Patient blood management (PBM)
Restrictive transfusion approaches

Imelda Marton dr., PhD

Szegedi Tudományegyetem

SZTER ÁOK Transzfuziológiai Tanszék
II. sz. Belgyógyászati Klinika és Kardiológiai Központ
Hematológia Osztály

Definition

Patient blood management (PBM) is:

- patient-focused
- evidence-based
- systematic and multidisciplinary approach

To optimize the management of patient and transfusion blood products for quality and effective patient care.

It is designed to improve patient outcomes through the:

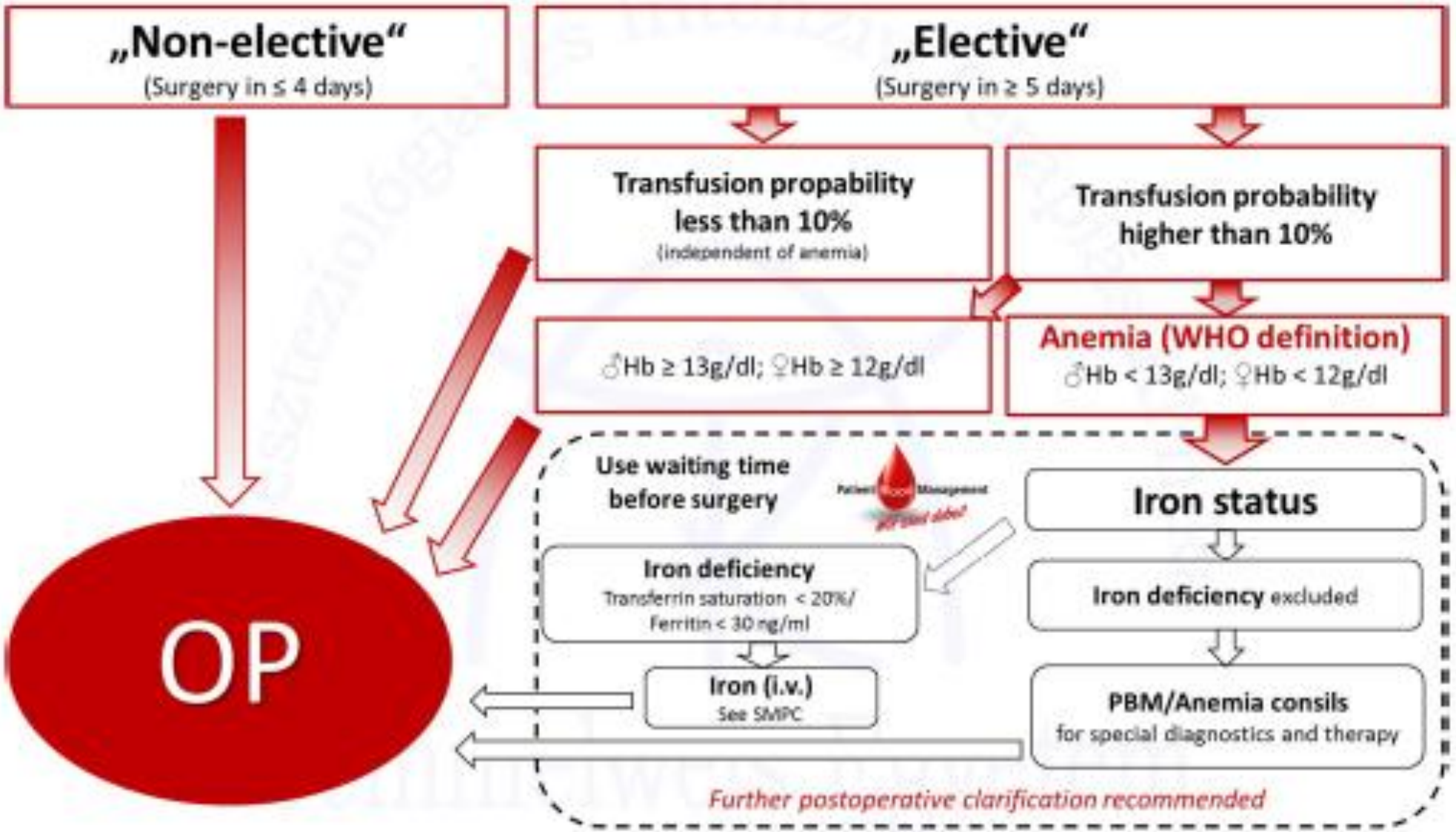
- safe and rational use of blood and blood products
- minimizing unnecessary exposure to blood products
- main focus on elective surgery

Patient Blood Management

- Patient blood management (PBM) is a patient-focused, evidence-based and systematic approach to optimize the management of patient and transfusion of blood products for quality and effective patient care.
- It is designed to improve patient outcomes through the safe and rational use of blood and blood products and by minimizing unnecessary exposure to blood products.
- Essential elements of patient blood management include:

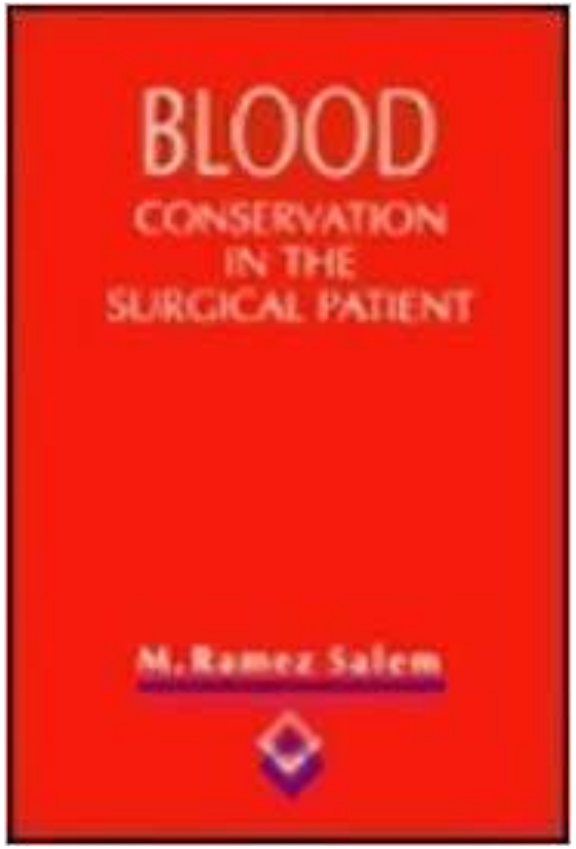
-the prevention of conditions that might otherwise result in the need for transfusion (through health promotion and screening for early detection),

-appropriate diagnosis and optimal treatment, including the use of alternatives to transfusion, good surgical and anaesthetic techniques, the use of alternatives to blood transfusion and blood conservation.


