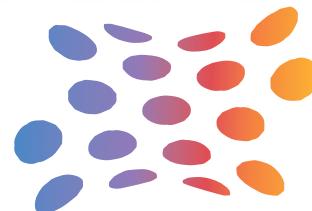


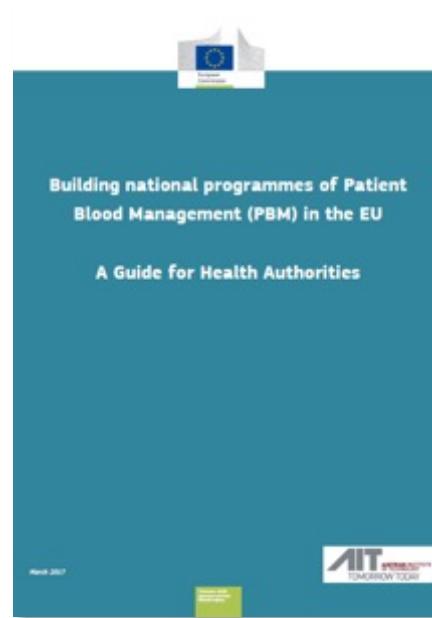
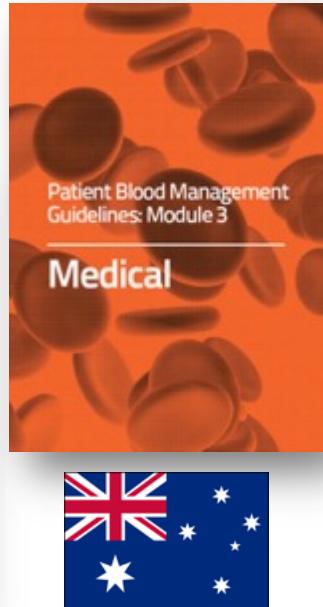
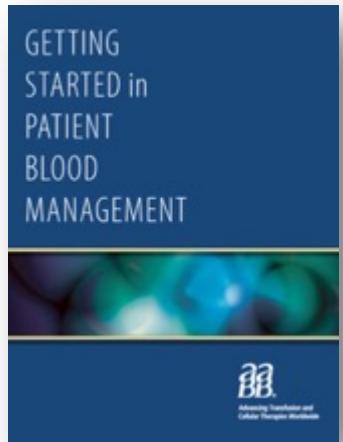
Patient Blood Management National initiative & economically reasonable



Department of Anaesthesiology, Intensive Care, Emergency and Pain Medicine
Director: Univ.-Prof. Dr. P. Meybohm, FESAIC



Various PBM - concepts



Bundesärztekammer
(German Medical Association)

**Cross-Sectional Guidelines for
Therapy with Blood Components
and Plasma Derivatives**

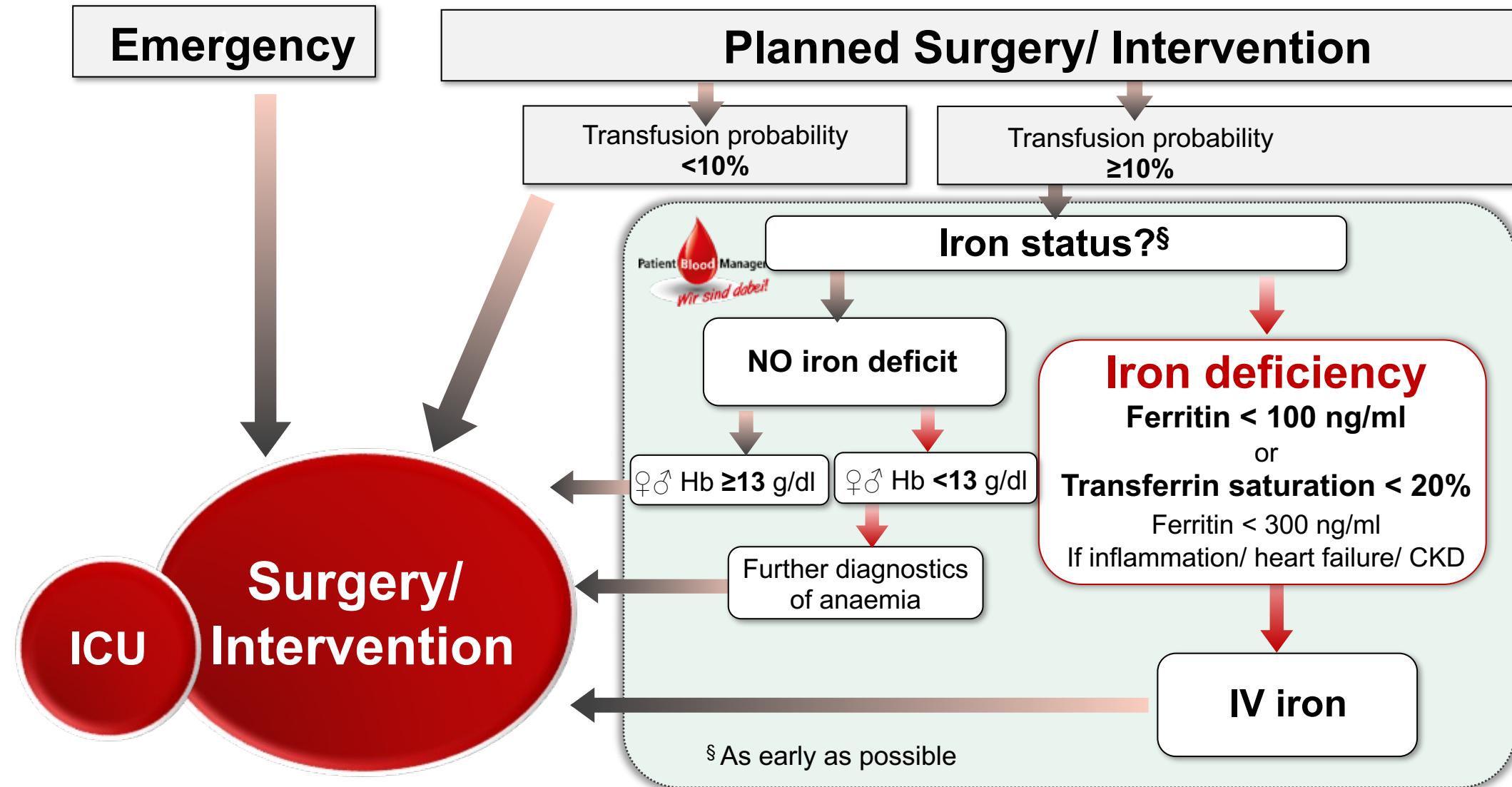


1. Management of pre-operative anemia

- ▶ Screening and diagnosis
- ▶ Treatment

2. Minimizing blood loss & bleeding

3. Restrictive use of blood units



Cost comparison Blood versus Iron therapy

- | | |
|--------------------------|-----------------------------------|
| ▶ Blood (2 Units) | ▶ Iron carboxymaltose (1g) |
| ▶ Units 180 € | ▶ Drug 284 € |
| ▶ Materials 60 € | ▶ Materials/Labor 30 € |
| ▶ Personal 90 € | ▶ Personal 30 € |
| ▶ Complications ?? | ▶ Complications -- |
| ▶ Total 350++ € | ▶ Total 344 € |

