

# Patient Blood Management

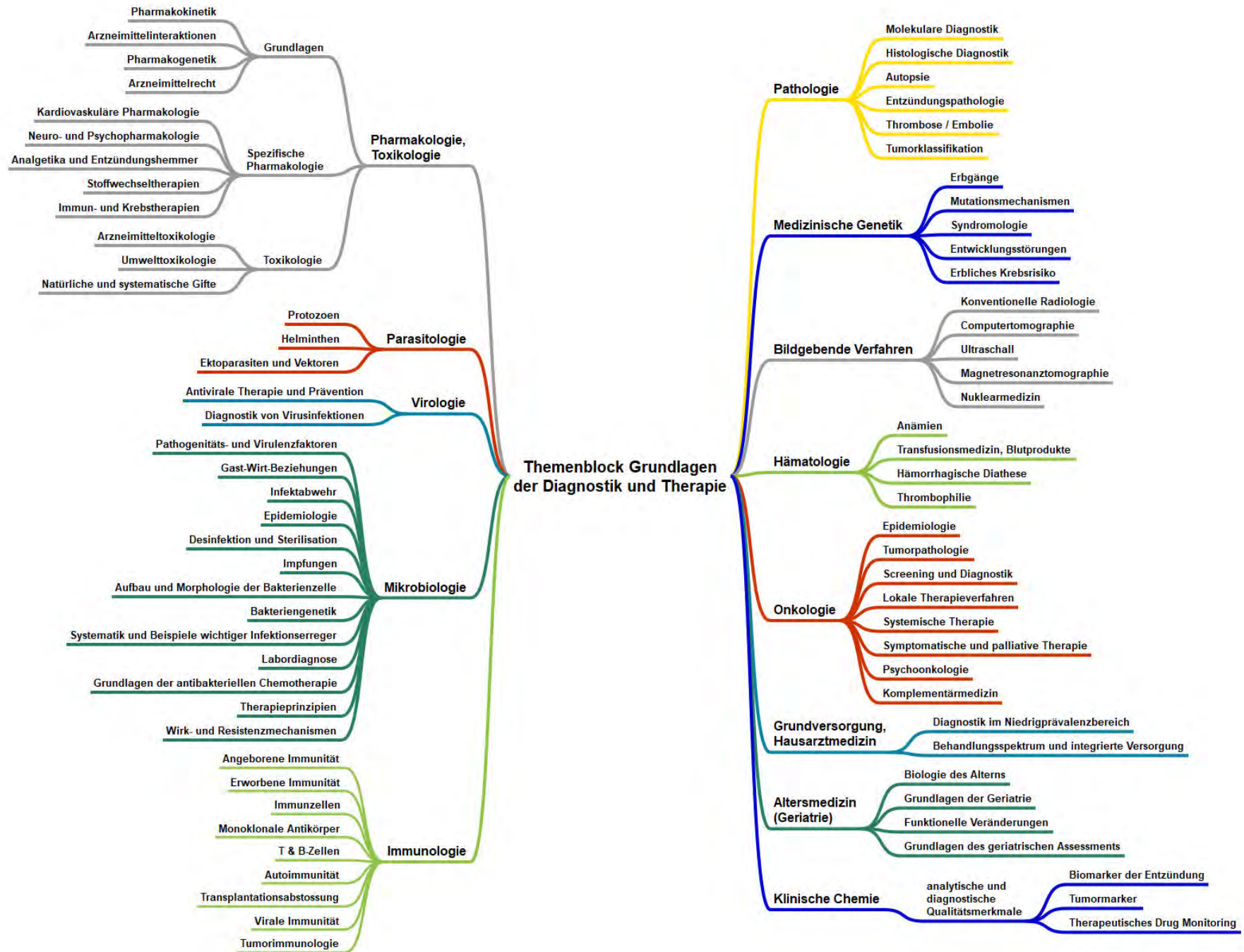
**Alexander Kaserer, PD Dr. med., DESAIC**

Leitender Arzt - Institut für Anästhesiologie, USZ

# Interessenskonflikte

- **AstraZeneca, Pharmacosmos:** Advisory Board
- **Bayer, CSL Behring, AstraZeneca:** Honorare für Vorträge
- **Baxter, Pharmacosmos, CSL Behring:** Reise- und Fortbildungsgebühren

# Mindmap



# Lernziele - Patient Blood Management

- Sie können die 3 Säulen des Patient Blood Managements benennen.
- Sie können die Häufigkeit und die Bedeutung der präoperativen Anämie wiedergeben.
- Sie können die Behandlungsprinzipien der präoperativen Anämie-Behandlung beschreiben.
- Sie können die 4 wichtigsten Outcome-Benefits des Patient Blood Managements benennen.



# WHAT IS PATIENT BLOOD MANAGEMENT?

## **Patient Blood Management**

(PBM) is the timely application of evidence-based medical and surgical concepts designed to maintain hemoglobin concentration, optimize hemostasis and minimize blood loss in an effort to improve patient outcomes.



# Die 3 Säulen des PBM

Implementierung des  
**PBM** von der **WHO**  
gefordert<sup>2</sup>

## Optimierung des Erythrozytenvolumens

Unter anderem Diagnostik und Behandlung einer präoperativen Anämie, zeitliche Planung des operativen Eingriffs, ggf. postoperative Stimulation der Erythropoese

## Minimierung von Blutverlusten & Blutungen

Unter anderem Minimierung des diagnostischen und des interventionellen Blutverlusts, exakte Blutstillung

## Nutzung & Optimierung der physiologischen Anämie-Reserve

Unter anderem strenge Indikationsstellung zur Bluttransfusion (restriktives Transfusionsregime)



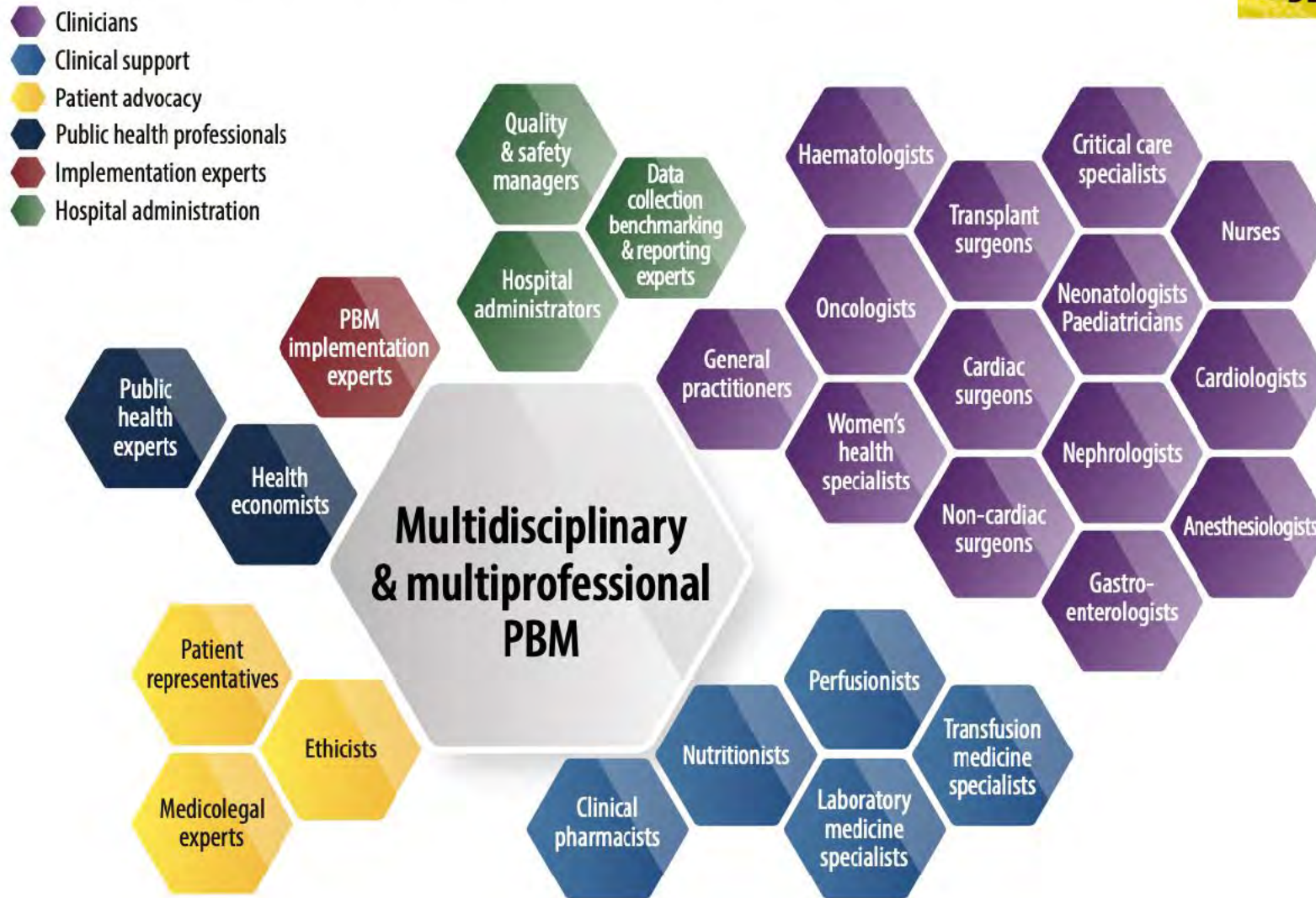
**POLICY BRIEF**

# THE URGENT NEED TO IMPLEMENT PATIENT BLOOD MANAGEMENT

This policy brief aims to:

- **create awareness** about the enormous, but greatly under-appreciated global disease burden of **iron deficiency, anaemia, blood loss and bleeding disorders;**
- **create a sense of urgency** for health care entities to implement **PBM**, a systematic, multidisciplinary, multiprofessional concept to routinely minimize these risk factors, and, in so doing, **significantly and cost-effectively improve health and clinical outcomes for hundreds of millions of medical and surgical patients, pregnant women, neonates, children, adolescents, elderly people, and the population as a whole;**
- **announce the upcoming World Health Organization (WHO) initiative to develop PBM Implementation Guidelines** that will serve as a framework for health care leaders of all Member States;

**Fig. 4. Stakeholders in multidisciplinary and multiprofessional PBM**





# Probleme der EC-Transfusion

- Allergische Reaktionen
- Fieber und Schüttelfrost
- Infektionen
- TRALI
- TACO
- Immunmodulation
- Nierenschädigung (AKI)
- Hämolyse → freies Hämoglobin: irreversible Endothelschäden
- Geldrollenphänomen → gestörte Mikrozirkulation
- Thromboembolien

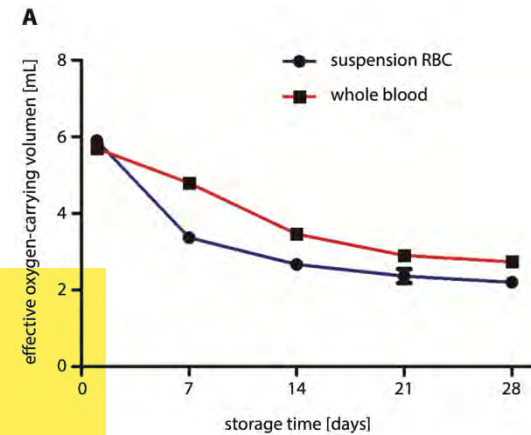
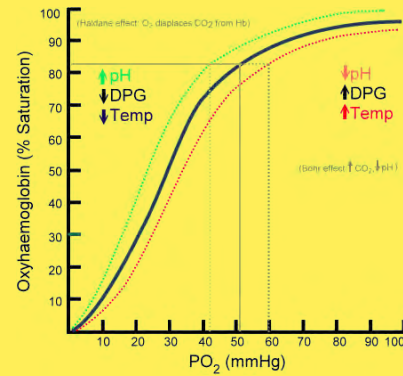


