bleeding persistent?
yes
Hemostasis, blood presssure, etc. optimized?
yes
Reoperation (liberal indication)?
yes
Reoperation (cycle process)
no
no
Optimizing hemostasis, blood pressure etc.
yes
Administration of recombinant faktor VIIa?
no
yes
Bleeding persistent?
Administration of factor VIIa
yes
Bleeding persistent?
Ende of algorithm (1)
no

Transfusion thresholds and other strategies for guiding allogeneic red blood cell transfusion

- Restrictive transfusion strategies reduced the risk of receiving a red blood cell (RBC) transfusion by a relative 42%. This equates to an average absolute risk reduction (ARR) of 40%.
- The volume of RBCs transfused was reduced on average by 0.93 units.
- However, heterogeneity between these trials was statistically significant ($p<0.00001$) for these outcomes.
- Mortality, rates of cardiac events, morbidity, and length of hospital stay were unaffected. Trials were of poor methodological quality.

Hill SR, et al: The Cochrane Library, Issue 4, 2003.

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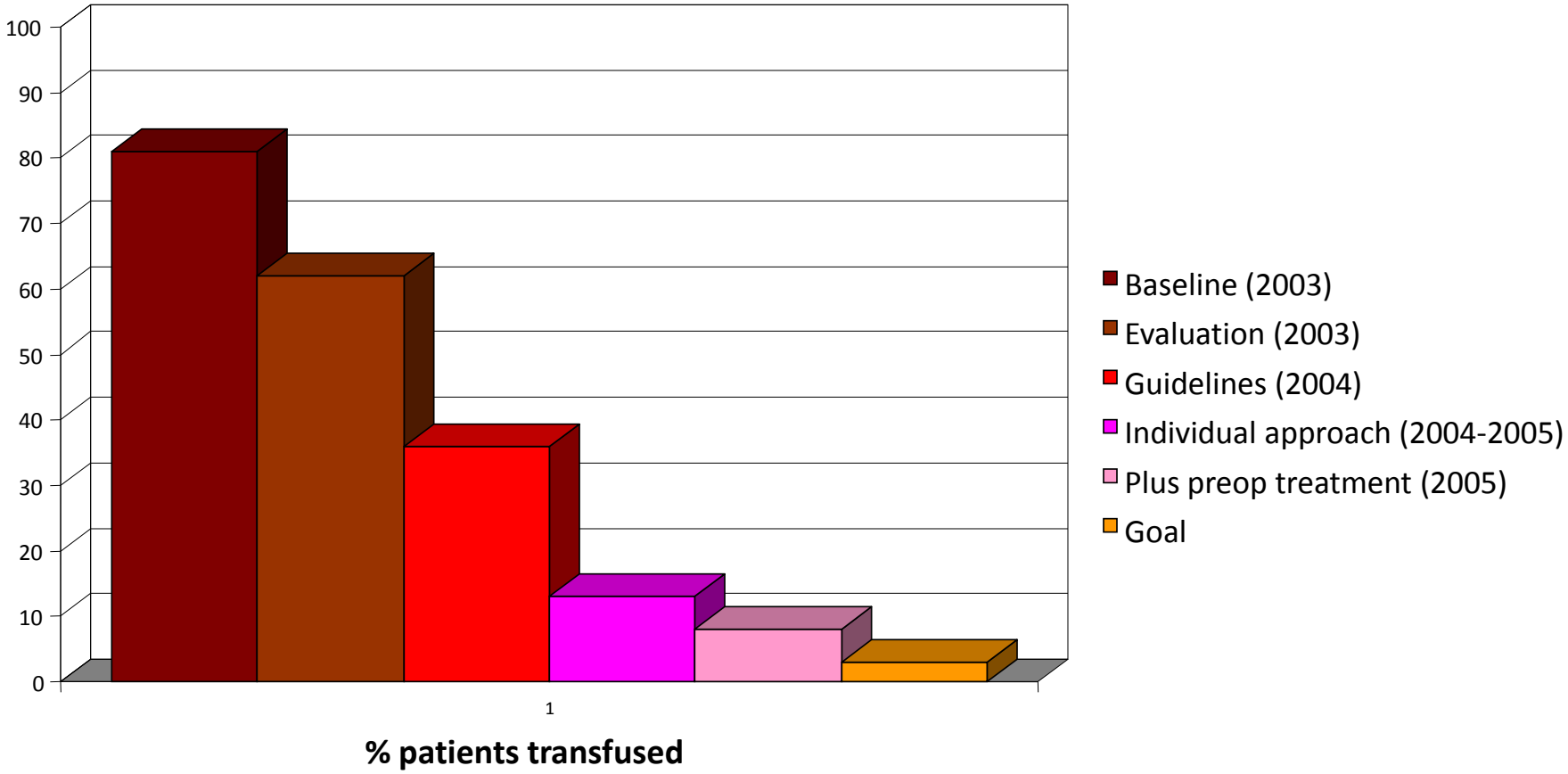
Principal Investigators