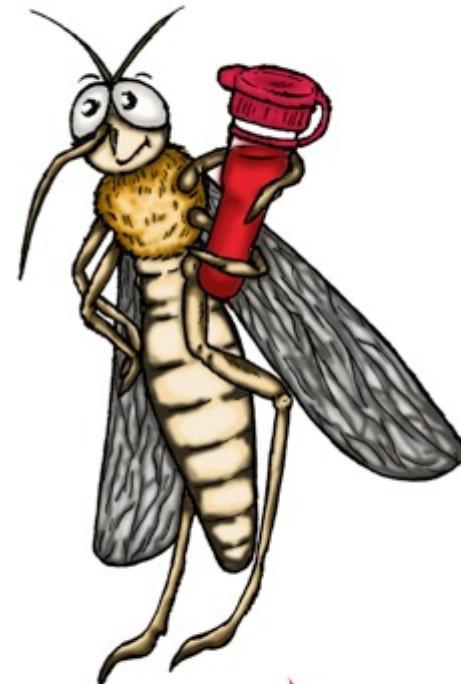
1. Management of pre-operative anemia

- ▶ Screening and diagnosis
- ▶ Treatment

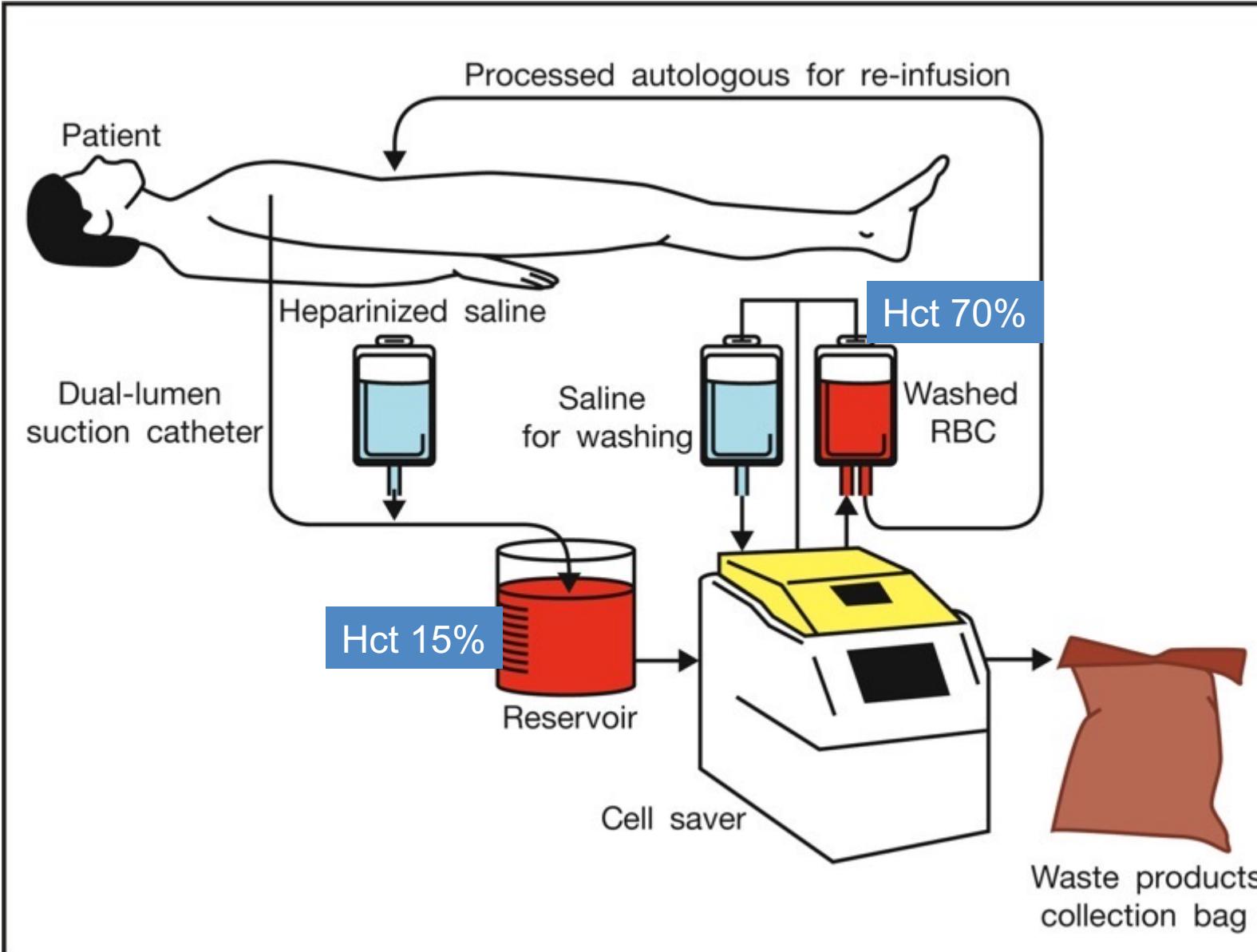
2. Minimizing blood loss & bleeding

3. Restrictive use of blood units

Restrictive Blood Sampling



Cell salvage





ca. 80 -130€



ca. 120-150€



- Costs for donor programs
- Costs for personal resources
- Costs for storage
- Costs for complications



Wang et al. *Journal of Cardiothoracic Surgery* (2018) 13:109
<https://doi.org/10.1186/s13019-018-0794-6>