Fig. 1. Changes in oxygen-carrying capacity in whole blood and suspension RBC

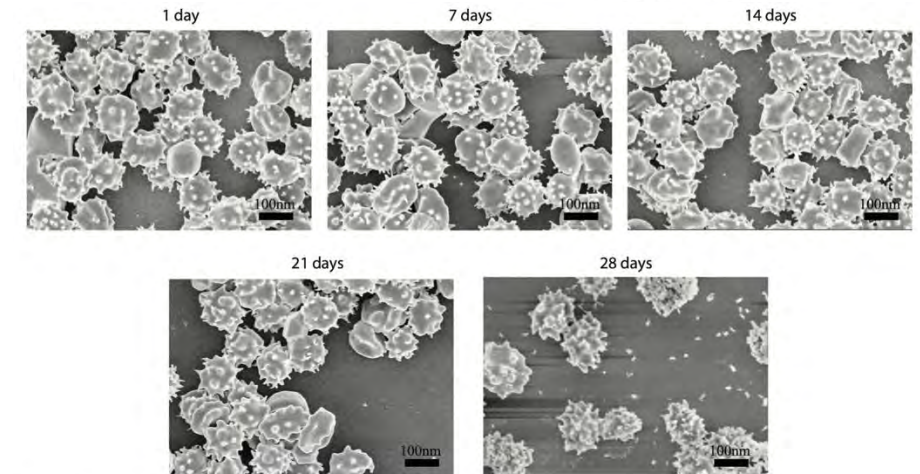
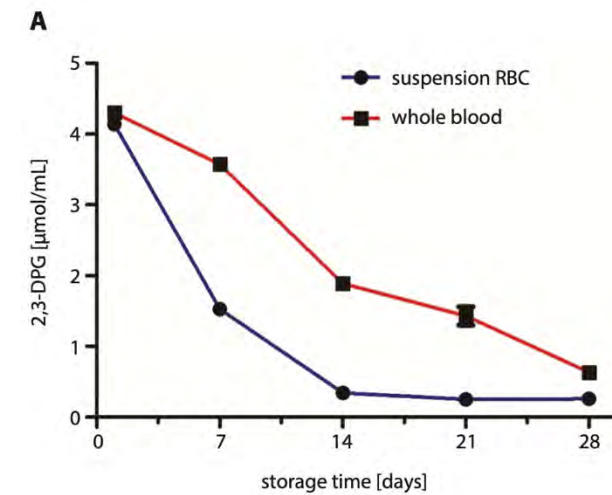
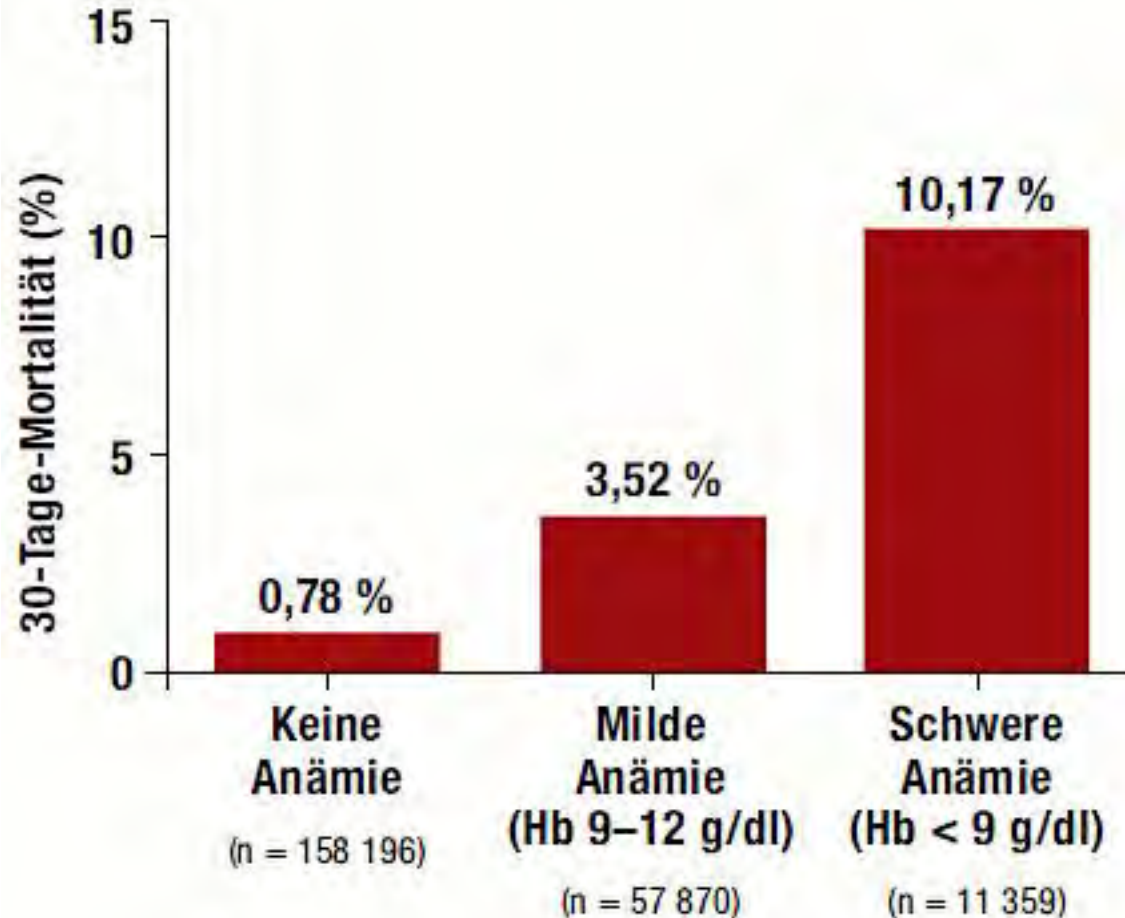


Fig. 3. Changes in erythrocyte morphology after different storage times. The scale bar was 100 nm