„Non-elective“
(Surgery in ≤ 4 days)
„Elective“
(Surgery in ≥ 5 days)
Transfusion propability less than 10%
(independent of anemia)
Transfusion probability higher than 10%
♂Hb ≥ 13g/dl; ♀Hb ≥ 12g/dl
Anemia (WHO definition)
♂Hb < 13g/dl; ♀Hb < 12g/dl
OP
Use waiting time before surgery
Iron status
Iron deficiency
Transferrin saturation < 20%/
Ferritin < 30 ng/ml
Iron deficiency excluded
Iron (i.v.)
See SMPC
PBM/Anemia consils
for special diagnostics and therapy
Further postoperative clarification recommended

Starting out from Australia after the 2000s

- **First book on the topic**: Mohammed Ramez Salem ed. Blood conservation in the surgical patient, 1996, Williams & Wilkins, Baltimore



3 ,,pillars”

Management of pre-operative **a naemia**:

(i)Screening and diagnosis

(ii)Treatment

Minimising **blood loss** & bleeding

R estrictive use of blood units

Improve patient tolerance of anemia

Anemia as a principal risk factor

Preoperative anaemia and postoperative outcomes in non-cardiac surgery: a retrospective c

Khaled M Musallam, Hani M Tamim, Toby Richards, Donat R Spahn, Frits R Rosendaal, Aid
Kaivan Khavandi, Pierre M Sfeir, Assaad Soweid, Jamal J Hoballah, Ali T Taher, Faek R Jama

Lancet 2011; 378: 1396–407
Published Online October 6, 2011
DOI:10.1016/S0140-6736(11)61381-0
See Comment page 1362

Department of Internal Medicine (K M Musallam MD, H M Tamim PhD, A Soweid MD, Prof A T Taher MD), Department of Surgery (A Habbal BSN, M Khreiss MD, F S Dahdaleh MD, P M Sfeir MD, Prof J J Hoballah MD, F R Jamali MD), American University of Beirut Medical Center, Beirut, Lebanon; Angelo Bianchi Bonomi Haemophilia and Thrombosis Centre, Fondazione IRCCS Ca Granda, Ospedale Maggiore Policlinico, Milan, Italy (K M Musallam); College of Medicine, King Abdullah International Medical Research Center, King Saud bin Abdulaziz University for Health Sciences, Riyadh, Saudi Arabia (H M Tamim); Division of Surgery and Interventional Science, University College London Hospital, London, UK

Summary

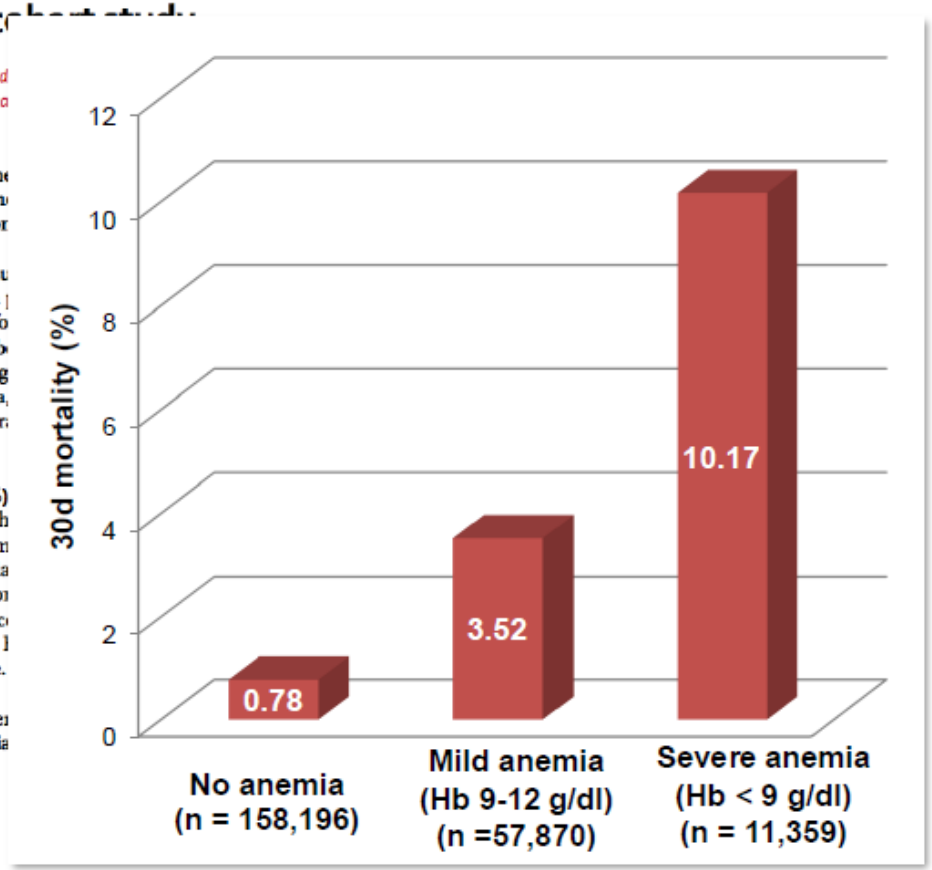
Background Preoperative anaemia is associated with adverse outcome non-cardiac surgery are not well established. We aimed to assess th postoperative morbidity and mortality in patients undergoing major nor

Methods We analysed data for patients undergoing major non-cardiac su Surgeons' National Surgical Quality Improvement Program database (a 211 hospitals worldwide in 2008). We obtained anonymised data fo respiratory, CNS, urinary tract, wound, sepsis, and venous thromb preoperative and perioperative risk factors. We used multivariate log modified (nine predefined risk factor subgroups) effect of anaemia, concentration >29–<39% in men and >29–<36% in women) or moder postoperative outcomes.

Findings We obtained data for 227 425 patients, of whom 69 229 (30·44%) postoperative mortality at 30 days was higher in patients with anaemia th 1·42, 95% CI 1·31–1·54); this difference was consistent in mild anaem anaemia (1·44, 1·29–1·60). Composite postoperative morbidity at 30 da than in those without anaemia (adjusted OR 1·35, 1·30–1·40), again co 1·26–1·36) and moderate-to-severe anaemia (1·56, 1·47–1·66). When c defined risk factor, patients with anaemia and most risk factors had a l morbidity than did patients with either anaemia or the risk factor alone.