Journal of
Cardiothoracic Surgery

RESEARCH ARTICLE

Open Access

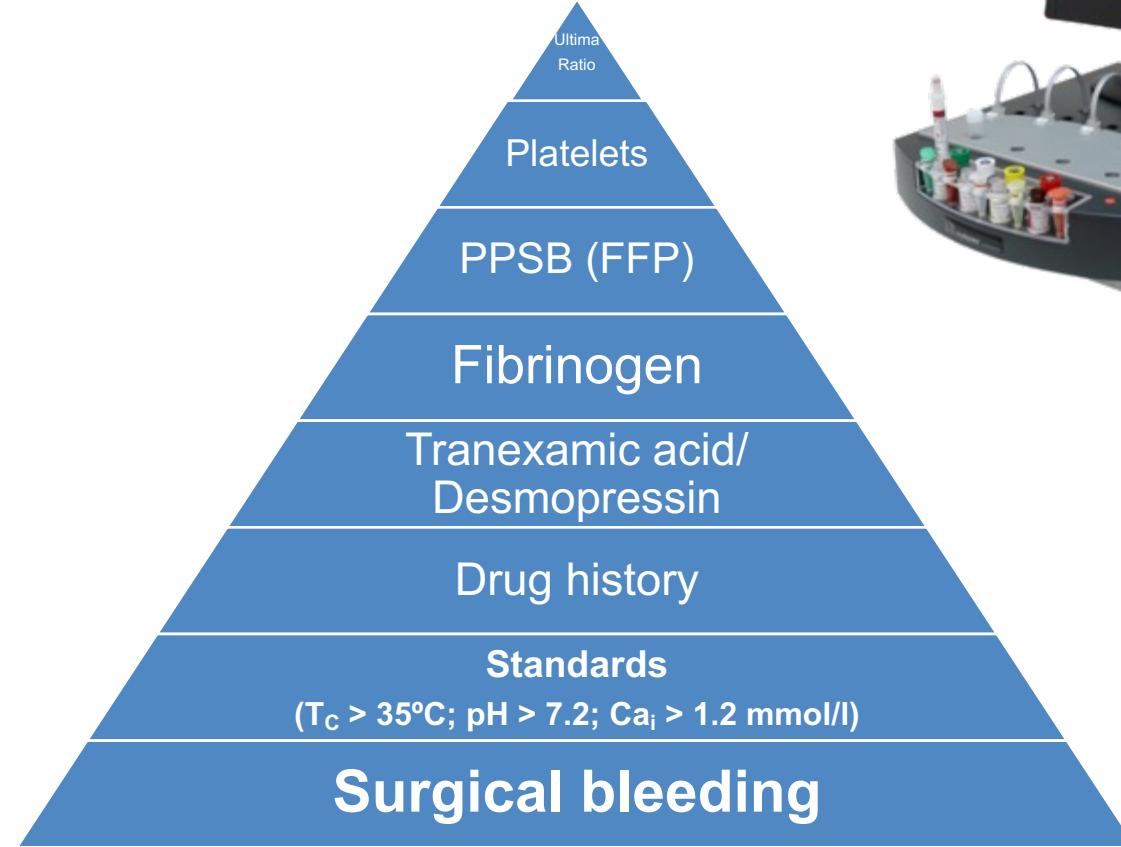
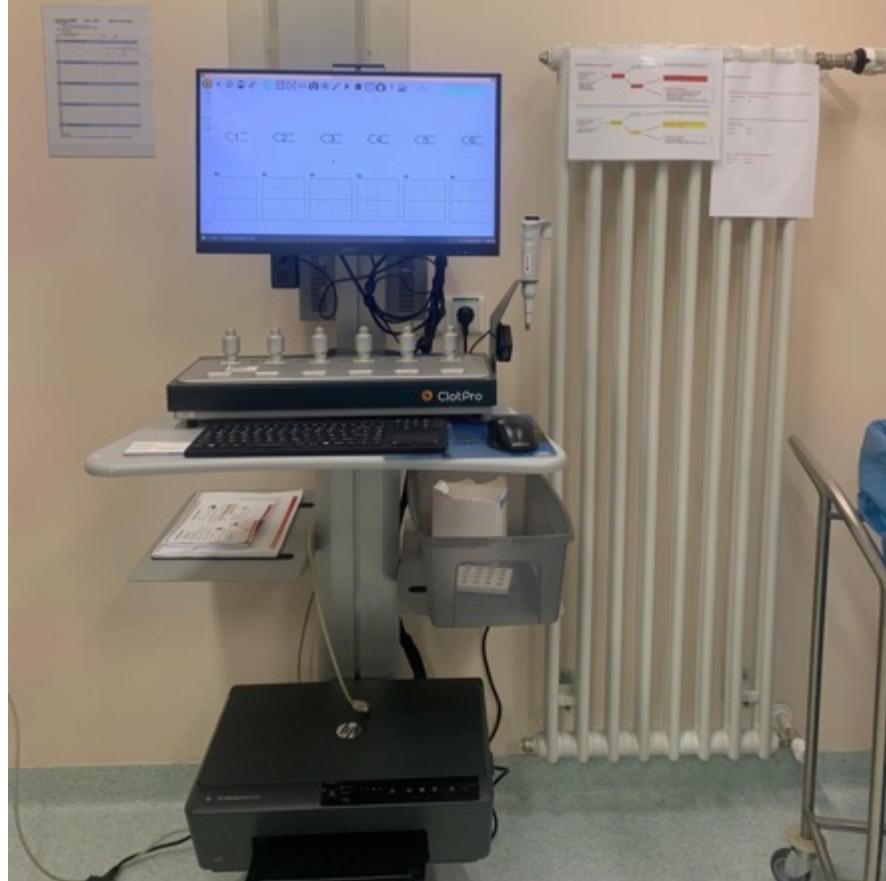


CrossMark

Safety, efficacy, and cost-effectiveness of intraoperative blood salvage in OPCABG with different amount of bleeding: a single-center, retrospective study

Huan Wang, Weijian Zheng, Weiping Fang, Gaige Meng, Lei Zhang, Yannan Zhou, Erwei Gu and Xuesheng Liu*

Management of Bleeding

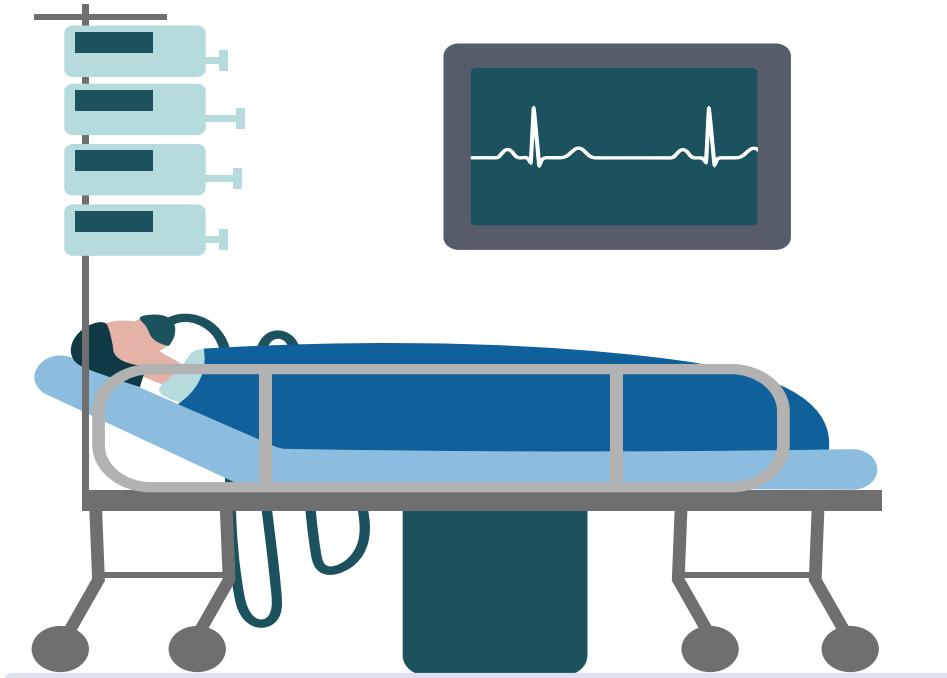


1. Management of pre-operative anemia

- ▶ Screening and diagnosis
- ▶ Treatment

2. Minimizing blood loss & bleeding

3. Restrictive use of blood units



Hb Trigger < 7-8 g/dl

**(irrespective of age, septic shock,
vasopressor, etc.)**

JAMA | Special Communication

Red Blood Cell Transfusion 2023 AABB International Guidelines

Jeffrey L. Carson, MD; Simon J. Stanworth, MD, DPhil; Gordon Guyatt, MD; Stacey Valentine, MD, MPH;
Jane Dennis, PhD; Sara Bakhtary, MD; Claudia S. Cohn, MD, PhD; Allan Dubon, MLS;
Brenda J. Grossman, MD, MPH; Gaurav K. Gupta, MD, PhD; Aaron S. Hess, MD, PhD; Jessica L. Jacobson, MD;
Lewis J. Kaplan, MD; Yulia Lin, MD; Ryan A. Metcalf, MD; Colin H. Murphy, MD; Katerina Pavenski, MD;
Micah T. Prochaska, MD; Jay S. Raval, MD; Eric Salazar, MD, PhD; Nabiha H. Saifee, MD, PhD;
Aaron A. R. Tobian, MD, PhD; Cynthia So-Osman, MD, PhD; Jonathan Waters, MD; Erica M. Wood, MD;
Nicole D. Zantek, MD, PhD; Monica B. Pagano, MD