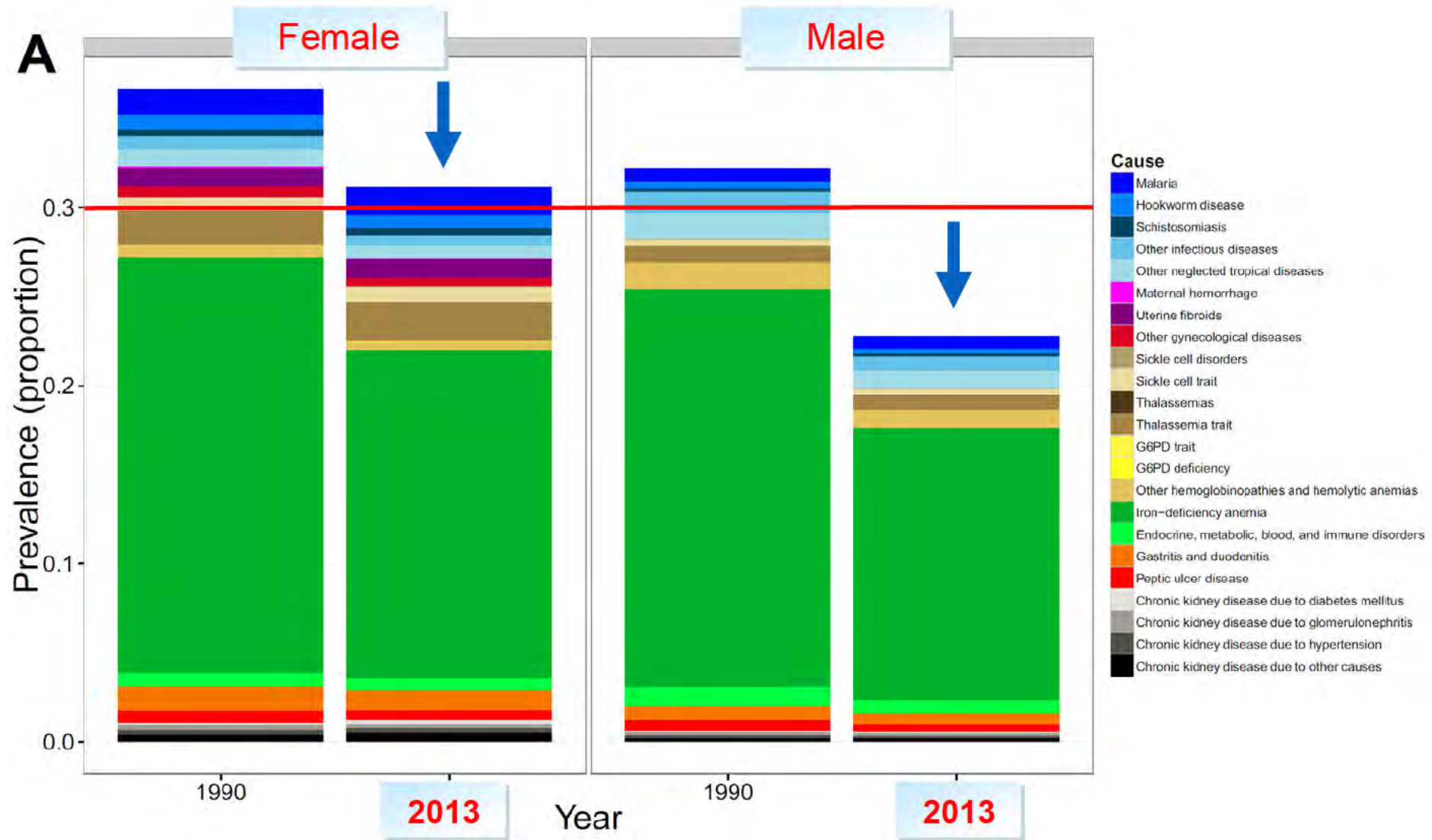


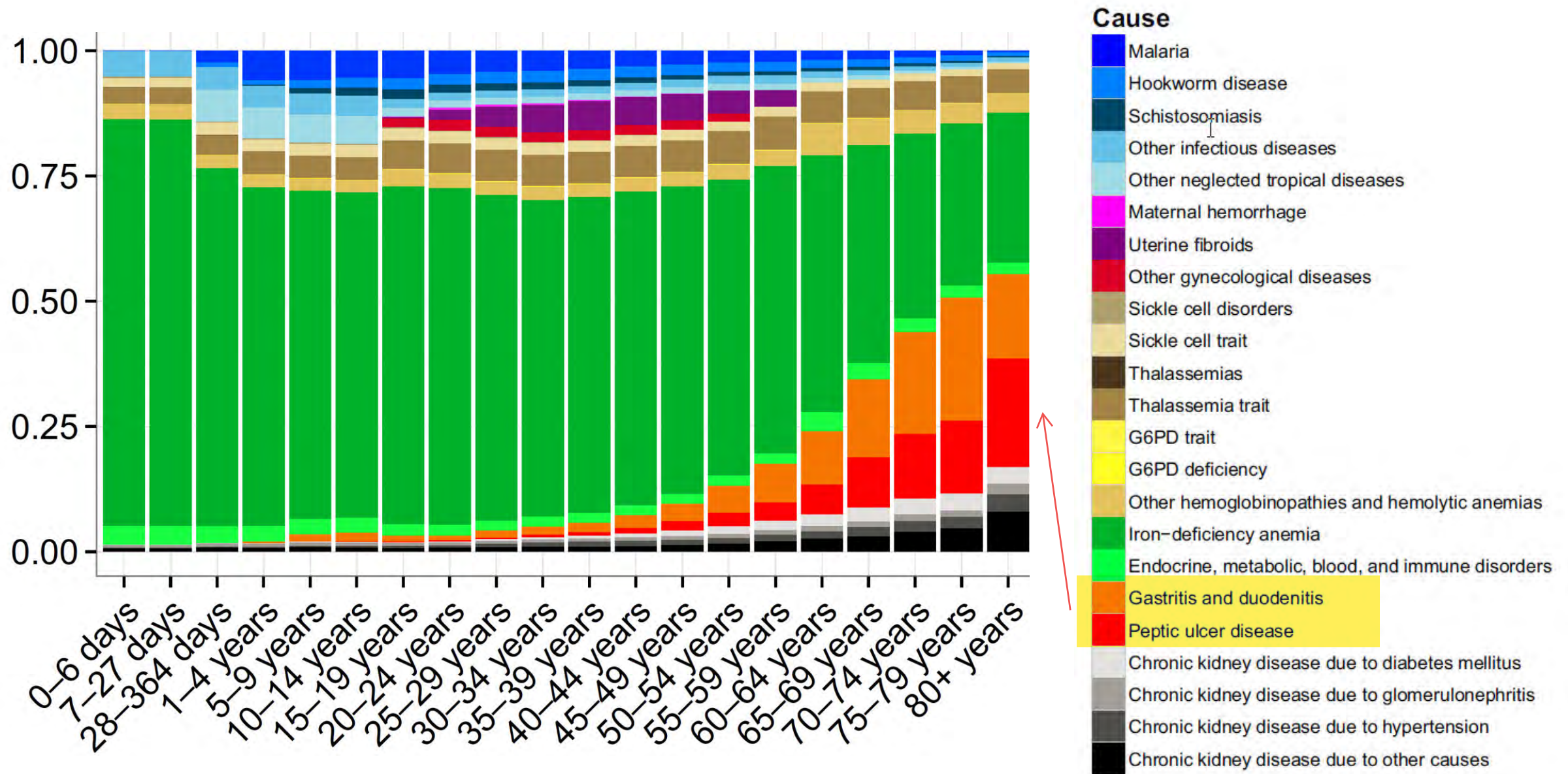
# **1. Säule: Präoperatives Anämie Screening und Behandlung**

# Einfluss einer präoperativen Anämie auf die 30-Tage-Mortalität bei nicht herzchirurgischen Patienten







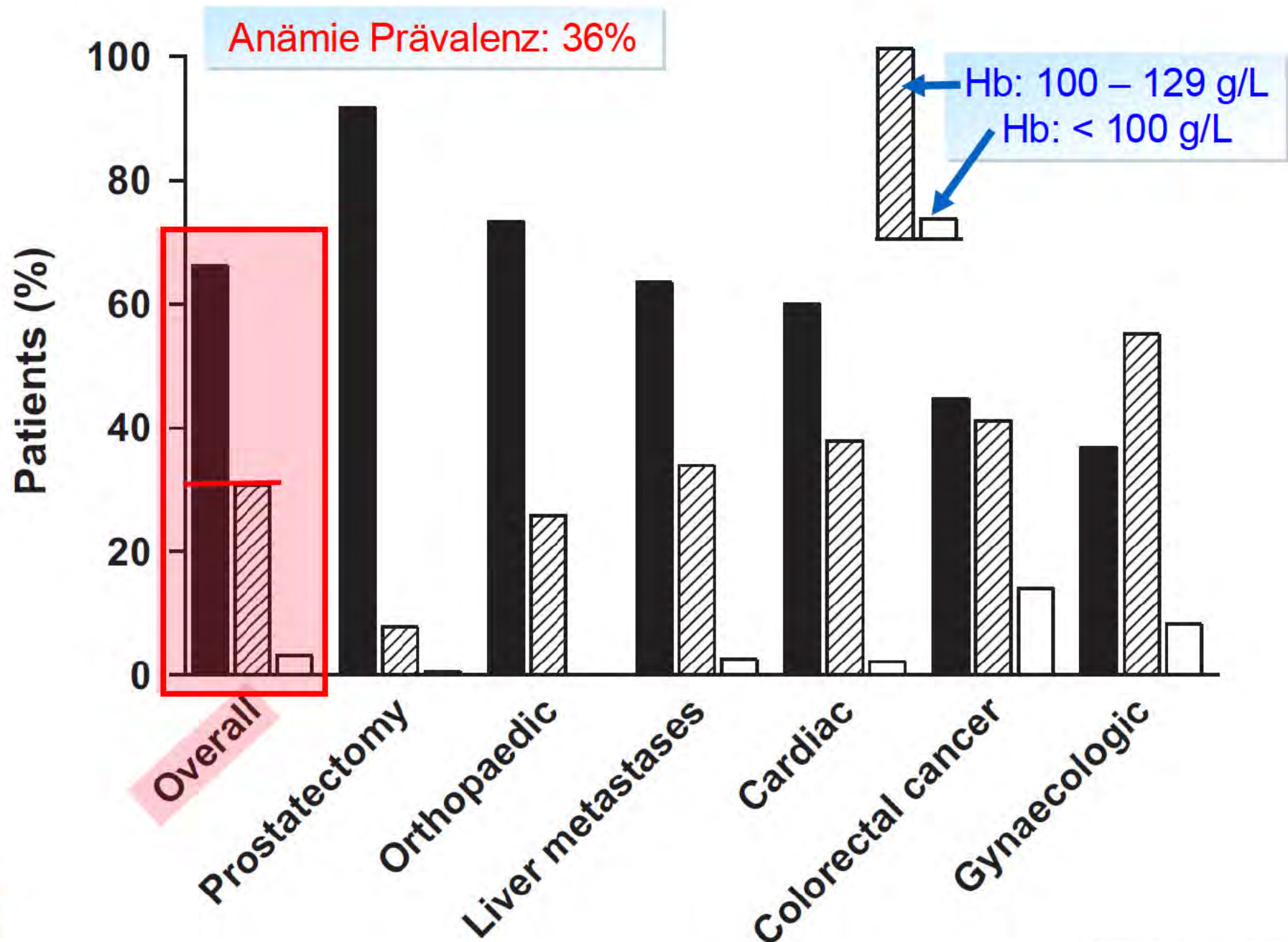


# Original Article

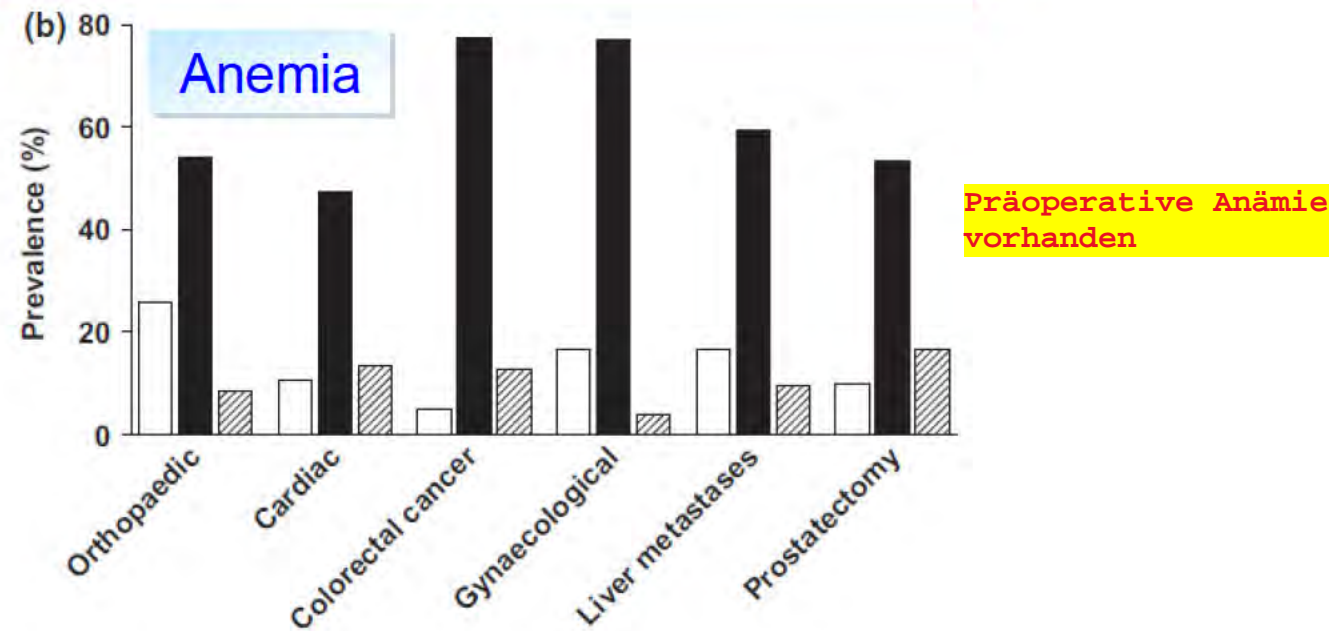
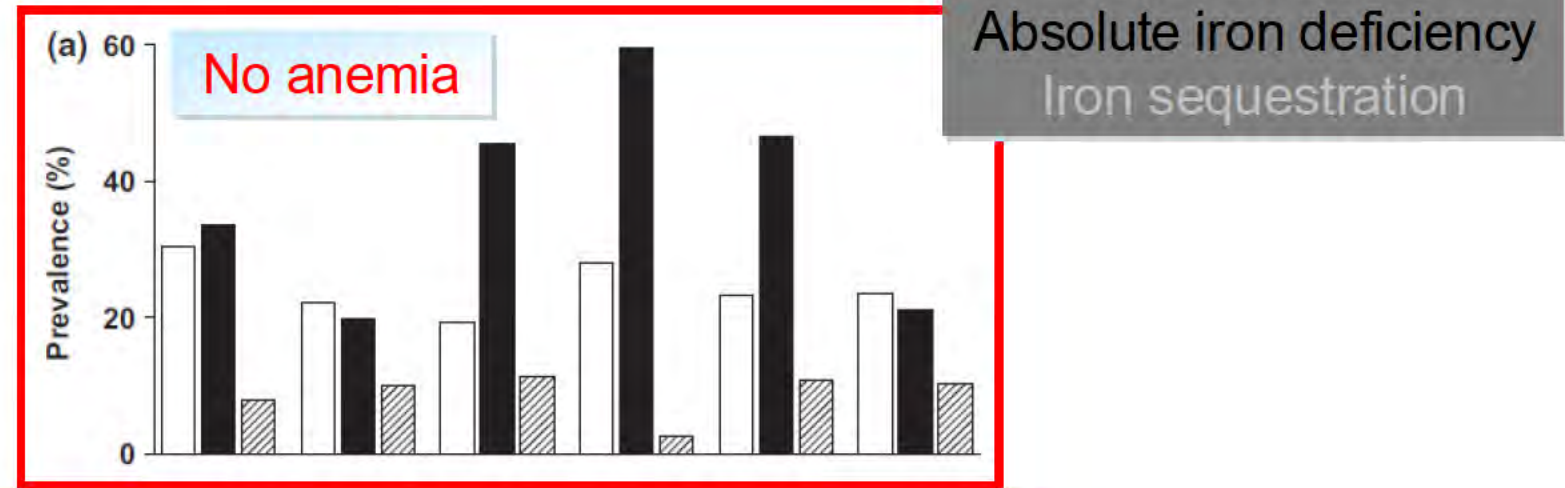
## Pre-operative haemoglobin levels and iron status in a large multicentre cohort of patients undergoing major elective surgery\*