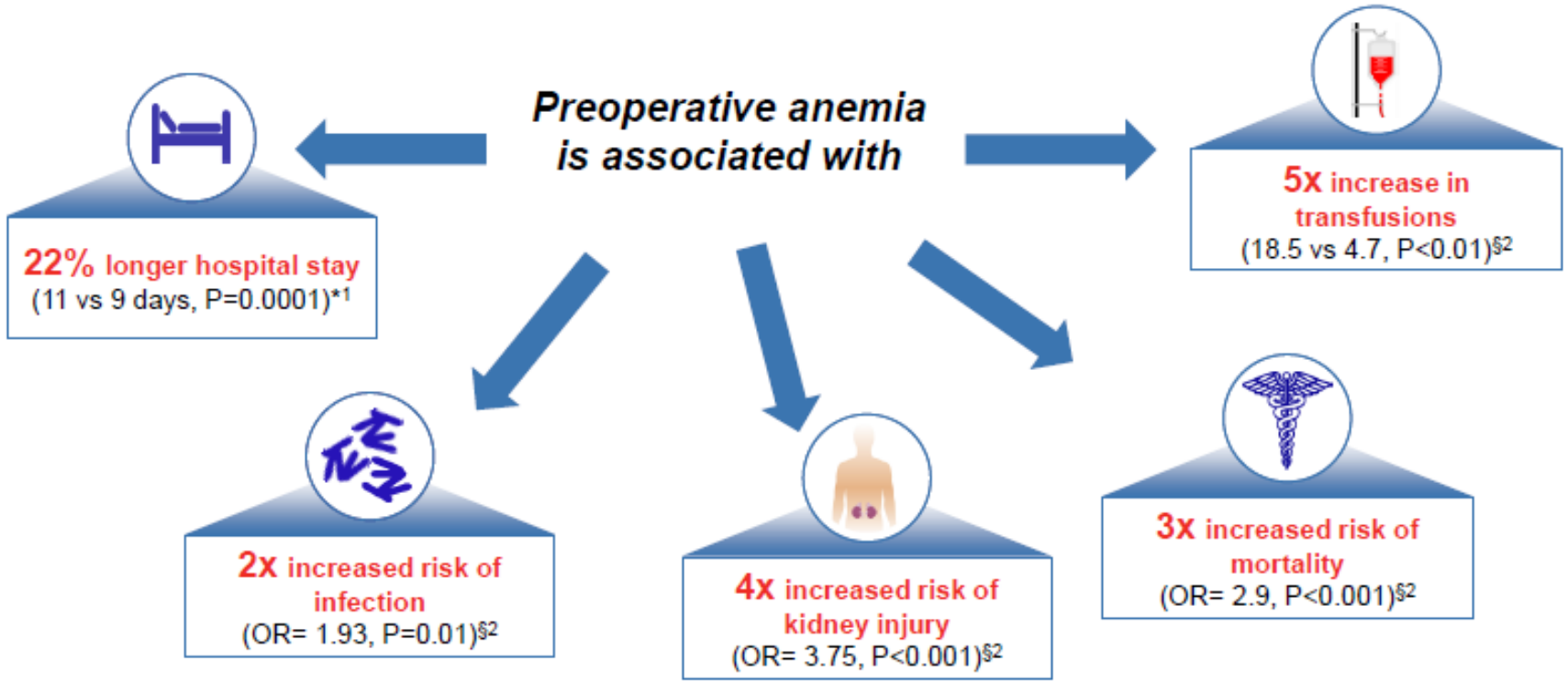
Interpretation Preoperative anaemia, even to a mild degree, is indepe 30-day morbidity and mortality in patients undergoing major non-cardia

Funding Vifor Pharma.



Musallam K et al. *Lancet 2011;378:1396-407*
Retrospective, 227,425 patients

Unfavorable consequences of pre-operative anemia



* Retrospective single-centre cohort study of consecutive patients >18 years undergoing non-cardiac surgery between March 2003 and June 2006 (N= 7,759). Shown are the propensity-matched values for variables that are potential confounders in the relationship between anaemia and postoperative mortality (N=2,090).[1] § Systematic review and meta-analysis of observational studies exploring associations between preoperative anaemia and postoperative outcomes (24 studies N=949,445).[2] † Retrospective cohort study of major non-cardiac surgery in 2008 (a prospective validated outcomes registry from 211 hospitals worldwide, N=227,425). OR presented had an extended adjustment for a large number of clinically relevant variables.[3]

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

Unfavorable conseqeunces of pre-operative anemia

- Transfusion need increases ⬆
- Independent risk factor of peri-operative complications: e.g. infection, kidney injury
- Overall mortality increases ⬆
- Mobilisation and rehabilitation is delayed – longer hospital stays
- Overall cost increases ⬆

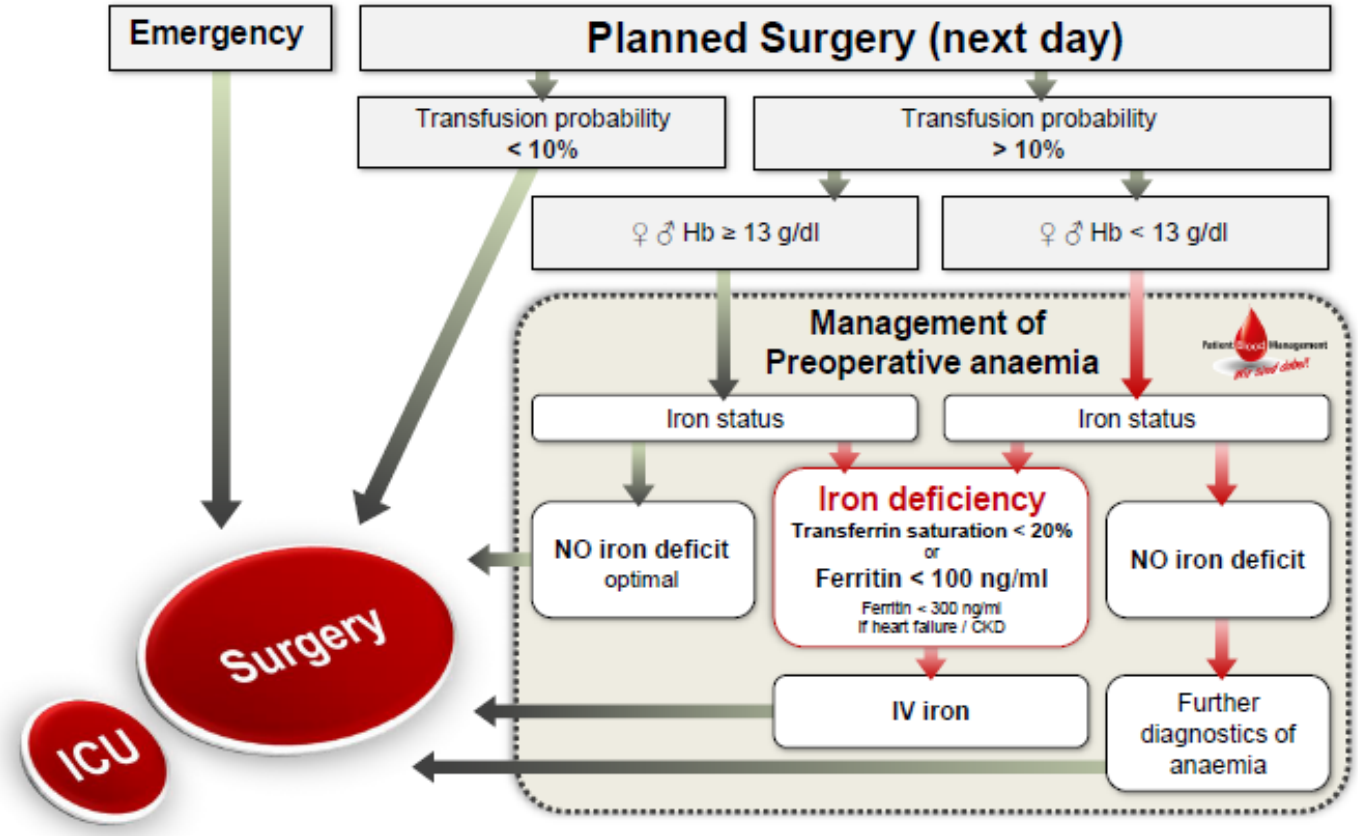
Activities against anemia

- **Pre-operative period:**
  - Early recognition: the diagnostic process starts 28 days preceeding the elective surgery
  - Causative and symptomatic treatment: iron supplementation, also i.v., EPO
- **Intra-operative period:**
  - Optimal Hb value (Hb > 130-150 g/L) during operation
- **Post-operative period:**
  - Further iron supplementation if needed
  - Erythropoesis stimulation by EPO
  - Increased awereness of drug interactions that may aggravate anemia

Best Pract Res Clin.Anesth. 2013, 27:69

Pre-operative algorhytm: German example

Preop Algorithm V4.0



Prof. Zacharowski szívességéből, 2019 Budapest

Planning

- Estimate the risk of surgical haemorrhage
- PBM is applied to patien whose estimated perioperative blood loss exceeds 500 ml = „High bleeding risk surgery”
- Preoperative anaesthesiology e valuation more than 1 week (ideally 4 weeks) before the planned surgery