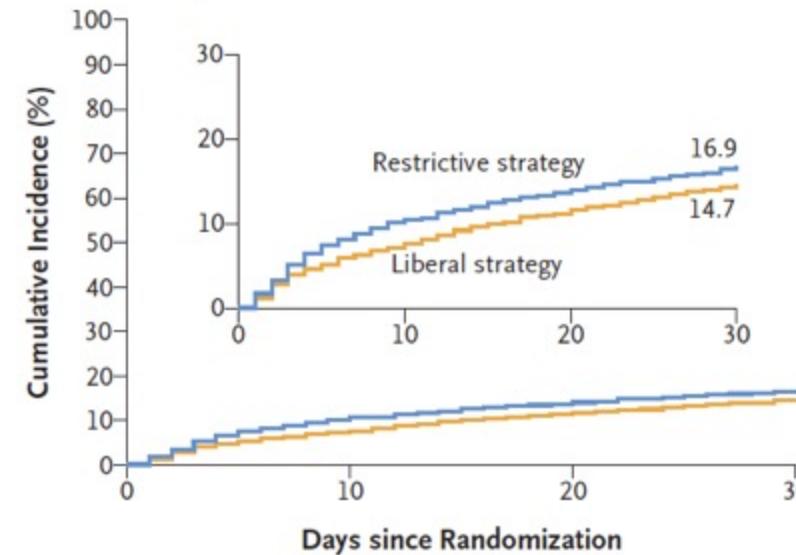
Table 1. Approximate Per-Unit Risk for Red Blood Cell (RBC) Transfusion
in the US^a

Adverse event	Approximate risk per RBC transfusion
Febrile reaction	1:161 ³
Allergic reaction	1:345 ³
Transfusion-associated circulatory overload	1:125 ³
Transfusion-related acute lung injury	1:1250 ³
Anaphylactic reactions	1:5000 ³
Hepatitis B virus	1:1 100 000 ⁴
Hepatitis C virus	1:1 200 000 ⁴
HIV	1:1 600 000 ⁴

Restrictive or Liberal Transfusion Strategy in Myocardial Infarction and Anemia

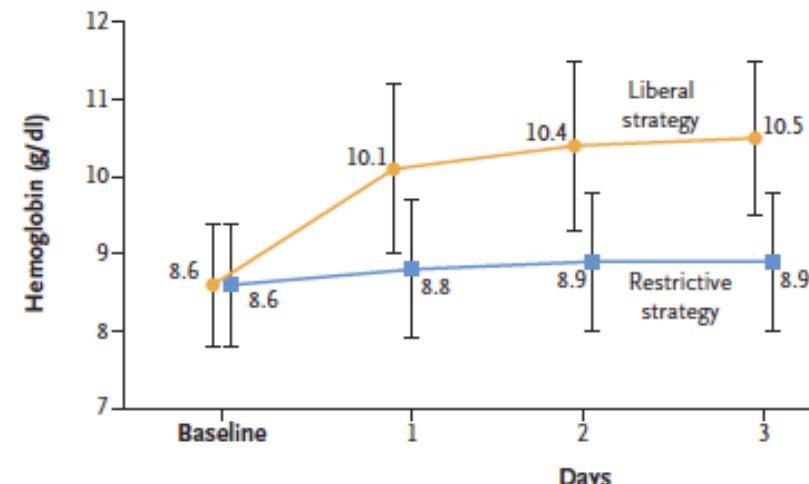
J.L. Carson, M.M. Brooks, P.C. Hébert, S.G. Goodman, M. Bertolet, S.A. Glynn,
 B.R. Chaitman, T. Simon, R.D. Lopes, A.M. Goldswieg, A.P. DeFilippis,
 J.D. Abbott, B.J. Potter, F.M. Carrier, S.V. Rao, H.A. Cooper, S. Ghafghazi,
 D.A. Ferguson, W.J. Kostis, H. Noveck, S. Kim, M. Tessalee, G. Ducrocq,
 P. Gabriel Melo de Barros e Silva, D.J. Triulzi, C. Alsweiler, M.A. Menegus,
 J.D. Neary, L. Uhl, J.B. Strom, C.B. Fordyce, E. Ferrari, J. Silvain, F.O. Wood,
 B. Daneault, T.S. Polonsky, M. Senaratne, E. Puymirat, C. Bouleti, B. Lattuca,
 H.D. White, S.F. Kelsey, P.G. Steg, and J.H. Alexander,
 for the MINT Investigators*