- ◆ 3'342 patients scheduled for orthopedic, cardiac, colon, prostatic, gynecological or liver (metastatic) surgery representing the **focus group**
  - ⇒ Expected RBC transfusion rate > 10%
  - ⇒ Expected blood loss > 500 ml
- ◆ Anemia definition: **Hb < 130 g/L (male and female)**
- ◆ **Iron deficiency** (data available in 2'884 patients)
  - ⇒ Absolute iron deficiency: Ferritin < 30 ng/ml or < 100 ng/ml and (TSAT < 20% or CRP > 5 mg/l)
  - ⇒ Low iron store: Ferritin < 100 ng/ml and TSAT > 20%
  - ⇒ Iron sequestration: Ferritin > 100 ng/ml and TSAT < 20%





# Eisenmangel

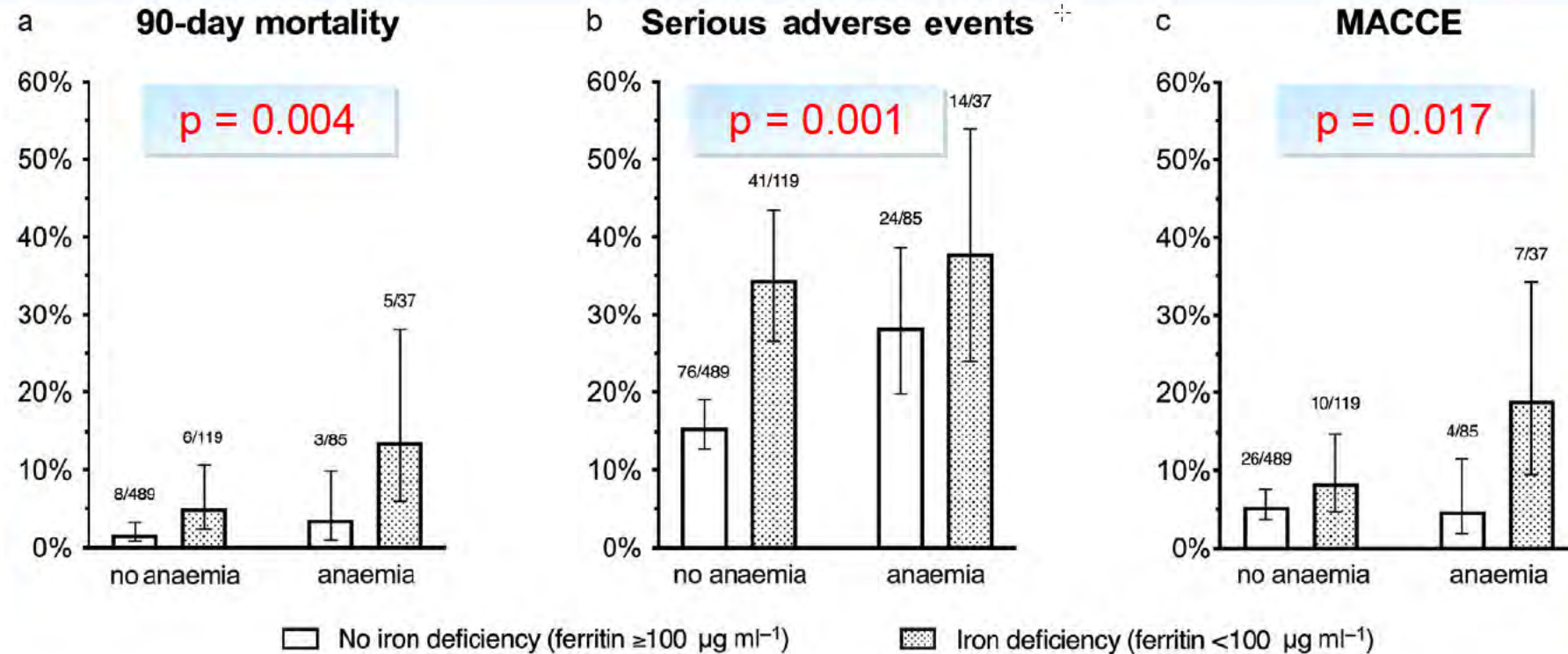


# Iron deficiency is associated with higher mortality in patients undergoing cardiac surgery: a prospective study

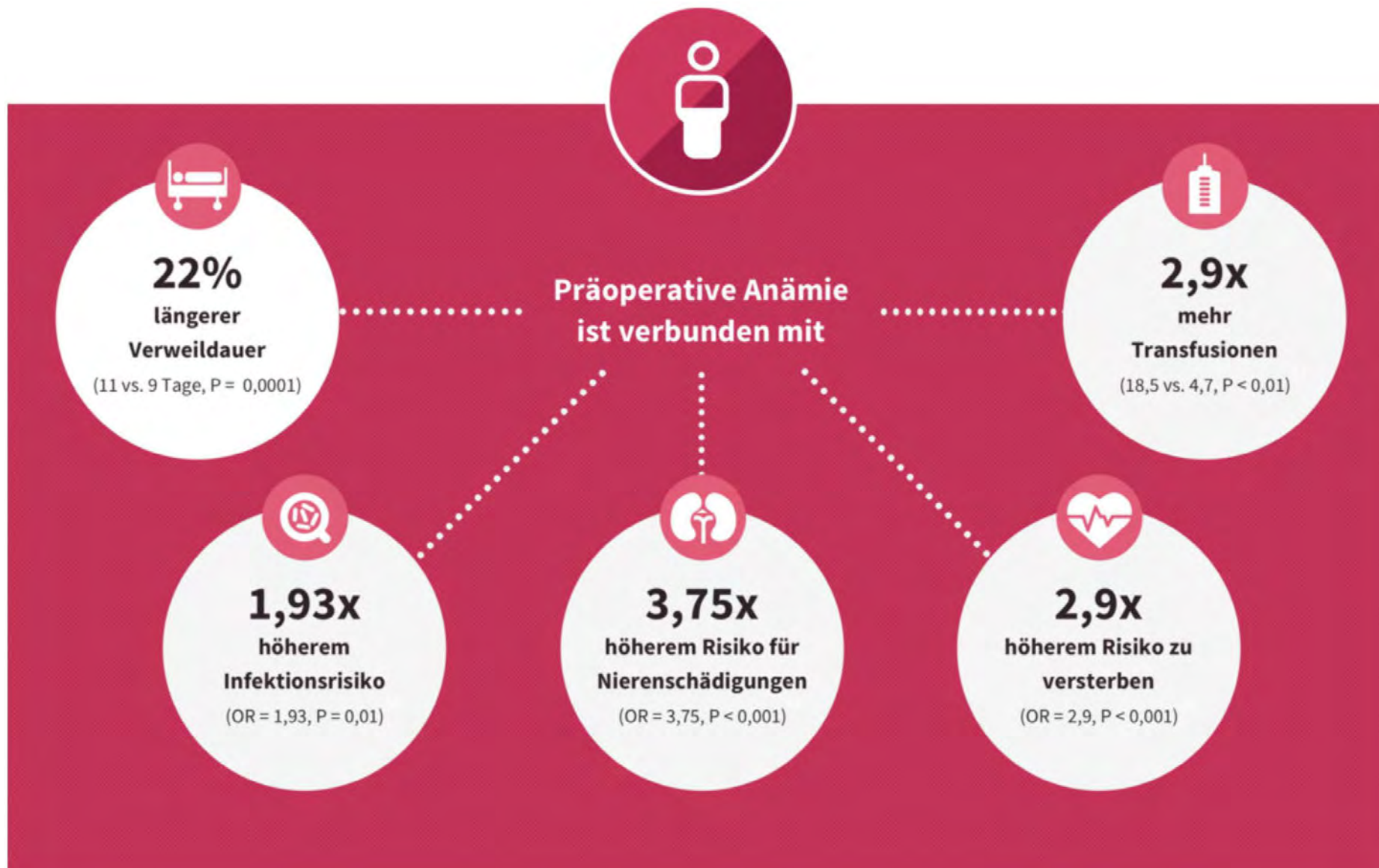
- ◆ 730 patients undergoing cardiac surgery
- ◆ Iron deficiency = ferritin < 100 ng/ml
- ◆ Anemia
  - ⇒ Hb < 130 g/l in man
  - ⇒ Hb < 120 g/l in women
- ◆ Outcome
  - ⇒ Mortality
  - ⇒ SAEs
  - ⇒ MACCEs
  - ⇒ Transfusion of RBC, FFP, platelets
  - ⇒ LOS



3-fach ↑



**Fig 2.** Frequency graphs. Bar graphs showing the frequency of (a) 90-day mortality, (b) serious adverse events, and (c) major adverse cardiac and cerebrovascular events (MACCE). The frequencies in the four groups are shown in percent with 95% Wilson confidence intervals. Group differences for iron deficiency adjusted for anaemia are significant: (a)  $P=0.004$ , (b)  $P=0.001$ , and (c)  $P=0.017$ .