General Surgery
- Hemihepatectomy
- Adrenalectomy
- Oesophagectomy
- Duodenopancreatectomy
- Gastrectomy
- Hemicolectomy
- Splenectomy
- Other major abdominal, pelvic or thoracic surgery

Vascular Surgery
- Large vessels surgery
- Lower limb amputation

Neurosurgery
- Osteosynthesis, open repositioning and spinal osteoplasty
- Craniotomy, incision of brain and/or cerebral meninges

Orthopaedics-Traumatology
- Pelvic and hip joint surgery
- Spinal surgery
- Flap surgery
- Lower limb surgery (osteosynthesis, osteotomy)
- Polytrauma patients
- Upper limb surgery (endoprosthesis, osteosynthesis, osteotomy)

Urology
- Cystectomy
- Nephrectomy (including partial)
- Open prostatectomy

Cardiac Surgery
- Procedures requiring extracorporeal circulation
- Pericardectomies

Scientific evidence in favour of i.v. iron

NARRATIVE REVIEW ARTICLE

Intravenous Iron for Treatment of Anemia in the 3 Perisurgical Phases: A Review and Analysis of the Current Literature

Frank Peters, MD,* Ines Ellermann, PHARM,† and Andrea U. Steinbicker, MD, MPH*

Before surgery: Meta-analyses of RCTs using IV iron administration led to an increase in Hb levels, a reduction of RBC use, and an improvement in patient outcome.

Perioperative setting: few studies recommended the use of perioperative IV iron in cases of severe anemia in orthopedic surgery but not in all types of surgery.

Postoperative setting: positive effects of IV iron on Hb levels, length of hospital stay, and transfusion requirements.

Anesth Analg 2018;126:1268–82

Treatment on day -1 before surgery

Effect of ultra-short-term treatment of patients with iron deficiency or anaemia undergoing cardiac surgery: a prospective randomised trial

Donat R Spahn, Felix Schoenrath*, Gabriela H Spahn, Burkhardt Seifert, Philipp Stein, Oliver M Theusinger, Alexander Kaserer, Inga Hegemann, Axel Hofmann, Francesco Maisano, Volkmar Falk*

Summary

Background Anaemia and iron deficiency are frequent in patients scheduled for cardiac surgery. This study assessed whether immediate preoperative treatment could result in reduced perioperative red blood cell (RBC) transfusions and improved outcome.

Methods In this single-centre, randomised, double-blind, parallel-group controlled study, patients undergoing elective cardiac surgery with anaemia (n=253; haemoglobin concentration (Hb) <120 g/L in women and Hb <130 g/L in men) or isolated iron deficiency (n=252; ferritin <100 mcg/L, no anaemia) were enrolled. Participants were randomly assigned (1:1) with the use of a computer-generated range minimisation (allocation probability 0·8) to receive either placebo or combination treatment consisting of a slow infusion of 20 mg/kg ferric carboxymaltose, 40 000 U subcutaneous erythropoietin alpha, 1 mg subcutaneous vitamin B12, and 5 mg oral folic acid or placebo on the day before surgery. Primary outcome was the number of RBC transfusions during the first 7 days. This trial is registered with ClinicalTrials.gov, number NCT02031289.

Findings Between Jan 9, 2014, and July 19, 2017, 1006 patients were enrolled; 505 with anaemia or isolated iron deficiency and 501 in the registry. The combination treatment significantly reduced RBC transfusions from a median of one unit in the placebo group (IQR 0–3) to zero units in the treatment group (0–2, during the first 7 days (odds ratio 0·70 [95% CI 0·50–0·98] for each threshold of number of RBC transfusions, p=0·036) and until postoperative day 90 (p=0·018). Despite fewer RBC units transfused, patients in the treatment group had a

Lancet 2019; 393: 2201–12

Published Online
April 25, 2019
http://dx.doi.org/10.1016/S0140-6736(18)32555-8

See Comment page 2177

*Contributed equally

Institute of Anaesthesiology, University of Zurich and University Hospital Zurich, Zurich, Switzerland (Prof D R Spahn, G H Spahn MD, P Stein MD, A Kaserer MD); **Department of Cardiothoracic and Vascular Surgery, German Heart Centre Berlin, Berlin, Germany** (F Schoenrath MD), **and German Centre for Cardiovascular Research, partner site Berlin, Germany** (F Schoenrath); **Department of**

3 ,,pillars”

Management of pre-operative **anaemia**:

(i)Screening and diagnosis

(ii)Treatment

Minimising **blood loss** & bleeding

R estrictive use of blood units

Improve patient tolerance of anemia

Hospital acquired (iatrogen) anaemia

Data (n= 1867 cardiac surgery patients: 221,498 labtests) ⟹ 118 inspections/patient!!!!

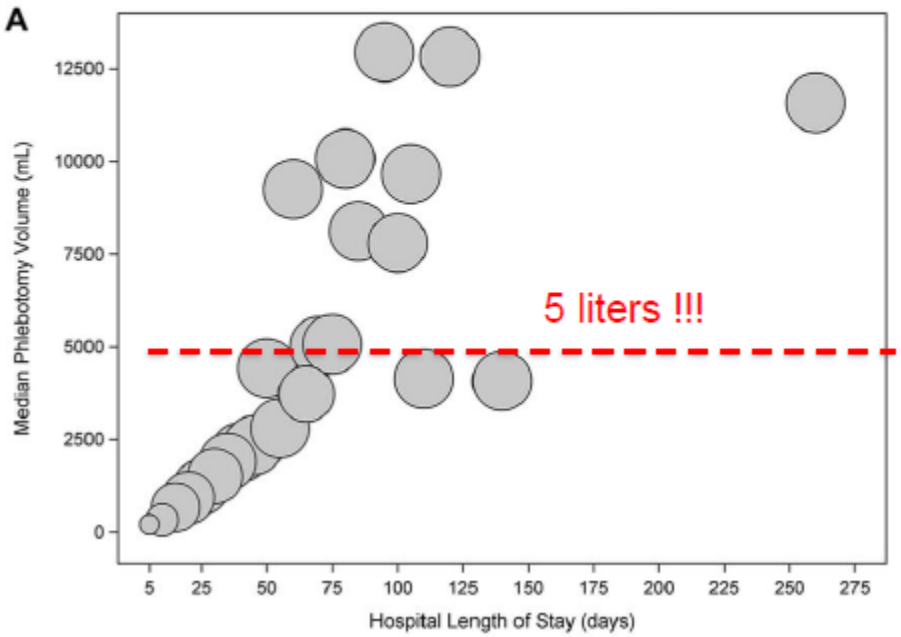
Contemporary Bloodletting in Cardiac Surgical Care

Colleen G. Koch, MD, MS, Edmunds Z. Reineks, MD, PhD, Anne S. Tang, MS, Eric D. Hixson, PhD, MBA, Shannon Phillips, MD, Joseph F. Sabik, III, MD, J. Michael Henderson, MD, and Eugene H. Blackstone, MD

Department of Cardiothoracic Anesthesia, Heart and Vasc Pathology & Laboratory Medicine Institute; Department of Medical Operations; Department of Thoracic and Cardiova Surgery, Digestive Disease Institute, Cleveland Clinic, Cle

Background. Health care providers are seldom awa the frequency and volume of phlebotomy for labor testing, bloodletting that often leads to hospital-acq anemia. Our objectives were to examine the frequ of laboratory testing in patients undergoing cardiac gery, calculate cumulative phlebotomy volume from of initial surgical consultation to hospital discharge, propose strategies to reduce phlebotomy volume.