A Composite Outcome of Myocardial Infarction or Death

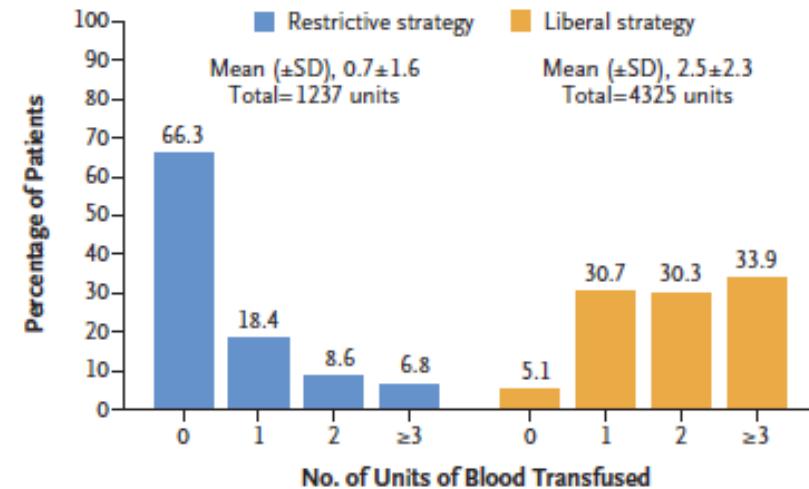


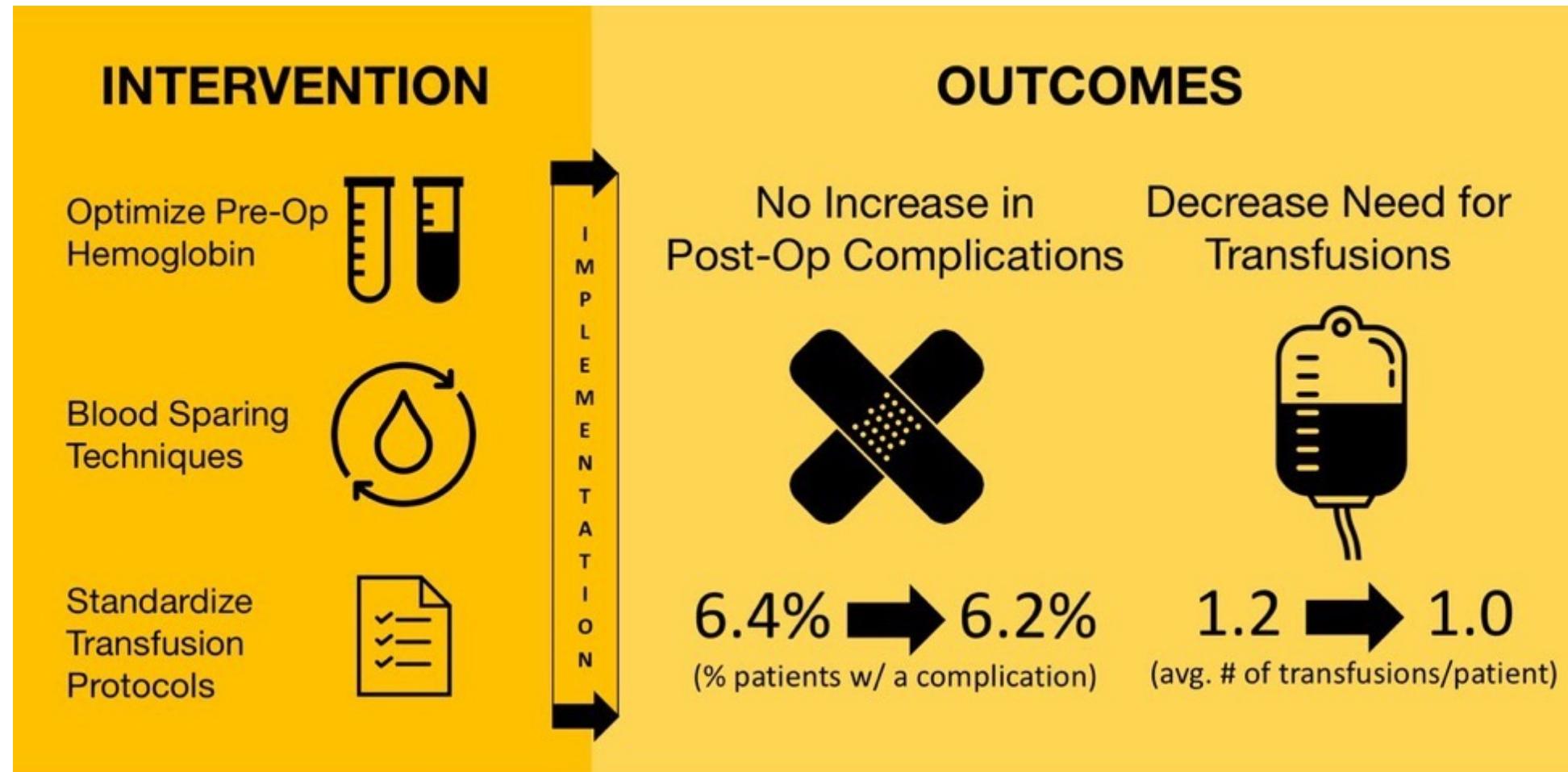
No. at Risk				
Restrictive strategy	1749	1565	1503	1439
Liberal strategy	1755	1605	1532	1467

A Hemoglobin Level



B Units of Blood Transfused





4 Hospitals (Bonn, Frankfurt, Kiel, Münster)
Pre-PBM (n=54,513) vs. PBM (n=75,206)

ORIGINAL RESEARCH

Improved outcomes and reduced costs associated with a health-system-wide patient blood management program: a retrospective observational study in four major adult tertiary-care hospitals



PBM Bundle:

- ✓ Preoperative anaemia management,
- ✓ Cell salvage,
- ✓ Coagulation management,
- ✓ Antihyperfibrinolytics,
- ✓ Minimisation of blood loss,
- ✓ Reduced blood sampling,
- ✓ 'Single-unit transfusion policy'
- ✓ Restrictive transfusion trigger

Results:

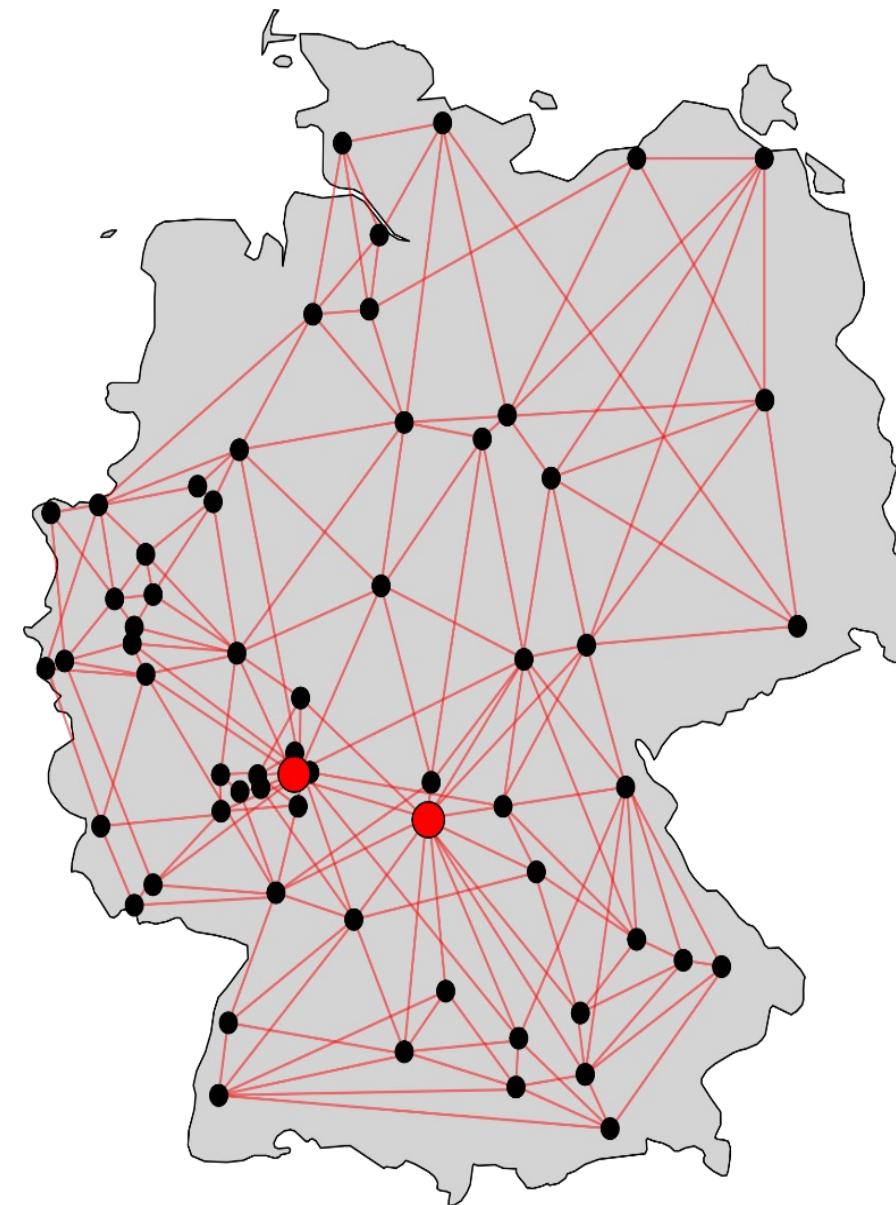
- ▶ RBC need 41% ↓
- ▶ In-hospital mortality ↓
- ▶ Costs ↓ (18.5 Mio. Australian Dollars)



4 Hospitals

Implementation PBM in 2008

Retrospective analysis n=605,046 patients Jul2008 – Jun2014



Patient Blood Management

Home | Project | Network | Contact | Archive | Downloads

Would you like to be a part of our national PBM-Network? [Contact us!](#)

[f](#)  

FREQUENTLY ASKED QUESTIONS (FAQ)

What is PBM?