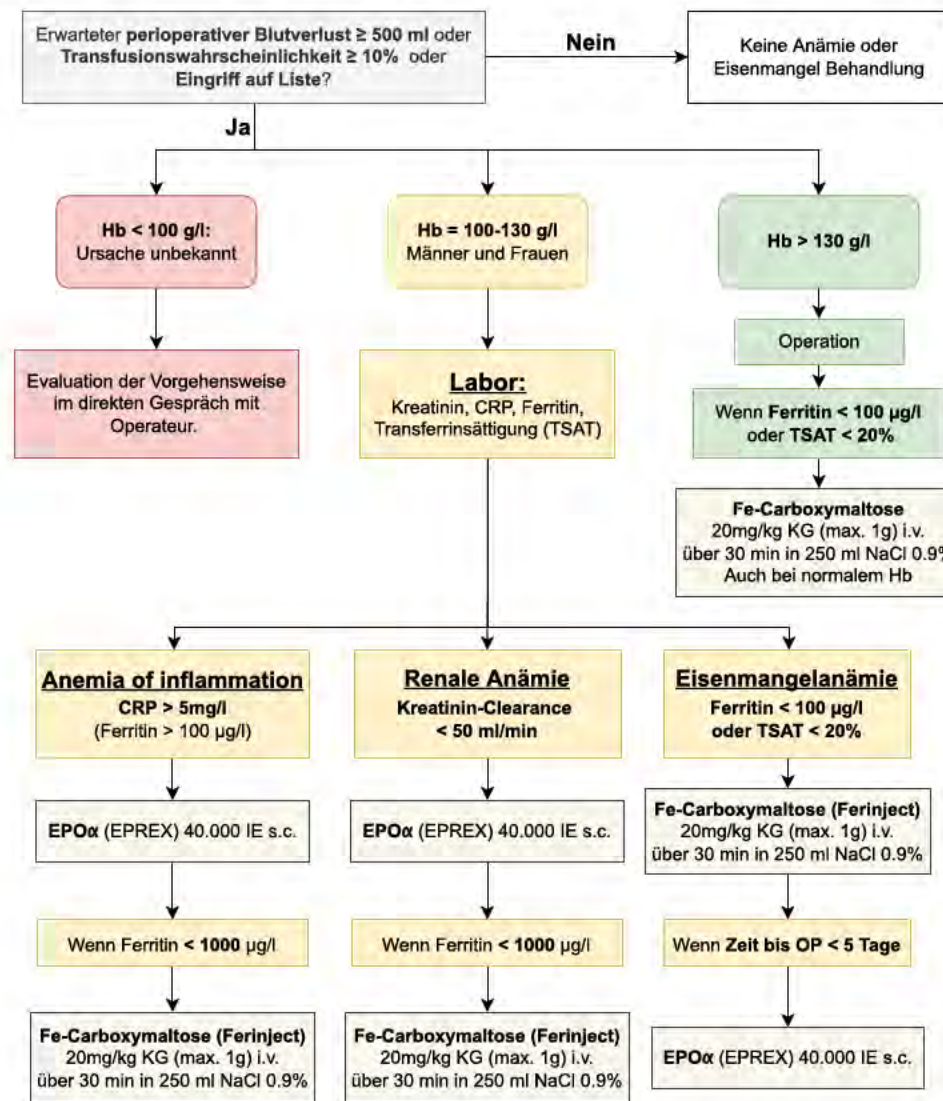




# Anämietherapie



Behandlung präoperative Anämie (Hb < 130 g/l) und Eisenmangel (Ferritin < 100 µg/l oder TSAT < 20%)  
Universitätsspital Zürich

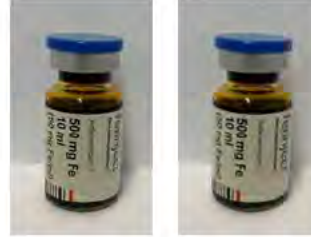


- Zu jeder Anämie Behandlung zusätzlich verabreicht werden:  
+ **Vitamin B12** (Vitarubin) 1 mg einmalig s.c.  
+ **Folsäure** (Acidum folicum Streuli) 5mg einmal täglich p.o. bis zur Operation  
- Bei Unklarheiten Patient Blood Manager kontaktieren. Tel.: 043 253 90 36



# Kosten

Ferinject



2x 177.40

EPREX



383.60

Vitamin B12



1.90

Folsäure



5.25

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

- 505 herzchirurgische Patienten (CABG, valve and combination)
  - Anämie (n = 253)
  - Isolierter Eisenmangel (n = 252)
- Stratifizierung
  - Art der OP (CABG, valve or CABG-valve)
  - Primary vs. re-do surgery
  - On- vs. off-pump ACPB
  - Duale Plättchenhemmung
- Behandlung vs. Placebo
  - Erythropoitin alpha 40'000 units s.c.
  - 20 mg/kg ferric carboxymaltose (max. 1'000 mg) in 250 ml saline in 30 min iv
  - Vit B 12, 1 mg s.c.
  - Folic acid 5 mg po

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

	Treatment (n=243)	Placebo (n=241)	p value
RBC units transfused in first 7 days	..	..	0.036
Mean (SD)	1.5 (2.7)	1.9 (2.9)	..
Median (IQR)	0 (0-2)	1 (0-3)	..
Distribution, n (%)			
0	135 (56%)	114 (47%)	..
1	31 (13%)	27 (11%)	..
2	33 (14%)	38 (16%)	..
3	10 (4%)	23 (10%)	..
4	12 (5%)	11 (5%)	..
≥5	22 (9%)	28 (12%)	..

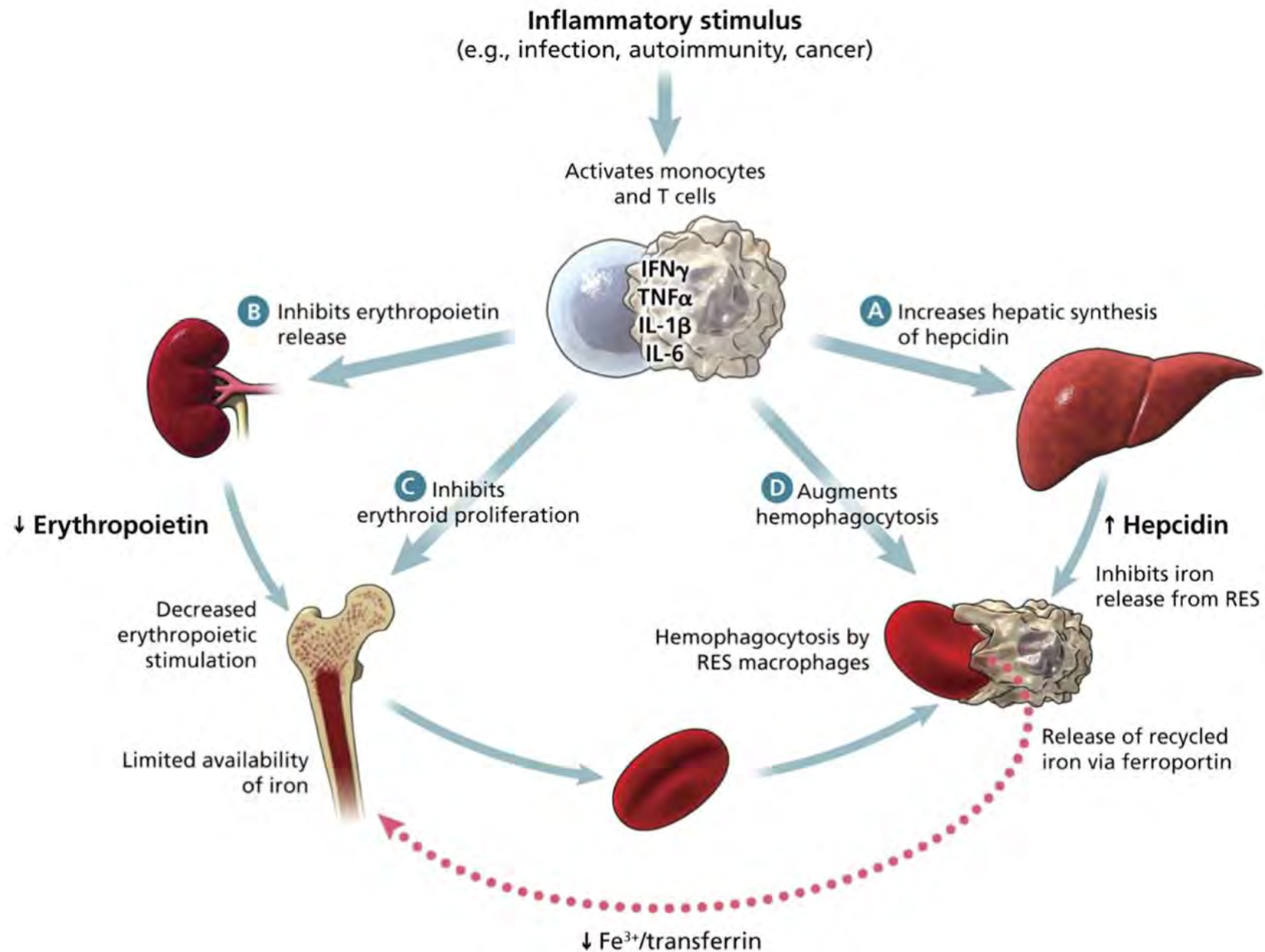
RBC units transfused in day 0 to POD 90	..	..	0.018
Mean (SD)	1.7 (3.2)	2.3 (3.3)	..
Median (IQR)	0 (0-2)	1 (0-3)	..
Distribution, n (%)			
0	129 (53%)	107 (44%)	..
1	28 (12%)	23 (10%)	..
2	37 (15%)	39 (16%)	..
3	13 (5%)	25 (10%)	..
4	12 (5%)	9 (4%)	..
≥5	24 (10%)	38 (16%)	..

	Treatment group (n=243)	Placebo group (n=241)	p value
Patients transfused (≥1 RBC), first 7 days	108 (44%)	127 (53%)	0.084
Combined allogeneic transfusions (≥1 RBC or ≥1 TC or ≥1 FFP), first 7 days	111 (46%)	129 (54%)	0.10
Length of stay in ICU (days)	..	..	0.33
Mean (SD)	3.5 (7.8)	2.7 (5.2)	..
Median (IQR)	1 (0.9-2.0)	1 (0.9-2.0)	..
Length of stay in hospital (days)	..	..	0.73
Mean (SD)	12.0 (9.7)	12.3 (11.0)	..
Median (IQR)	8.8 (6.9-12.9)	8.9 (6.9-13.7)	..
Duration of mechanical ventilation (h)	..	..	0.95
Mean (SD)	28.1 (79.3)	20.8 (56.3)	..
Median (IQR)	5.7 (3.7-9.2)	5.5 (3.9-10.6)	..
MACCE	23 (10%)	21 (9%)	0.88
Allergy	5 (2%)	2 (1%)	0.45
Angina	4 (2%)	4 (2%)	1.00
Myocardial infarction	1 (0%)	6 (3%)	0.068
Maximum postoperative hs troponin until POD 2 (g/L)	..	..	0.40
Mean (SD)	1259 (2654)	1259 (2383)	..
Median (IQR)	571 (222-1110)	578 (293-1230)	..
Stroke	6 (3%)	6 (3%)	1.00
Acute kidney injury	22 (9%)	18 (8%)	0.62
Dialysis	15 (6%)	8 (3%)	0.20
Atrial fibrillation	43 (18%)	52 (22%)	0.30
Infection	88 (36%)	77 (32%)	0.34

# Preoperative Inflammation

Operation	C-reactive Protein threshold	Percent inflammation (CRP > x)
Colorectal cancer surgery	10 mg/L	34%
Colorectal cancer surgery	7 mg/L	50%
Colorectal cancer surgery	8 mg/L	31%
Esophageal cancer surgery	10 mg/L	37%
Pancreatic cancer surgery	3 mg/L	50%
Liver cancer surgery	10 mg/L	28%
Ovarian cancer surgery	10 mg/L	50%





# Eisendynamik bei Inflammation

		Entnahme Eingang Befund-Nr.	25.02.2022-05:00 25.02.2022-09:15 Q202250419	24.02.2022-05:00 24.02.2022-09:07 Q202240376	23.02.2022-08:30 23.02.2022-08:53 Q202230320
<b>BLUTSTATUS</b>					
<b>Blutstatus</b>					
Hämoglobin	117-153	g/l	126	124	143
Hämatokrit	0.350-0.460	l/l	0.375	0.379	0.414
Erythrozyten	3.9-5.2	(l) T/l	4.19	4.19	4.75
MCV	80-100	fl	89.5	90.5	87.2
MCH	26-34	pg	30.1	29.6	30.1
<b>Entzündung</b>					
CRP (C-reakt.Prot.)	< 5	mg/l	16 *	34 *	35 *
<b>Eisenstoffwechsel</b>					
Eisen	7.0 - 26.0	µmol/l	13.0 (2)	5.4 * (2)	3.4 * (2)
Ferritin (ECLIA)	(ll) 13 - 300	µg/l	276 (2)	229 (2)	168 (2)
Ferritin bei Risiko (ECLIA)	> 100	µg/l	276 (2)	229 (2)	168 (2)
Transferrin	25 - 50	µmol/l			
Transferrin	25 - 50	µmol/l	24 * (2)	22 * (2)	29 (2)
Transferrin-Sättigung	15 - 50	%	27 (2)	12 * (2)	6 * (2)
TSAT bei Risiko	>20	%	27 (2)	12 * (2)	6 * (2)