Methods. From January 1, 2012 to June 30, 2012, patients underwent cardiac surgery at Cleveland C 1,867 had 1 hospitalization and 27 had 2. Each laborator



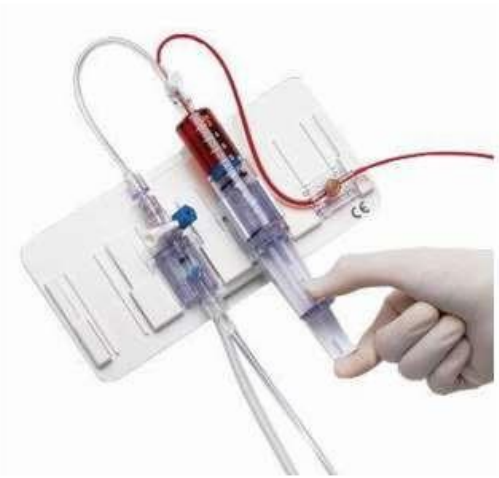
Koch CG et al. Ann ThoracSurg2015

Restrictive blood sampling for diagnostics

Patient Blood Management .de /en

Fischer D, et al. CritCare. 2014

Closed invasive pressure monitoring devices



Westphal S et al. A&I 2018

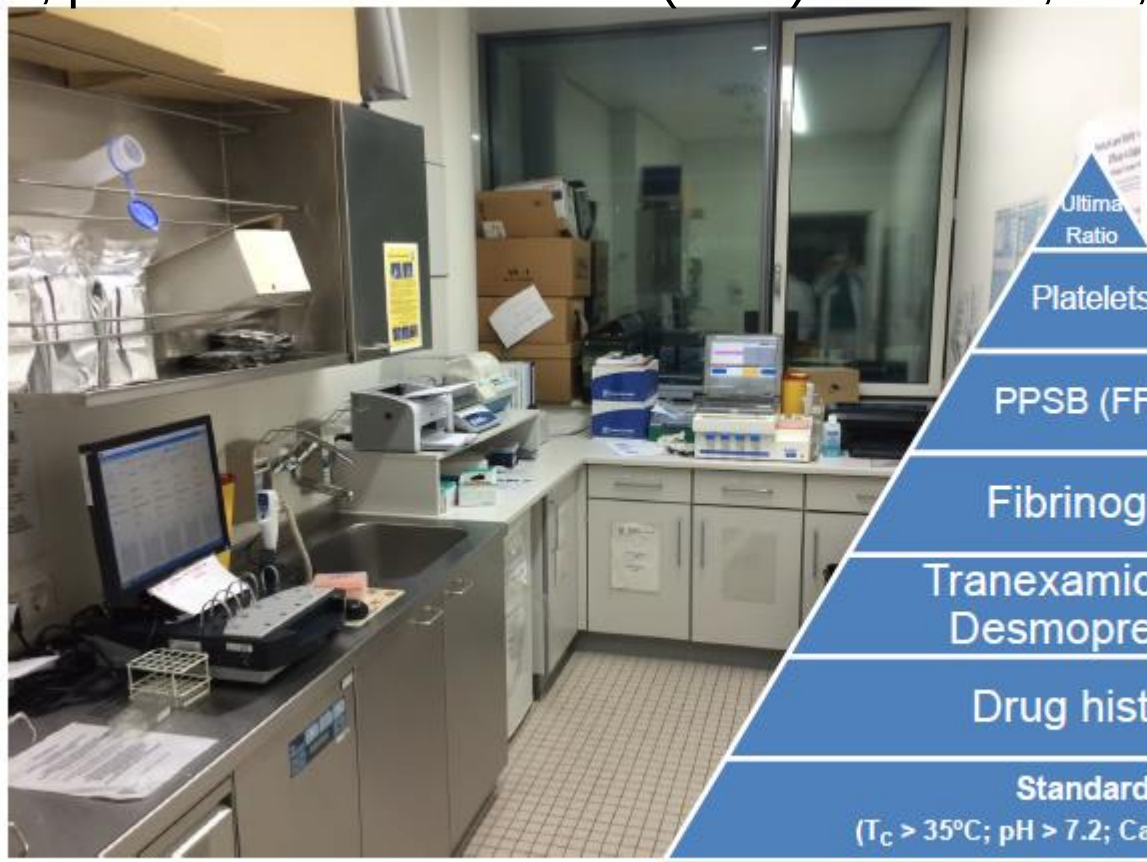
New approaches to assess and improve hemostasis status

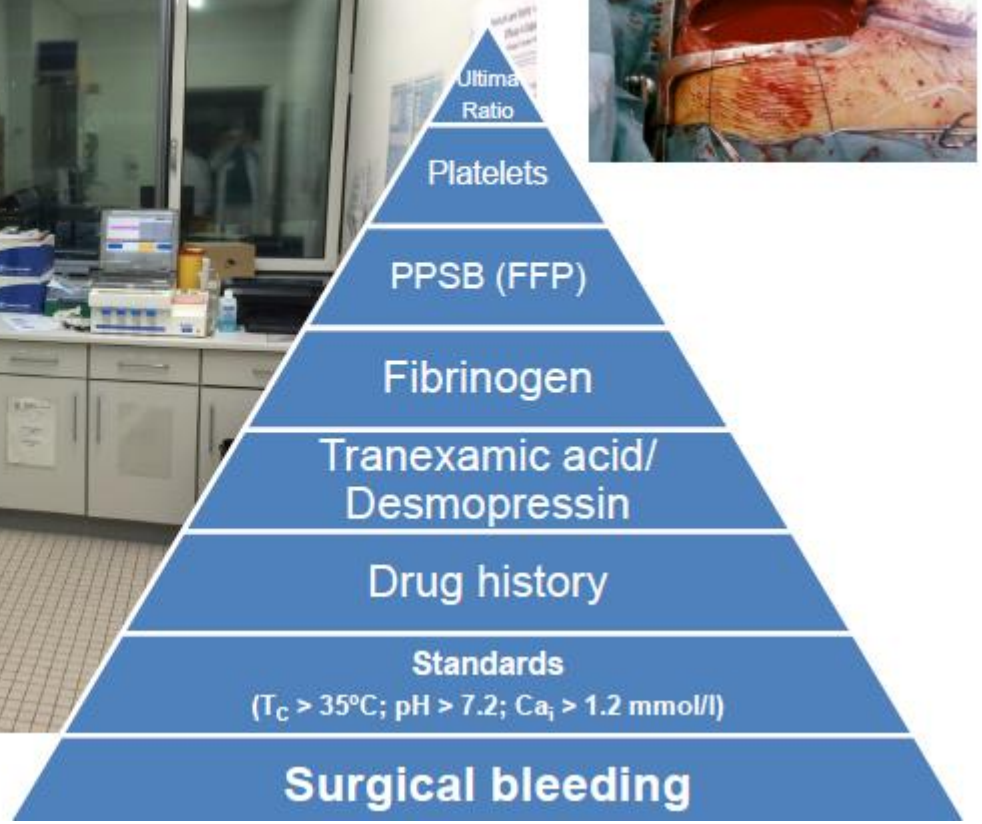
- Haemostasis abnormality assessment by a standardised questionnarie to be applied preoperatively
- Preoperative adjustment of anticoagulant and antiplatelet treatment
- Usage of point of care testing (POCT)
- Usage of tranexamic acid (fibrinolysis inhibitor), desmopressin (antagonizing ant-aggregation), fibrinogen
- Maintaining optimal haemostasis conditions during the entire perioperative period