Jeffrey L Carson, MD
Principal Investigator and Study Chairman
Clinical Coordinating Center

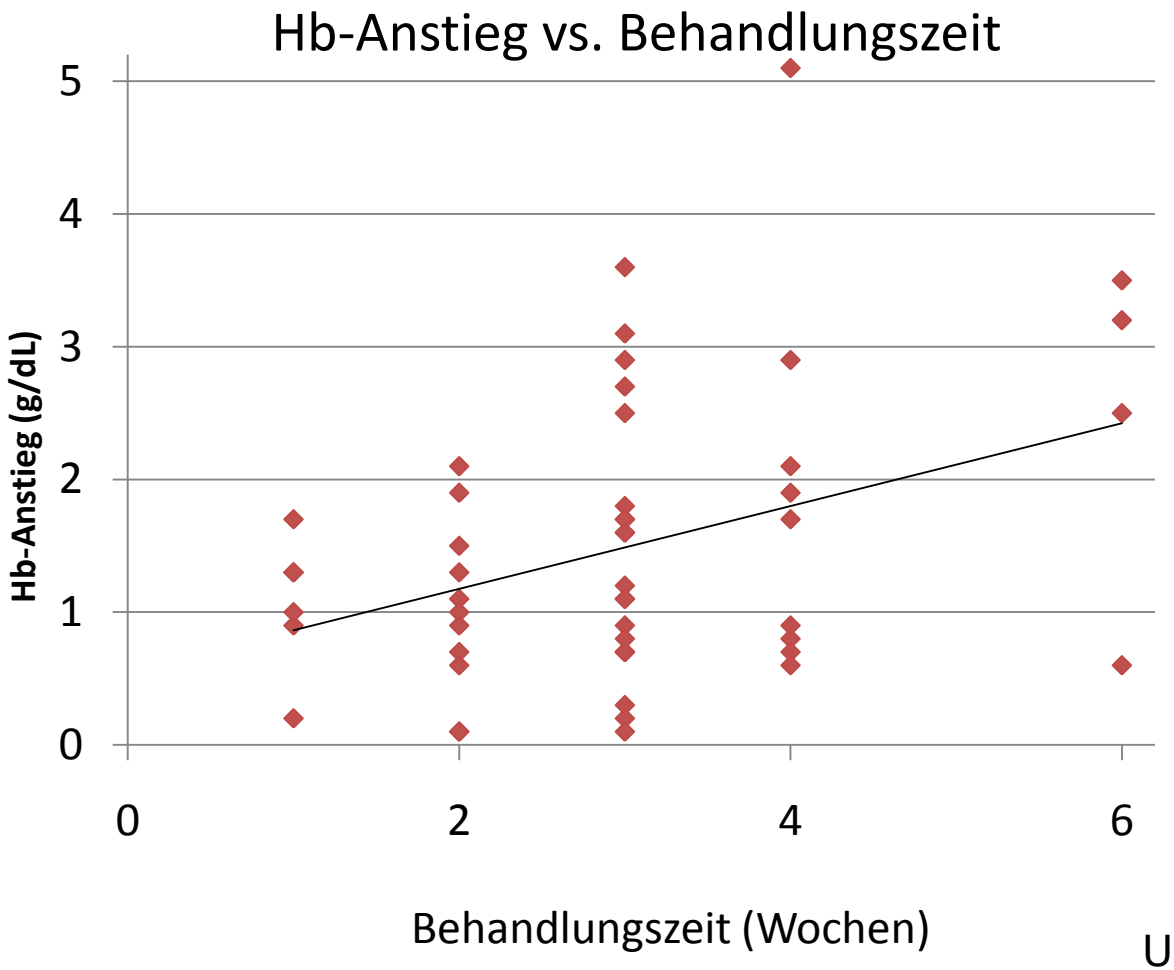
Focus trial

AKH Linz Experience
Primary Hip and Knee Replacement



Gombotz H. et al. Unpublished data.

Retrospektiver Vergleich bei anämischen PatientInnen mit einseitigem Hüftgelenksersatz