# The role of iron in chronic inflammatory diseases: from mechanisms to treatment options in anemia of inflammation

Disease	Anemia prevalence	AI / Inflammation Hepcidin ↑
CKD	21-62%	++
IBD	~67%	+++
Autoimmune disease	30-60%	+++
Cancer	40-80%	+++
Lung disease (COPD)	7-33%	+++
CHF	30-50%	++
Infectious disease		+++



## Review Series

I

### IRON METABOLISM AND ITS DISORDERS

## Anemia of inflammation

Guenter Weiss,<sup>1,2</sup> Tomas Ganz,<sup>3</sup> and Lawrence T. Goodnough<sup>4,5</sup>

- ◆ Iron deficiency / reduced iron availability
- ◆ EPO response to anemia ↓
- ◆ Erythroid cell differentiation ↓
- ◆ RBC life span ↓

Table 1. Disease groups in which AI is common

Disease group
Cancer and hematological malignancies
Infections
Immune-mediated diseases
Inflammatory diseases
Chronic kidney disease
Congestive heart failure
Chronic pulmonary disease
Obesity
Anemia of the elderly
Anemia of critical illness (accelerated course)



# Erfolg der präoperativen Anämiebehandlung

Operation	Iron deficiency anemia	Benefit
Colorectal cancer surgery	F<30 or F<100+TSAT<20%	RBC↓, LOS↓, finance↑
Major abdominal surgery *	F<300 or TSAT<25%	RBC↓, LOS↓
Cardiac surgery * EPO+iv Iron	Anemia WHO	RBC↓, AKI↓
Cardiac surgery * EPO+iv Iron	F<100 or TSAT<30%	RBC↓
Cardiac surgery * EPO+iv Iron+VitB12+FA	Anemia WHO or F<100	RBC↓
Major orthopedic surgery * EPO +/- iv Iron	Anemia WHO	RBC-production↑

# Conclusion 1

- Eine **präoperative Anämie** ist assoziiert mit:
  - Mortalität ↑
  - Morbidität ↑
  - RBC Transfusion ↑
  - Aufnahme IPS ↑
  - Länge des Spitalaufenthaltes ↑
- Eine **präoperative Anämie** muss und/oder ein **isolierter präoperativer Eisenmangel** (d. h. ohne Anämie) muss frühzeitig erkannt und präoperativ behandelt werden

# Blutungsprävention

Petechiale Blutungen  
Schleimhautblutungen

thrombozytär

Flächenhafte Blutungen  
Weichteilblutung  
Gelenkblutung

plasmatisch

Nachbluten

von Willebrand, F XIII

Gefässfaktoren

# Strukturierte Gerinnungsanamnese

Präoperative Bestimmung globaler Gerinnungstests schliessen Gerinnungsdefekte nicht sicher aus.

Sorgfältige, strukturierte Anamnese hat eine höhere Sensitivität und Spezifität für die Aufdeckung bis dahin unbekannter Störungen der Blutgerinnung als eine routinemässig durchgeführte Bestimmung von Quick, PTT und Thrombozytenzahl.

<b>Fragebogen zur Detektion einer Blutungsneigung (Erwachsene)</b>				
Bitte Zutreffendes ankreuzen, unterstreichen, bzw. ergänzen:		<input type="checkbox"/> N Nein	<input type="checkbox"/> J Ja	<b>Zusatzfragen u. Notizen des Arztes:</b>
1	Ist bei Ihnen jemals eine <b>Blutungsneigung</b> oder <b>Thrombose</b> festgestellt worden?	<input type="checkbox"/> N	<input type="checkbox"/> J	<input type="checkbox"/> JA (2)
2	Beobachten Sie folgende <b>Blutungsarten</b> - auch ohne erkennbaren Grund?			<b>pos. Blutungs-Anamnese</b>
2a	<b>Nasenbluten</b> (ohne andere Ursachen wie Schnupfen, trockene Luft, starkes Nasenputzen etc.)	<input type="checkbox"/> N	<input type="checkbox"/> J	<input type="checkbox"/> immer (2) <input type="checkbox"/> nur saisonal (0) <input type="checkbox"/> bei Medikamenteneinnahme (1) <input type="checkbox"/> arterielle Hypertonie? (4) <input type="checkbox"/> HNO-Ursache? (3)
2b	<b>blaue Flecken</b> oder punktförmige Blutungen (auch am Körperstamm; auch ohne sich anzustoßen)	<input type="checkbox"/> N	<input type="checkbox"/> J	<input type="checkbox"/> unfallträchtige Tätigkeiten? (0) <input type="checkbox"/> immer schon oder ab wann? (2) <input type="checkbox"/> bei Medikamenteneinnahme (1)
2c	<b>Gelenksblutungen, Blutungen in Weichteile oder Muskel</b>	<input type="checkbox"/> N	<input type="checkbox"/> J	<input type="checkbox"/> JA (2)
3	Beobachten Sie bei Schnittwunden und/oder Schürfwunden ein längeres <b>Nachbluten</b> ?	<input type="checkbox"/> N	<input type="checkbox"/> J	<input type="checkbox"/> > 5 Minuten (2) <input type="checkbox"/> bei Nassrasur etc.? (2) <input type="checkbox"/> bei Medikamenteneinnahme (1)
4	Gab es in der Vorgeschichte <b>längeres / verstärktes Nachbluten</b> beim Zahnziehen?	<input type="checkbox"/> N	<input type="checkbox"/> J	<input type="checkbox"/> Nachbehandlung nötig? (5,2) <input type="checkbox"/> bei Medikamenteneinnahme (1)
5	Gab es in der Vorgeschichte eine <b>verstärkte Blutung</b> während oder nach Operationen?	<input type="checkbox"/> N	<input type="checkbox"/> J	<input type="checkbox"/> welche Operationen? (5) <input type="checkbox"/> Blutung nicht chirurgisch (2)
6	Heilen <b>Wunden</b> schlecht ab?	<input type="checkbox"/> N	<input type="checkbox"/> J	<input type="checkbox"/> lange nässend, klaffend? (2) <input type="checkbox"/> Neigung zur Kelloidbildung? (2)
7	Gab / gibt es in der Familie (Blutsverwandtschaft) Fälle von <b>Blutungsneigung</b> ?	<input type="checkbox"/> N	<input type="checkbox"/> J	<input type="checkbox"/> Verwandtschaftsgrad (2) <input type="checkbox"/> Diagnose bekannt? (2)
8a	Nehmen Sie <b>Medikamente zur Blutverdünnung</b> ein? VKA: Sintrom®, Marcoumar® XABANE: Eliquis®, Lixiana®, Xarelto® DTI: Pradaxa® API: ASS, Plavix®, Efigent®, Brilique®)	<input type="checkbox"/> N	<input type="checkbox"/> J	<input type="checkbox"/> Angabe der Medikamente (1) <input type="checkbox"/> Blutungsneigung bei Medikamenteneinnahme? (2, 4, 6)
8b	Nehmen Sie <b>Schmerz- oder Rheumamittel</b> ein? (z.B. Aspirin®, Thomapyrin®, Voltaren®, Proxen®, Seractil®, etc.)			
8c	Nehmen Sie <b>pflanzliche Präparate</b> oder Vitamin-Präparate ein? (z.B. Tebonin®, Tebofortan®, Ceremin®, Ginsana®, Geriatric-Pharmaton®, Supradyn vital plus®, Zintona®, Kwai® etc.)			
9	<b>Zusatzfrage an Patientinnen:</b> Sind <b>Monatsblutungen</b> verlängert (> 7 Tage) und/oder verstärkt (häufiger Wechsel von Tampons/Binden)?	<input type="checkbox"/> N	<input type="checkbox"/> J	<input type="checkbox"/> seit Menarche? (2)
<b>Konsequenzen</b> (0) keine; (1) Medikamentenanamnese; (2) Konsultation Gerinnungsteam; (3) Konsultation FA für HNO; (4) Konsultation Internist; (5) Befundaushubung; (6) Konsultation Internist/Chirurg - ggf. Karenz / Bridging				
Datum		Arzt		Patient



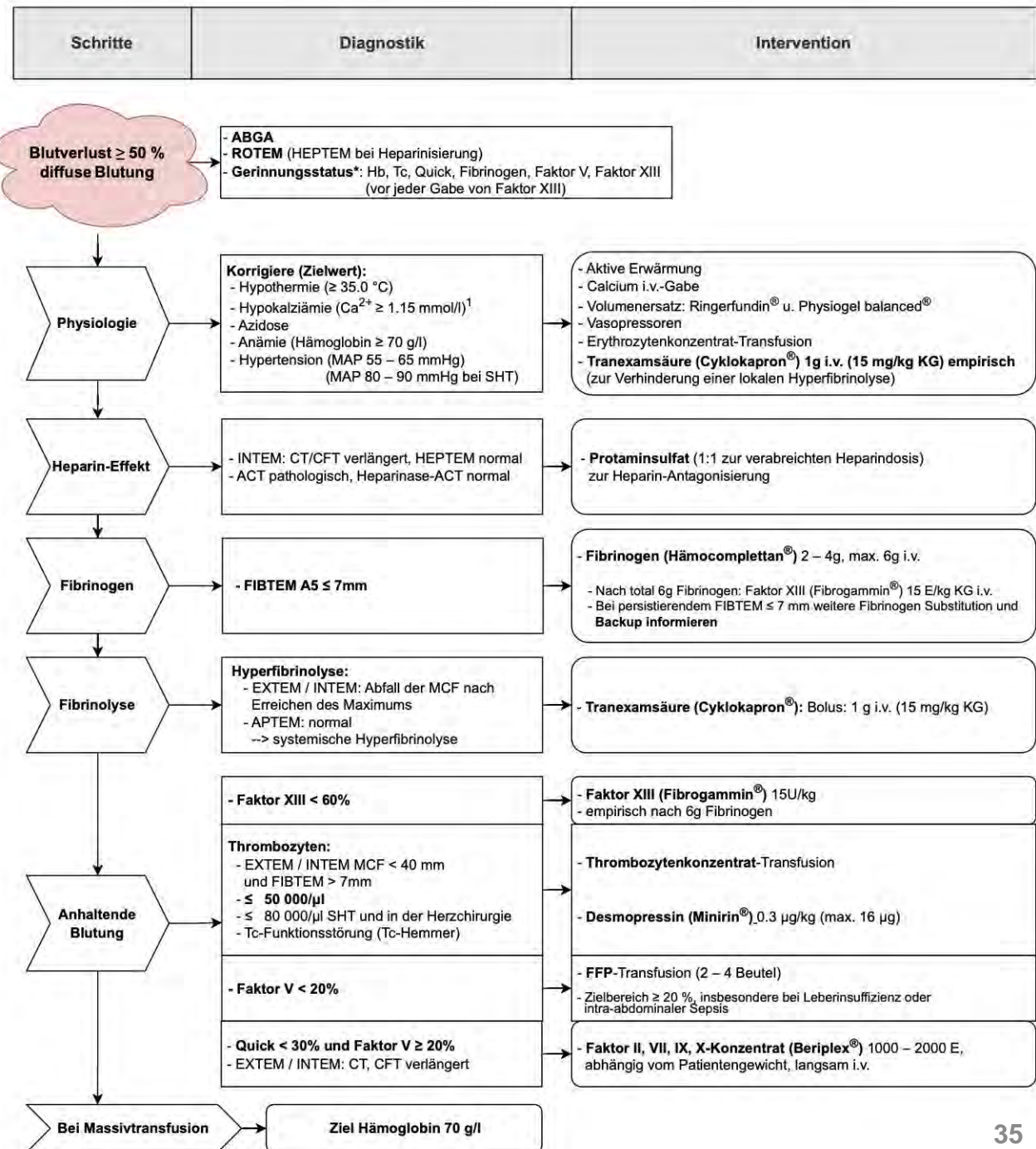
## **2. Säule: Minimierung von Blutverlusten und Blutungen**