More effective bleeding management

Diagnostics: Viscoelasthic, POCT test (TEG-ROTEM) guided hemo-substitution

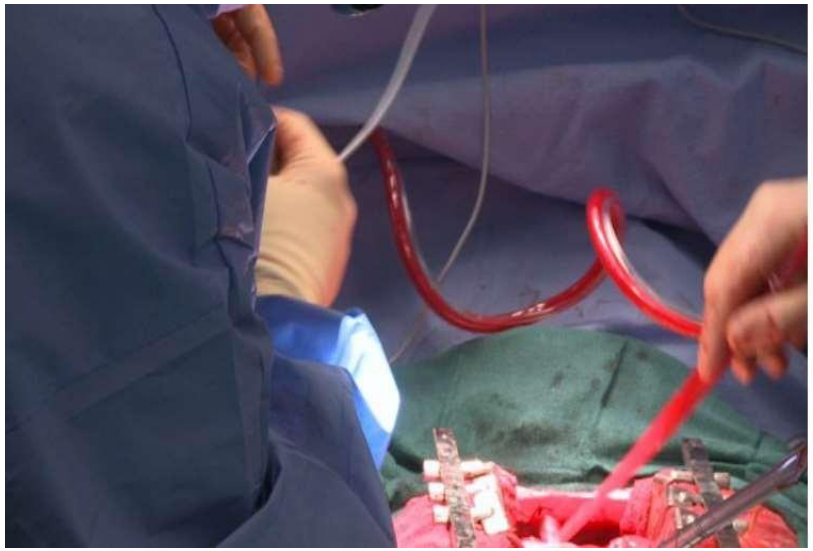
PPSB = Prothromplex, prothrombin concentrate (PCC): factors II, VII, IX, X.

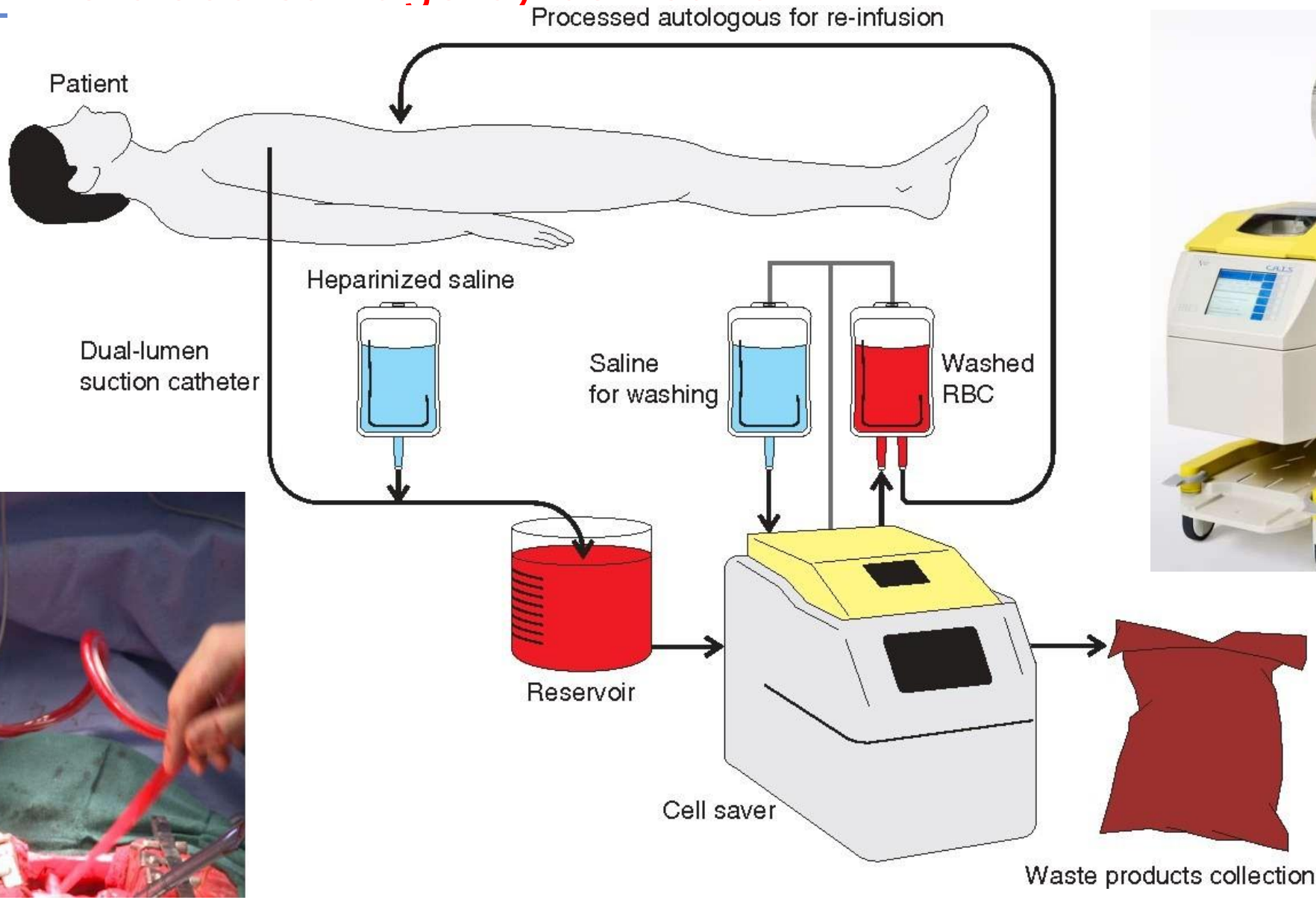




Weber CF et al., Anesthesiology. 2012 Sep;117(3):531-47.

Intra-operative blood salvage by cell-saver





Additional peri-operative measures against bleeding

- **Cuffs** and **special devices** blocking local circulation
- **Temperature control** of patient and infusions
- **ARGON coagulator** for precise local tissue damaging
- Point of care (**POCT**) monitoring of actual coagulation status – TEG-ROTEM
- **Local anti-bleeding agents**: e.g. fibrin glue, collagen preparations

3 ,,pillars”

Management of pre-operative **anaemia:**

(i)Screening and diagnosis

(ii)Treatment

Minimising **blood loss** & bleeding

Restrictive use of blood units

Improve patient tolerance of anemia

International guidelines for lower transfusion triggers + fill-out requirement prio to each transfusion

1. Carson JL, Grossman BJ, Kleinman S, Tinmouth AT, Marques MB, Fung MK, et al. Red blood cell transfusion: a clinical practice guideline from the AABB*. Annals of internal medicine. 2012;157(1):49-58
2. Guidelines of the German Medical Association regarding the use of blood and blood components 2014; 1-137
3. Retter A, Wyncoll D, Pearse R, Carson D, McKechnie S, Stanworth S, et al. Guidelines on the management of anaemia and red cell transfusion in adult critically ill patients. British journal of haematology. 2013;160(4):445-64
4. Padhi S, Kemmis-Betty S, Rajesh S, Hill J, Murphy MF, Guideline Development G. Blood transfusion: summary of NICE guidance. BMJ (Clinical research ed. 2015;351:h5832.
5. …
6. …

Transfusion trigger checklist

List has to be filled for each RBC!!!!!