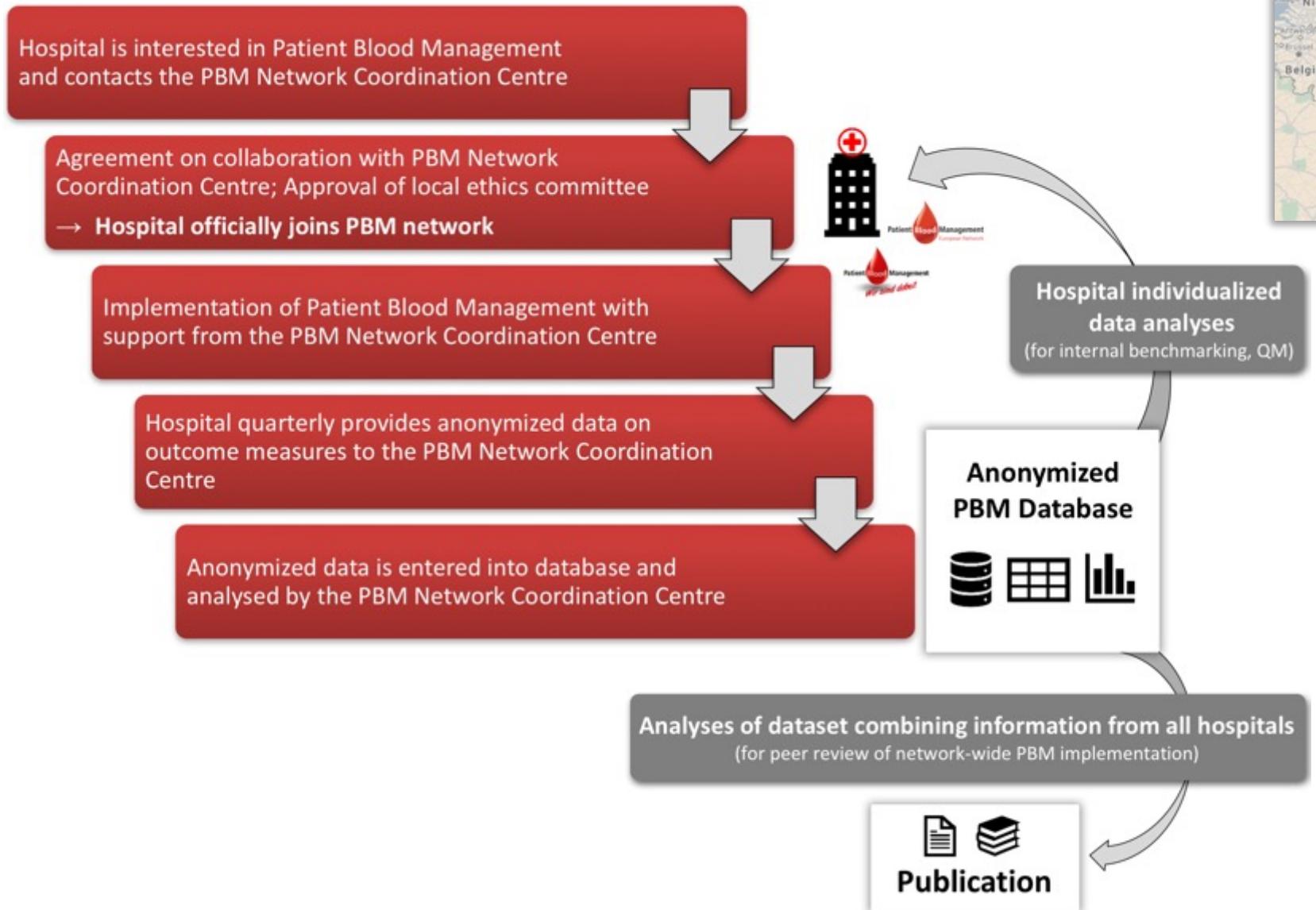
The Patient Blood Management (PBM) program is a clinical project with the aim to increase patient safety. The concept, as shown in Figure 1, is built on three pillars, of which each contain a bundle of several individual measures. The aim is to improve, to preserve and exploit patient's own blood resources.

Patient Blood Management: The Three Pillars

- Early detection and treatment of anemia before elective surgery associated with high risk of transfusion
- Minimize blood loss and increase usage of blood saving procedures
- Adequately use of blood components

Figure 1: Three pillar concept of Patient Blood Management.

Data collection/ Benchmark





Patient Blood Management Bundles to Facilitate Implementation

Patrick Meybohm ^{a,*}, Toby Richards ^b, James Isbister ^c, Axel Hofmann ^d, Aryeh Shander ^e, Lawrence Tim Goodnough ^f, Manuel Muñoz ^g, Hans Gombotz ^h, Christian Friedrich Weber ^a, Suma Choorapoikayil ^a, Donat R. Spahn ⁱ, Kai Zacharowski ^a



Table 1
Patient Blood Management project management

Block 1: General PBM project management	
Involvement of key PBM stakeholders [role]	
PBM coordinator with protected time [central role for communication, networking, education, documentation, and benchmarking]	0□1□2□
Hospital board of directors [eg, chief medical officer, chief executive officer, chief nursing officer] [support; official directive]	0□1□2□
Surgeons [eg, orthopedic/trauma, cardiac, vascular, visceral, trauma, urology, neurosurgery] [interdisciplinary consensus]	0□1□2□
Anesthesiologists/intensive care specialists [central role for perioperative care]	0□1□2□
Transfusion medicine specialists/transfusion committee [prevention of blood wastage, optimal blood use, changes in donor blood management]	0□1□2□
Internists/gastroenterologists/hematologists/cardiologists/nephrologists [anemia management, optimal blood use]	0□1□2□
General practitioners/family doctors [determine the necessity for elective surgery, assign patients to a hospital, preoperative anemia management]	0□1□2□
Patient's representative [need to be informed about the different alternatives to treat anemia/create awareness]	0□1□2□
Pediatrics [mainly refers to blood conservation strategies]	0□1□2□
Central laboratory/laboratory scientists [smaller blood collecting tubes]	0□1□2□
Pharmacy/purchasing department [introduction of new drugs for the management of anemia and coagulopathy]	0□1□2□
Information technology department [sampling of routine data and key performance metrics]	0□1□2□
Finance department [finance experience for program budget plan, initial project costs; hospital-wide cost savings]	0□1□2□
Quality management [project management experience; PBM as a fixed part of a quality improvement initiative]	0□1□2□
Public affairs [dissemination channels/marketing of the PBM project (eg, via journal/intranet/e-mails/posters/roll-ups/press conferences)]	0□1□2□
Undergraduate and postgraduate education	
Undergraduate education [nursing school/medical school]	0□1□2□
Postgraduate education of physiciansclinicians [lectures, workshops; initial and once a year]	0□1□2□
Postgraduate education of nurses [intensive care unit, normal ward; initial and once a year]	0□1□2□
Certificate (eg, by online E-learning courses)–to enhance PBM education and knowledge transfer	0□1□2□
Local standard operating procedures/protocols	
Standard operating procedures for PBM	
Anemia management	0□1□2□
Coagulation management	0□1□2□
Blood conservation	0□1□2□
Optimal blood use/transfusion of blood products (list of index procedures for "type and screen" or "type and crossmatch (and supply)")	0□1□2□
Massive hemorrhage protocols (including such as damage controlled surgery, arterial embolization, hemotherapy algorithm)	