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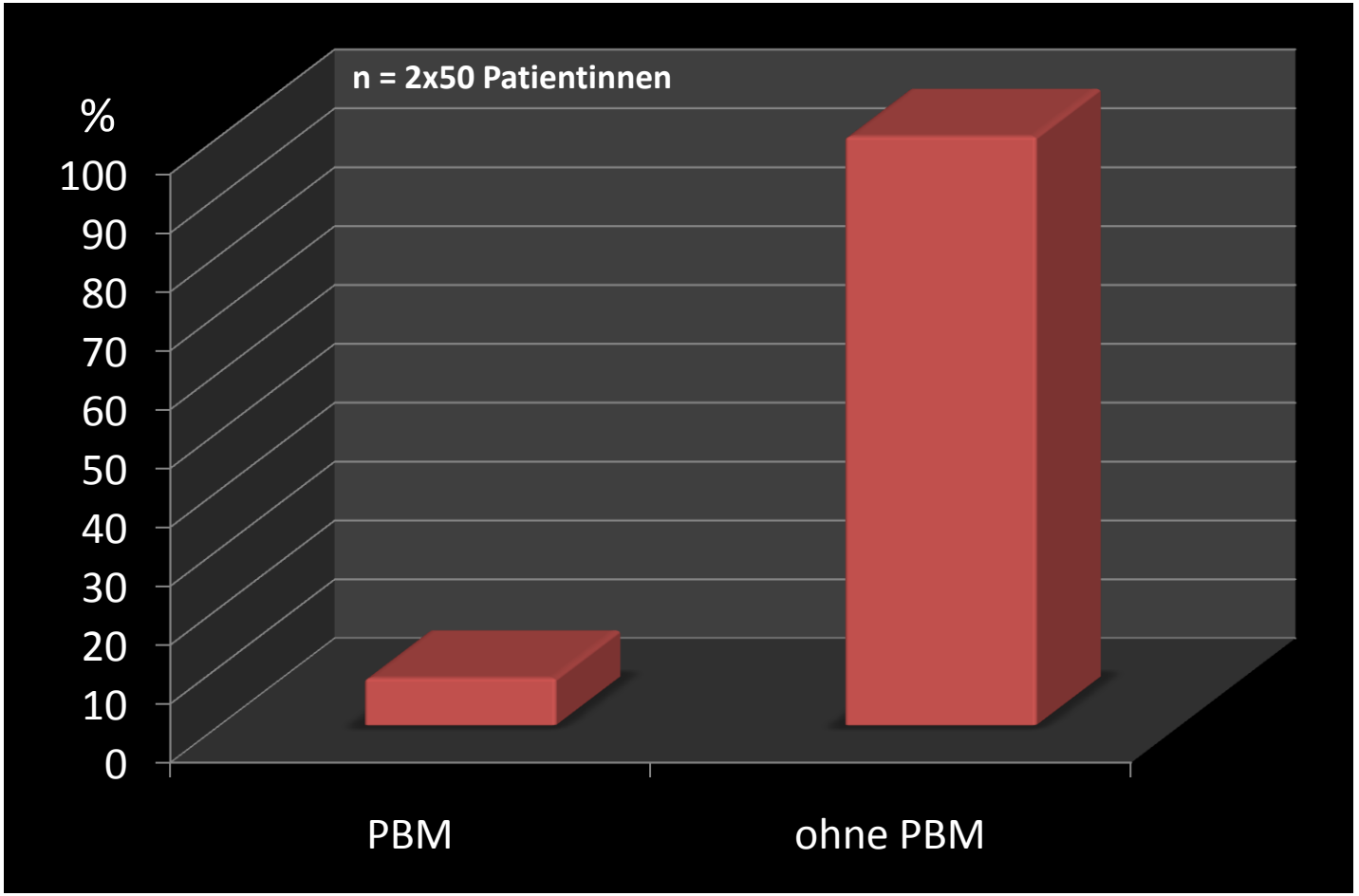

Unpublished data.

ENGLEWOOD HOSPITAL AND MEDICAL CENTER

Study evaluating PBM Outcomes

The Impact of Blood Conservation on Outcomes in Cardiac Surgery: Is It Safe and Effective?

David M. Moskowitz, MD, Jock N. McCullough, MD, Aryeh Shander, MD, James J. Klein, MD, Carol A. Bodian, DrPH, Richard S. Goldweit, MD, and M. Arisan Ergin, MD

Department of Anesthesiology, Critical Care Medicine, Hyperbaric Medicine and Pain Management, Department of Cardiothoracic Surgery, and Division of Cardiology, Department of Internal Medicine, Englewood Hospital and Medical Center, Englewood, New Jersey; and Department of Anesthesiology, Division of Biostatistics, The Mount Sinai Hospital and Medical Center, New York, New York

Ann Thorac Surg 2010;90:451–9

propensity-score matched cohort of 586 pts from institutions without a PBMP

Isolated CABG includes elective & urgent and primary & redo procedures

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Ann Thorac Surg 2010;90:451–9

PBM strategies used:

1. Preop haemoglobin optimisation
2. Intraop ANH and Intra & Postop cell salvage
3. Meticulous surgical technique
4. Endovascular vein harvesting
5. Point-of-care coagulation testing
6. Targeted haemostatic therapy
7. Tolerance of perioperative anaemia (60 – 70 g/L depending on patient-specific physiology)

CABG Outcomes PBMP vs Non-PBMP

Outcome	PBMP cohort (n=586)	Non-PBMP cohort (n=586)	P-value
% Transfused	10.6%	42.5%	<0.0001
Mortality	0.8%	2.5%	0.02
Serious complication	11.1%	18.7%	0.0002

Moskowitz et al. TheThe impact of blood conservation on outcomes in cardiac surgery: is it safe and effective? Ann Thorac Surg 2010;90:451-9