(Exception: massive bleeding)

Hb < 6 g/dl

- ☐ **Independent of any compensation possibilty**

Hb 6 - 8 g/dl

- ☐ **Clinical symptoms for Anemic hypoxia** (tachycardia, hypotension, ischemic ECG changes, lactate acidosis)
- ☐ **Limited compensation, existing risk factors** (e.g. coronary artery disease, heart failure, cerebrovascular insufficiency)
- ☐ **(Other indication: .....)**

Transfusion in case of Hb > 8 g/dl are related to an unclear risk-benefit balance

- ☐ Hb > 8 g/dl (only indicated in indiviual cases; Very low recommendation level (2 C))

Activities to improve patient anaemia tolerance

Pre-operative period:

-Optimise cardiac output: normovolemia+hemodynamic stabilisation

-Assess patient's physiological reserve

Intra-operative period:

-Optimise cardiac output, ventilation and oxygenation

-Avoid hypothermia

-Reduce intra-operative oxygen consumption

Post-operative period:

-Maximise oxygen delivery, minimse oxygen consumption

-Pay increased attention to infection control

-Use restrictive transfusion protocols

Testing anemia tolerance

TRANSFUSION PRACTICE

CME **An update on mortality and morbidity in patients with very low postoperative hemoglobin levels who decline blood transfusion**

Aryeh Shander, Mazyar Javidroozi, Sajjad Naqvi, Oshuare Aregbeyen, Mustafa Çaylan, Selma Demir, and Anna Juhl

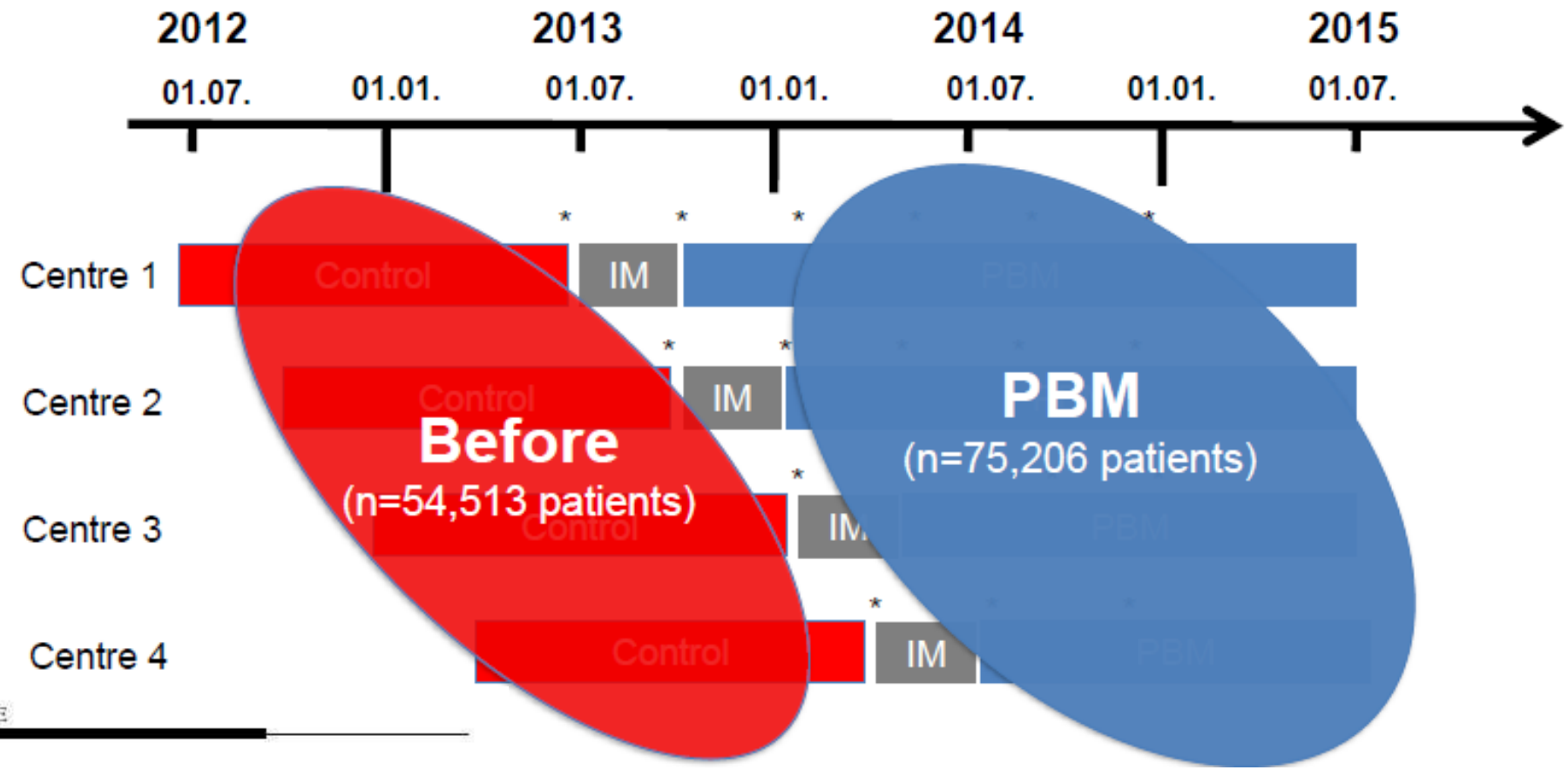
Cohort: Members of the Jehovah Witnesses church, n=288, age: 61.5 : +- 16.9 years, mostly women