Table 2
Anemia management

Block 2: First strategy—manage the patient's anemia	
Preoperative management of anemia (subgroup of surgical patients)	
Diagnosis of anemia	
Identification of anemic patients (screening)	0□1□2□
Diagnosis of iron deficiency anemia (eg, blood count, ferritin, transferrin saturation, calculation of the individual iron deficit)	0□1□2□
Diagnosis of vitamin B12 or folic acid deficiency	0□1□2□
Extended diagnostic of anemia (eg, consultant for gastroenterology, endoscopy; hematology, bone marrow biopsy)	0□1□2□
Diagnosis of anemia ideally 3–4 wk before surgery	0□1□2□
Diagnosis of anemia although time to surgery is shorter than 3–4 wk	0□1□2□
Anemia clinic; anemia/PBM nurse	0□1□2□
Treatment of anemia	
Administration of intravenous iron	0□1□2□
Administration of vitamin B12 and/or folic acid	0□1□2□
Administration of erythropoietin	0□1□2□
Optimizing cardiovascular and pulmonary function to improve tolerance of anemia	
Increase of oxygen delivery (increase of inspiratory oxygen concentration); decrease of oxygen consumption	0□1□2□
Hemodynamic monitoring in high-risk procedures/patients (normovolemia, optimization of cardiac output)	0□1□2□
Acute normovolemic hemodilution	0□1□2□
Management of anemia in hospitalized patients and/or after surgery	
Diagnosis of anemia	
Diagnosis of iron deficiency anemia	0□1□2□
Treatment of anemia	
Administration of intravenous iron	0□1□2□
Administration of erythropoietin	0□1□2□
Absence of unnecessary therapies, eg, "top up" RBC transfusion	0□1□2□
Table 3 Optimization of coagulopathy	
Block 3: Second strategy—optimizing coagulopathy	
Preoperative management of coagulopathy	
Algorithm for management of patients with oral/parenteral anticoagulation and/or antiplatelet therapy	0□1□2□
Questionnaire/tests of hemostasis	0□1□2□
Hemostasis management in hospitalized patients	
Physiological conditions of hemostasis	
Body temperature >36°C (normothermia)	0□1□2□
pH > 7.2/ionized Ca ²⁺ > 1.1 mmol/L	0□1□2□
Point-of-care diagnostic in coagulopathy	
Coagulation system (eg, viscoelastic methods)	0□1□2□
Platelet function (eg, aggregometric methods)	0□1□2□
Use of a coagulation algorithm for administration of blood products, clotting factor concentrates, tranxamic acid	0□1□2□
Empiric administration of tranxamic acid in certain procedures (particular in cardiac, orthopedic, transplant surgery, massive hemorrhage)	0□1□2□
Empiric therapy of platelet dysfunction (eg, desmopressin)	0□1□2□

Table 4
Blood conservation strategy

Block 4: Third strategy—interdisciplinary blood conservation modalities

Reduction of diagnostic-associated blood loss	
Reduced size of blood collection tubes	0□1□2□
EDTA tube	0□1□2□
Citrate tube	0□1□2□
Lithium-heparin/serum tube	0□1□2□
Type and screen tubes	0□1□2□
Restrictive frequency of blood collection	0□1□2□
Appropriate timing of postoperative blood tests and not daily judicious use ("weekend" plan)	0□1□2□
Reduced sampling for blood cultures in daily routine (limit to established indications)	0□1□2□
Closed in-line flush devices (arterial pressure transducer systems, central venous blood collection)	0□1□2□
Reduction of surgery-related blood loss (subgroup of surgical patients)	
Extreme attention to minimize blood loss (eg, diathermy for tissue dissection), hemostatic adjuncts	0□1□2□
Laparoscopic surgery/minimal invasive techniques/modern surgical instruments	0□1□2□
Limited numbers of swabs for blood absorption/swab washing and cell salvage ("single swab")	0□1□2□
Controlled hypotension (if no contraindication is present)	0□1□2□
Autologous blood collection and retransfusion (cell salvage)—intraoperatively and postoperatively	
Nononcological procedures: if expected blood loss >500 mL	0□1□2□
Oncological procedures: if massive blood loss	0□1□2□
Oncological procedures: if expected blood loss >500 mL (radiation of washed blood; filtration using leukocyte depletion filters)	0□1□2□
Cardiac surgery	
Small extracorporeal circuits (priming volume <12 L; 3/8" lines; minimized extracorporeal circuits)	0□1□2□
Extracorporeal circuits (retrograde autologous priming; blood cardioplegia, modified ultrafiltration/hemofiltration)	0□1□2□
Bleeding saphenous vein graft removal/immediate wound closure/endoscopic vein removal	0□1□2□

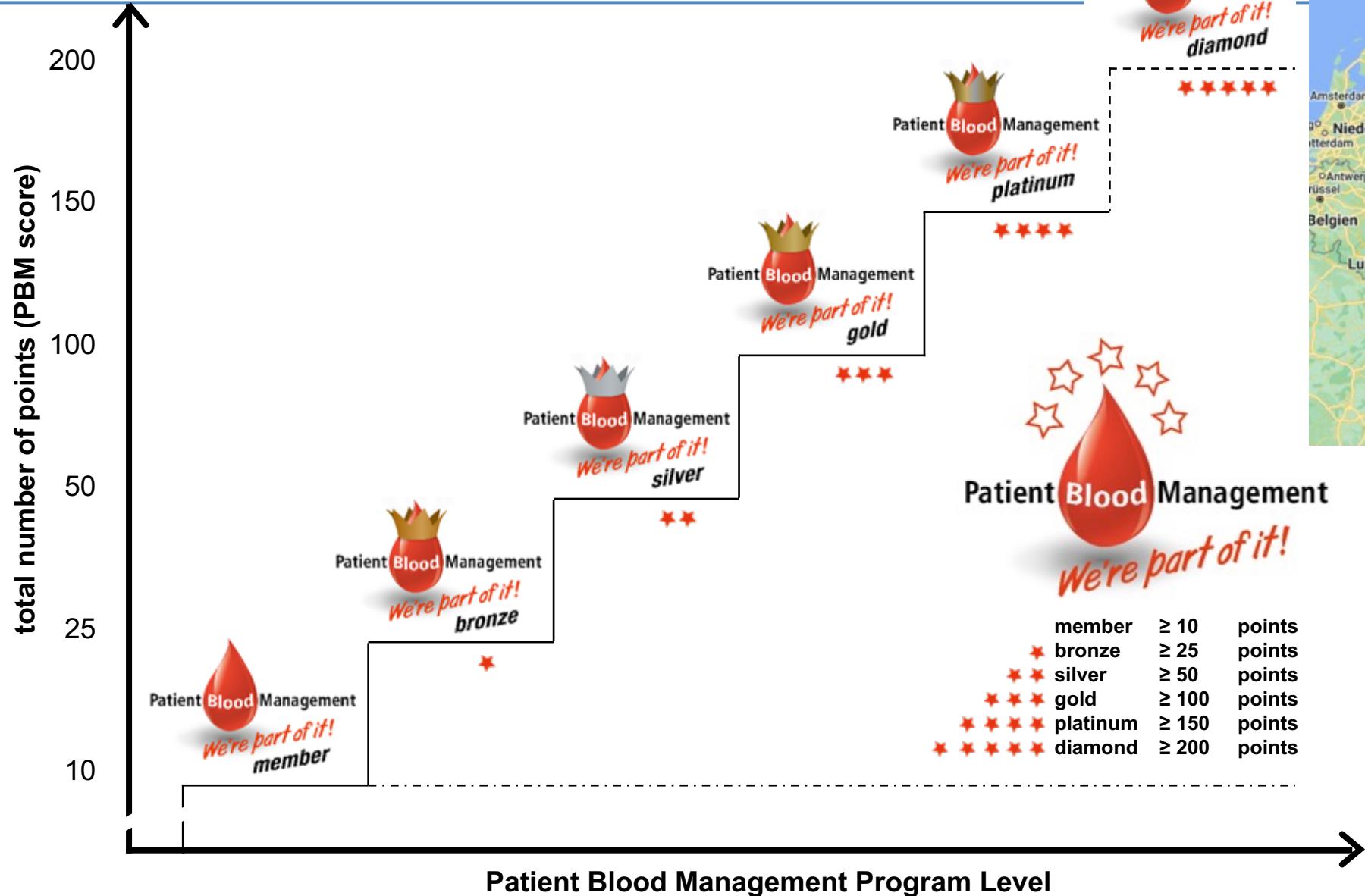
Table 5
Patient Blood Management-related metrics