# Intraoperative Massnahmen

- Blutungsarme Operationstechniken
- Cellsaver
- Gerinnungsalgorithmus



# Individualisierte, faktorenbasierte, zielgerichtete Gerinnungstherapie

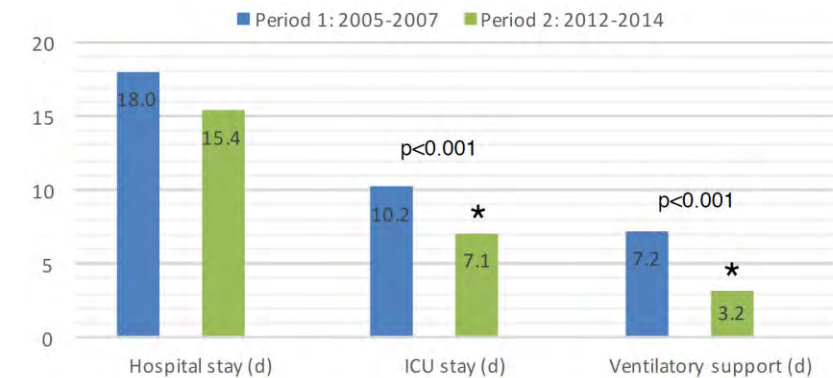
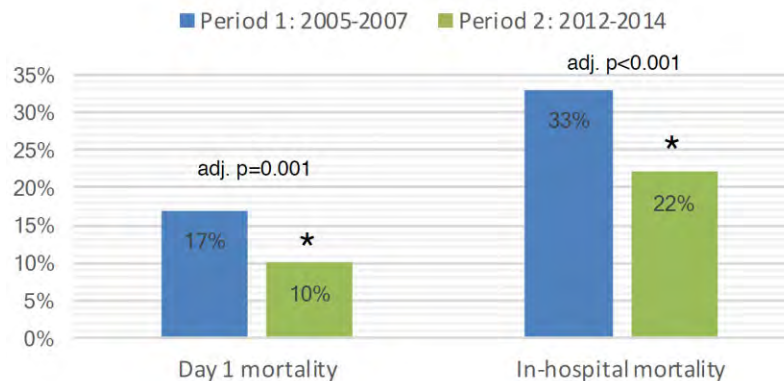
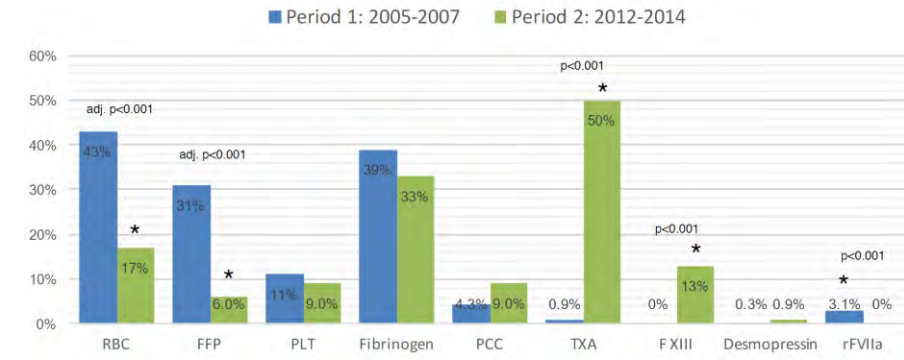
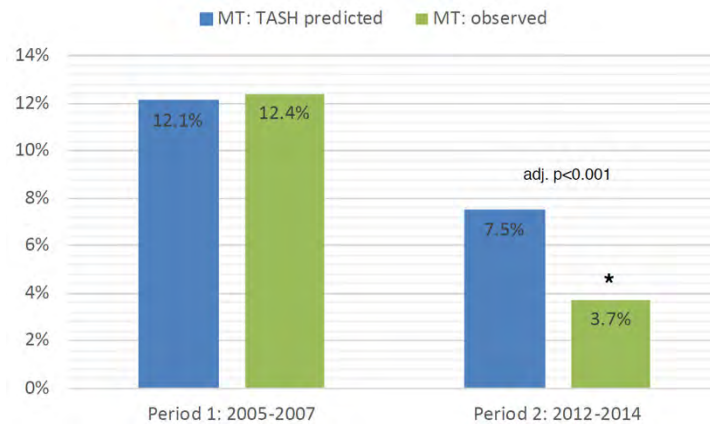
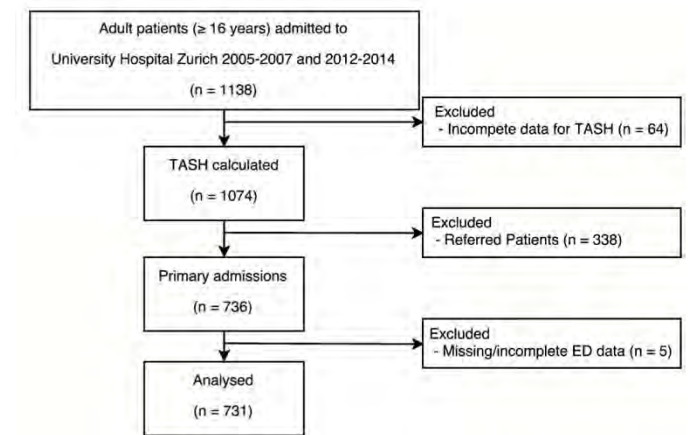




## Original Article

CPD available at <http://www.learnataagbi.org/>

## Change of transfusion and treatment paradigm in major trauma patients

P. Stein,<sup>1</sup> A. Kaserer,<sup>2</sup> K. Sprengel,<sup>3</sup> G. A. Wanner,<sup>4</sup> B. Seifert,<sup>5</sup> O. M. Theusinger<sup>1</sup> and D. R. Spahn<sup>6</sup>

## Effect of a factor-based coagulation management on blood product use after major burn injury: A retrospective cohort study

Sebastian D. Sahli<sup>a,1</sup>, Nadine Pedrazzi<sup>b,1</sup>, Julia Braun<sup>c</sup>, Donat R. Spahn<sup>a</sup>,  
Alexander Kaserer<sup>a,2</sup>, Jan A. Plock<sup>d,e,\*,2</sup>

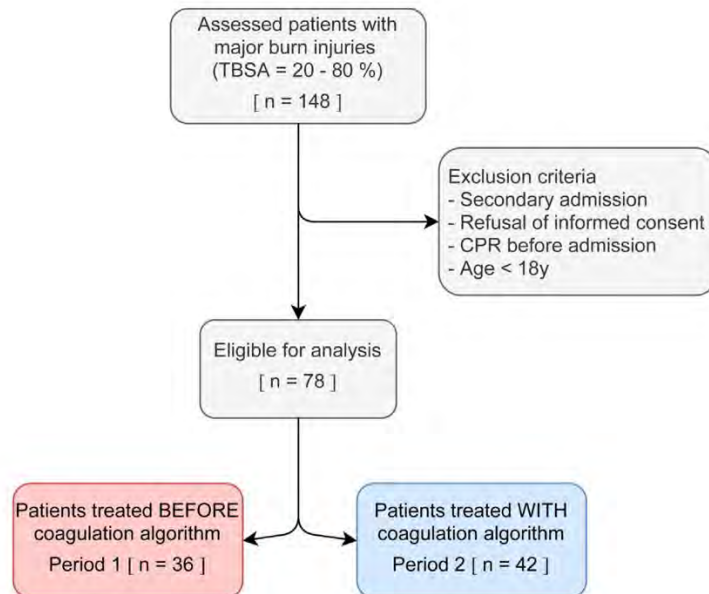


Fig. 2 – Flowchart of patient selection.

**Table 3 – Adjusted models for the comparison of transfused allogeneic blood products and administered coagulation factors between the periods.**

	Coefficient	95% confidence interval	p-value
Allogeneic transfusions			
Red blood cells (units)	−33	−52.8 to −12.9	0.002
Fresh frozen plasma (units)	−9	−14.7 to −2.6	0.006
Platelet concentrate (units)	0	−0.7 to 0.2	0.300
Coagulation factors			
4-factor PCC (IU)	−61	−141.9 to 19.7	0.140
Coagulation factor XIII (IU)	−1211	−2443.7 to 20.9	0.054
Fibrinogen (g)	−1.4	−2.2 to −0.5	0.001

The coefficients represent the difference for the patients treated according to the coagulation algorithm (period 2) in comparison with patients treated before (period 1). The models are adjusted for age, sex, the Abbreviated Burn Severity Index (ABSI) and Charlson Comorbidity Index. Abbreviation: 4-factor PCC, 4-factor prothrombin complex concentrate.

Table 2. Differences in the number of patients receiving allogeneic blood products and coagulation factors between the periods during the length of hospital stay.

	Period 1	Period 2	Odds ratio	p-value
	[n = 36]	[n = 42]	[95% CI]	
Allogenic transfusions				
Red blood cells	26 (72.2%)	23 (54.8%)	0.47 [0.18 to 1.19]	0.11
Fresh frozen plasma	14 (38.9%)	4 (9.5%)	0.17 [0.04 to 0.53]	<0.01
Platelet concentrate	2 (5.6%)	2 (4.8%)	0.85 [0.10 to 7.39]	0.87
Coagulation factors				
4-factor PCC	4 (11.1%)	2 (4.8%)	0.40 [0.05 to 2.18]	0.31
Coagulation factor XIII	17 (47.2%)	17 (40.5%)	0.76 [0.31 to 1.87]	0.55
Fibrinogen	11 (30.6%)	4 (9.5%)	0.24 [0.06 to 0.79]	0.03

Data reported as number and percentage (%). **Period 1** refers to the patient cohort before the introduction and **Period 2** to the cohort treated according to the coagulation algorithm.