Outcome: 30 days mortality in the post-operative period

Hb level, g/L	Mortality (%)
70-80	1
50-70	9.2
30-50	27

Transfusion 2014, 54, 2688

Design of an international PBM study



FEATURE

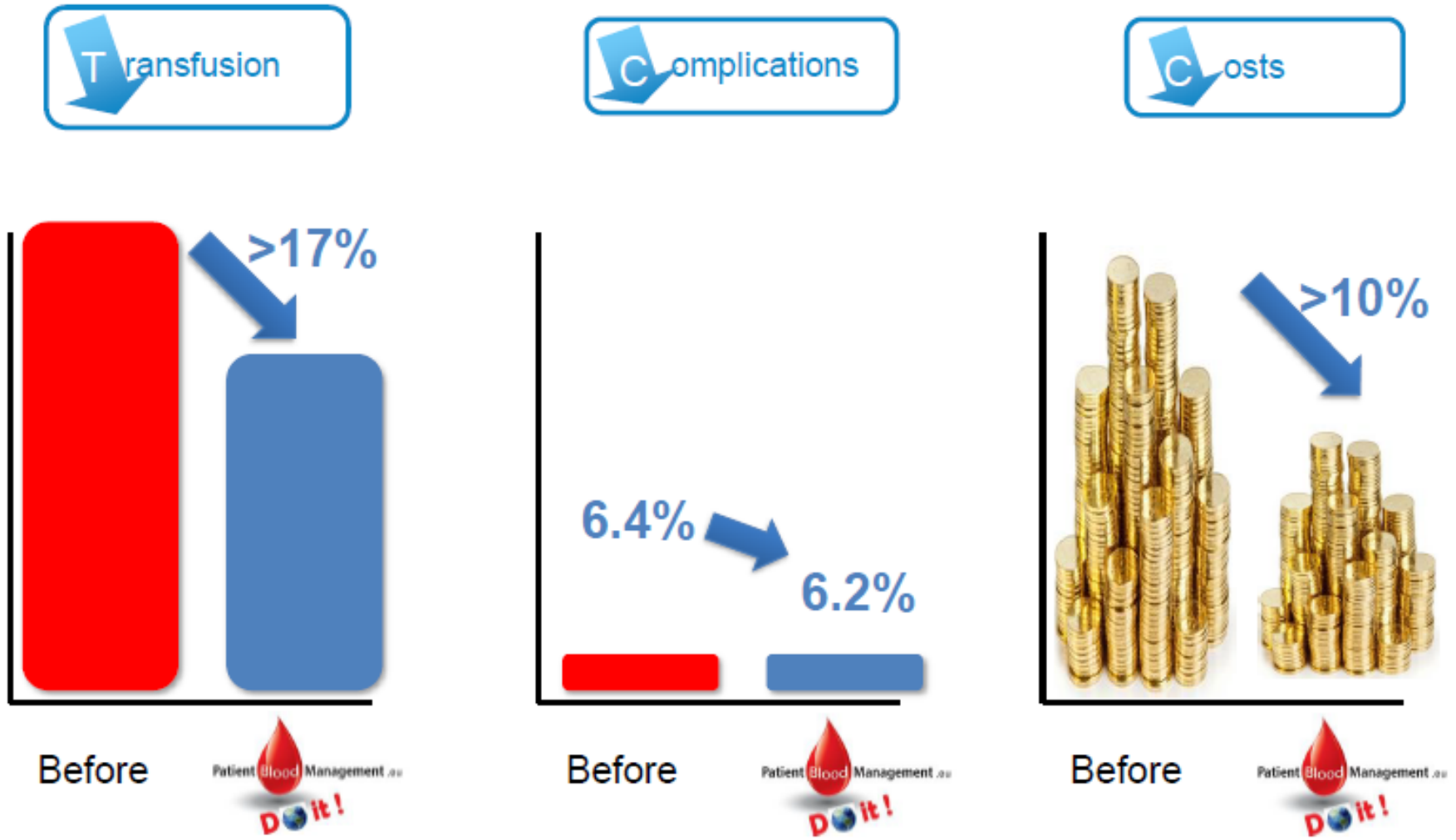
Patient Blood Management is Associated With a Substantial Reduction of Red Blood Cell Utilization and Safe for Patient's Outcome

A Prospective, Multicenter Cohort Study With a Noninferiority Design

Patrick Meybohm, MD, Eva Herrmann, PhD,† Andrea U. Steinbicker, MD, MPH,‡ Maria Wittmann, MD,§*

Meybohm P et al. Ann Surg 2016

Results of the 2016 international PBM study



Meybohm et al. 2016 (Annals of Surgery)

PBM Network in Germany and worldwide

German PBM-Network
(2014 founded)

European PBM-Network
(2016 founded)

Patient Blood Management

Wir sind dabei!

Patient Blood Management
European Network

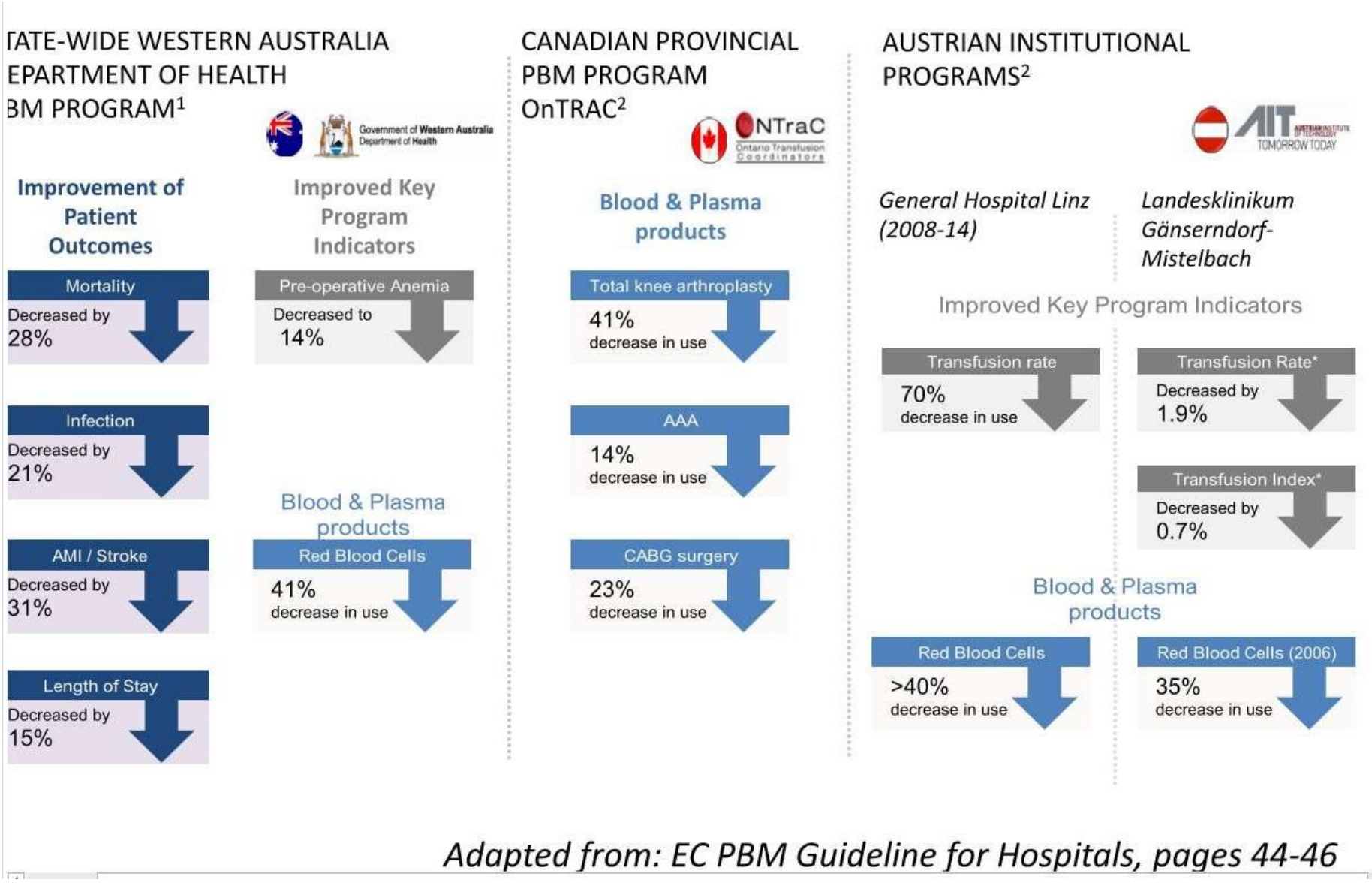
DEUTSCHER PREIS FÜR PATIENTENSICHERHEIT

- ✓ Participation free
- ✓ Support with Implementation
- ✓ Marketing- & Education

Global PBM-Network
(2017 founded)

More than 160 Hospitals worldwide

Examples of international ongoing PBM programs



Adapted from: EC PBM Guideline for Hospitals, pages 44-46

Thank you for your attention!