Block 6: PBM-related metrics/patient's outcome/benchmark

PBM-related metrics	
Anemia—itemized for each department with percentage of patients	
Preoperative anemia	0□1□2□
Hospital-acquired anemia	0□1□2□
Treated anemic patients (eg, parenteral iron, vitamin B12, folic acid, erythropoiesis-stimulating agents)	0□1□2□
Use of blood conservation techniques—itemized for each department with number of units and percentage of patients	
Use of hemostatic agents (tranxamic acid, desmopressin)	0□1□2□
Use of cell salvage	0□1□2□
Hemotherapy product use—itemized for each department with number of units/dosage and percentage of patients	
Blood products (RBC units, platelets concentrates, FFP units)	0□1□2□
Coagulation factors (prothrombin complex concentrate, fibrinogen, recombinant VIIa, XIII)	0□1□2□
Transfusion episodes where a single unit of RBCs/platelet issued	0□1□2□
Indications for blood product use—mean pretransfusion levels (hemoglobin, platelet count, INR)	0□1□2□
Blood product use that falls outside of hospital or professional transfusion guidelines	0□1□2□
Blood wastage—number of units	
Crossmatch (supply)/transfusion ratio (aim: as low as possible; ratio <1.7:1)	0□1□2□
Discarded blood products (RBC units, platelet concentrates, FFP units)	0□1□2□
Report to clinicians/administrative departments about PBM-related metrics (once a year)	0□1□2□
Patient's outcome	
Mortality (inhospital)	0□1□2□
Morbidity (eg, ICD-10 codes)	
Infections (sepsis, pneumonia), acute renal failure, acute myocardial infarction, acute ischemic stroke	0□1□2□
Length of stay in hospital/intensive care unit	0□1□2□
Hemovigilance (transfusion reactions, transfusion-associated cardiac overload, transfusion-associated acute lung injury)	0□1□2□
Benchmarking	
Internal/external benchmarking (eg, for selected surgical procedures)	0□1□2□
Membership of a PBM network	0□1□2□
Program budget for PBM	
Initial/ongoing project costs (personnel resources, dissemination); PBM-related cost savings (reduced blood products, laboratory analyses)	0□1□2□
Hospital audit for PBM	
Participation in hospital audit for PBM practice and transfusion decisions in a sample of scheduled cases	0□1□2□
Hospital accreditation for PBM	
Participation in a hospital certification (accreditation) program for PBM	0□1□2□

Abbreviations: INR, international normalized ratio; ICD-10, International Statistical Classification of Diseases and Related Health Problems, Tenth Revision.

Patient Blood Management



German PBM Network

CLINICAL INVESTIGATION

German Patient Blood Management Network: effectiveness and safety analysis in 1.2 million patients

Patrick Meybohm^{1,2,*}, Elke Schmitt^{1,3}, Suma Choorapoikayil¹, Lotta Hof¹, Oliver Old^{1*}, Markus M. Müller^{4,5}, Christof Geisen⁵, Erhard Seifried^{5*}, Olaf Baumhove^{6*}, Samuel de Leeuw van Weenen⁶, Alexandra Bayer⁷, Patrick Friederich⁸, Brigitte Bräutigam⁹, Jens Friedrich¹⁰, Matthias Gruenewald¹¹, Gunnar Elke^{11*}, Gerd P. Molter¹⁰, Diana Narita¹², Ansgar Raadts¹³, Christoph Haas¹⁴, Klaus Schwendner¹⁵, Andrea U. Steinbicker^{1,16}, Dana J. Jenke¹⁶, Josef Thoma¹⁷, Viola Weber¹⁷, Markus Velten^{18*}, Henry Weigt¹⁹, Björn Lange¹⁹, Maria Wittmann^{18*}, Eva Herrmann³, Kai Zacharowski^{1,*}, and the German Patient Blood Management Network Collaborators[†]

14 Hospitals; Jan 2010 to Dec 2019

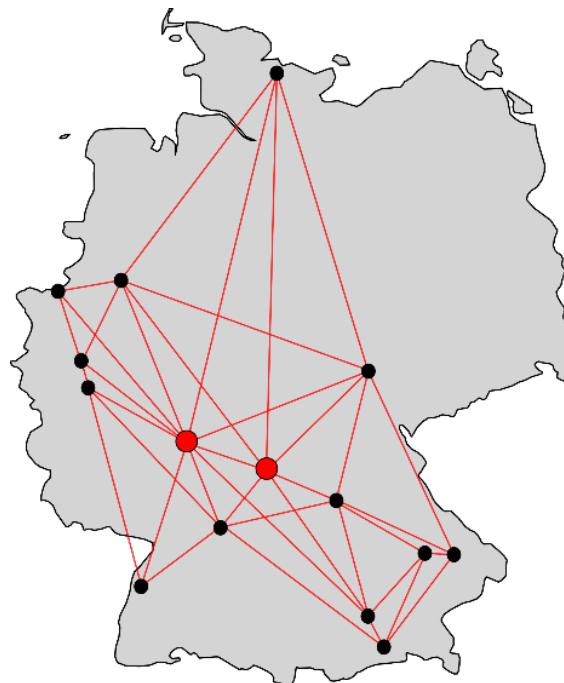
1.2 mio patients:

- Pre-PBM-Cohort: n=441,082
- Post-PBM-Cohort: n=760,735

effectiveness



safety



- ✓ RBC transfusion (p<0.001) 
- ✓ Hospital length of stay (p<0.001) 
- ✓ Postoperative complications 
- ✓ Mortality 



Thank you – meybohm_p@ukw.de