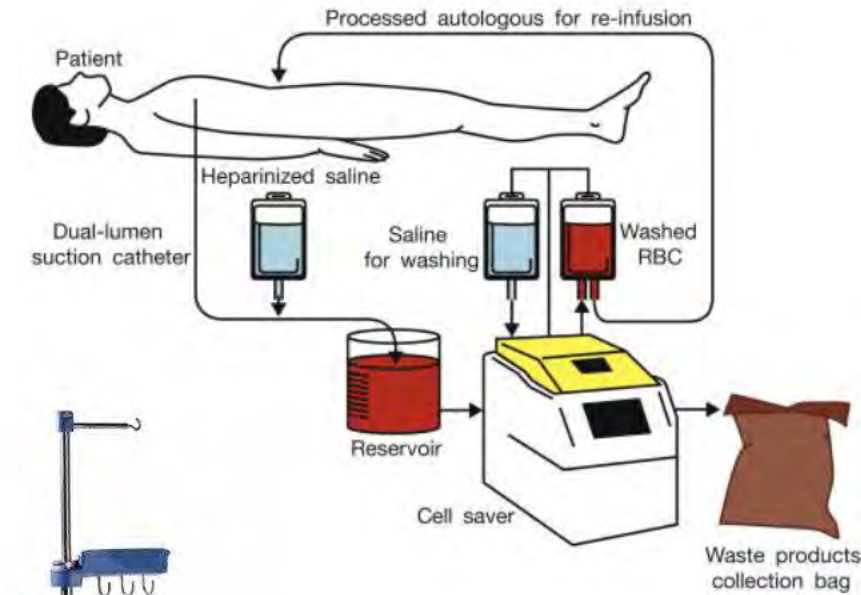
Table 4. Descriptive of complications and outcome of patients treated before and according to the coagulation algorithm.

	Before algorithm	With algorithm	p-value
	Period 1 [n = 36]	Period 2 [n = 42]	
Surgeries (frequency)	4.0 (2.0–9.5)	3.0 (2.0–6.0)	0.33
Multi-organ failure	4 (11.8%)	6 (14.6%)	1.00
Sepsis	15 (44.1%)	16 (39.0%)	0.81
Positive blood culture	17 (50.0%)	18 (43.9%)	0.65
Overall infection rate	21 (61.8%)	17 (41.5%)	0.11
Respiratory	17 (50.0%)	17 (41.5%)	0.49
Skin	18 (52.9%)	12 (29.3%)	0.06
Osteomyelitis	1 (2.8%)	1 (2.4%)	1.00
Abdominal	2 (5.9%)	2 (4.9%)	1.00
Urinary	14 (41.2%)	4 (9.8%)	<0.01
Antibiotic drugs	21 (61.8%)	22 (53.7%)	0.49
Antifungal drugs	14 (38.9%)	6 (14.3%)	0.02
HIT	0 (0%)	3 (7.3%)	0.25
Thrombo-embolic events	5 (14.7%)	7 (17.1%)	1.00
Duration			
Length ICU (days)	22.0 (5.0–48.2)	12.0 (3.0–30.0)	0.13
Length of stay (days)	29.0 (16.5–56.0)	23.0 (11.0–54.0)	0.49
In-hospital mortality	14 (38.9%)	11 (26.8%)	0.33



# Cellsaver

- Insbesondere bei Blutungen im Bauch, Becken oder Thorax
- Senkt Gabe von Fremdblut um bis zu 39%
- Verbesserte Immunfunktion nach Transfusion von patienteneigener gewaschenen Erythrozyten (ICS) im Vergleich zu allogenen Bluttransfusionen
  - Mechanismus der Immunmodulation unklar
- Aufrüsten braucht Personal und Zeit → frühzeitig dran denken!





# Leukozytenfilter

- Filtration auch von Lipiden, Bakterien und Tumorzellen  
→ durch Grösse (40  $\mu\text{m}$ ), Adhäsion, Oberflächenladung, Benetzbarkeit und Oberflächenstruktur
- 99.6 % - 99.9 % Filtrierung von Tumorzellen <sup>1</sup>  
(quantitative Erschöpfung bei rupturierten Tumoren möglich  
→ 2. Filter )
- Empfehlungsgrad IIb für Hochrisikopatienten in USA <sup>2</sup>



# Bestrahlung

- Bestrahlung mit 50Gy Cäsium 137 für 15 Minuten
- Beseitigung von 99.86% aller Tumorzellen (max. 500ml) <sup>3</sup>
- Kein internationaler Standard für die Bestrahlungsdosis von Erythrozyten (USA/FDA: 15-25 Gy, UK: 25-50 Gy) <sup>4</sup>
- Sterilisation: Bestrahlung von Bakterien bis zu 50kGy (50'000 Gy)



# Cellsaver

- Filtration-based autotransfusion device
- Retransfusion von Erythrozyten und Thrombozyten



## Combined Platelet and Red Blood Cell Recovery during On-pump Cardiac Surgery using same™ by i-SEP Autotransfusion Device (i-TRANSEP Study)

First-in-human noncomparative study of a blood and platelet recovery device in 50 adult patients undergoing cardiac surgery with cardiopulmonary bypass



- Hypothesis:**
- Red blood cell recovery >80%
  - Posttreatment hematocrit >40%
  - Removal of >90% heparin
  - Removal of >75% free hemoglobin

**Observed 50 patients:**

- 18 CABG
- 26 valve surgery
- 6 aortic root surgery



	Median (25-75th percentile)
RBC recovery/cycle (%)	86.1 (80.8 - 91.6)
Posttreatment Hct (%)	41.8 (39.7 - 44.2 )
Platelet recovery (%)	52.4 (44.2 - 60.1)
Posttreatment platelet concentration (10 <sup>9</sup> /l)	116 (93 - 146)

In this first-in-human study, the blood and platelet recovery device was able to simultaneously recover and wash both platelets and red blood cells for transfusion during cardiac surgical procedures

Mansour A, et al. ANESTHESIOLOGY, 2023.

### **3. Säule: Rationaler Einsatz von Blutprodukten**





## Transfusion Threshold of 7 g per Deciliter — The New Normal

Paul C. Hébert, M.D., and Jeffrey L. Carson, M.D.

We believe it has become abundantly clear that a transfusion threshold of 7 g per deciliter should become the new normal, recommended in all critically ill patients, including those with severe sepsis and septic shock. To speed up adoption, we should ensure that clinical practice



# Restrictive transfusion strategies are standard today

# Incidence and Impact of a Single-Unit Red Blood Cell Transfusion: Analysis of The Society of Thoracic Surgeons Database

- Database 2010 to 2019 (N=2'151'430)
  - Type of surgery (CABG, aortic valve replacement)
  - 0 RBC: 1'303'988 patients
  - 1 RBC: 206'555 patients
  - >1 RBC: 640'887 patients
- Comparison between patients with 0 vs. 1 RBC transfusions
  - Propensity matching between patients with 0 and 1 RBC transfusion

**TABLE 4 Outcomes of Propensity-Matched Cohort**

Variable	No RBCs	1 Unit of RBCs	P Value
	(n = 206,555)	(n = 206,555)	
Operative mortality	2058 (1.0)	2990 (1.4)	<.001
Stroke	2492 (1.2)	3458 (1.7)	<.001
Sternal wound infection	1070 (0.5)	1343 (0.7)	<.001
Prolonged ventilation	6990 (3.4)	13,305 (6.4)	<.001
New hemodialysis	1816 (0.9)	3703 (1.8)	<.001
Reoperation for bleeding	1064 (0.5)	2685 (1.3)	<.001

Data are presented as n (%). RBC, red blood cells.

# Evidenzbasierte Transfusionstrigger

Patientencharakteristika	Transfusion Trigger
Gesunde Gebärende	Hb < 60 g/L
Patienten mit: Schädelhirntrauma, Verbrennung, GI-Blutung, Sepsis, stabile IPS-Patienten, freie Lappenplastik, vv-ECMO	Hb < 70 g/L
Patienten bei komplexen herzchirurgischen Eingriffen	Hb < 75 g/L
Patienten mit: schwerer KHK, akutem Herzinfarkt, Herzinsuffizienz, Karotisstenose >70%, > 80 Jahre und kardiovaskulärer Krankheit, va-ECMO	Hb < 80 g/L

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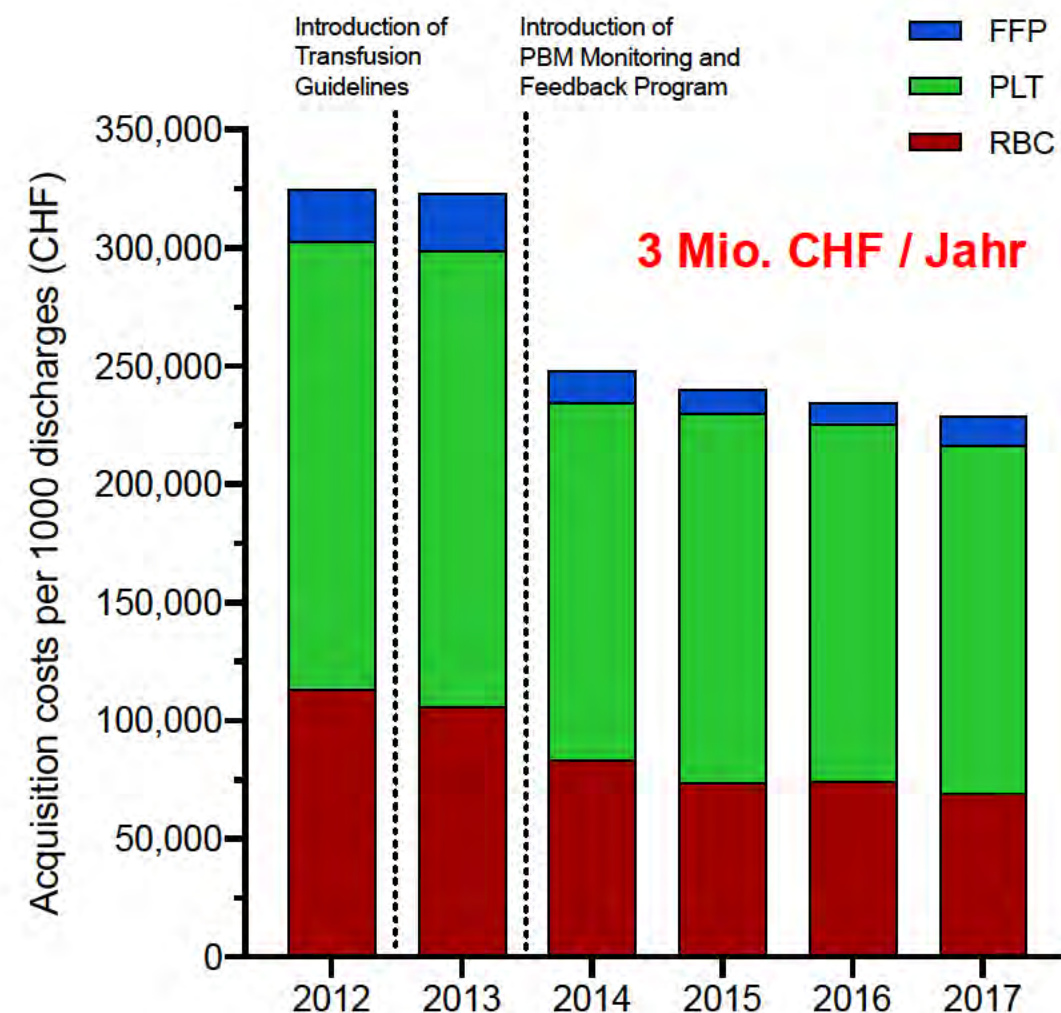
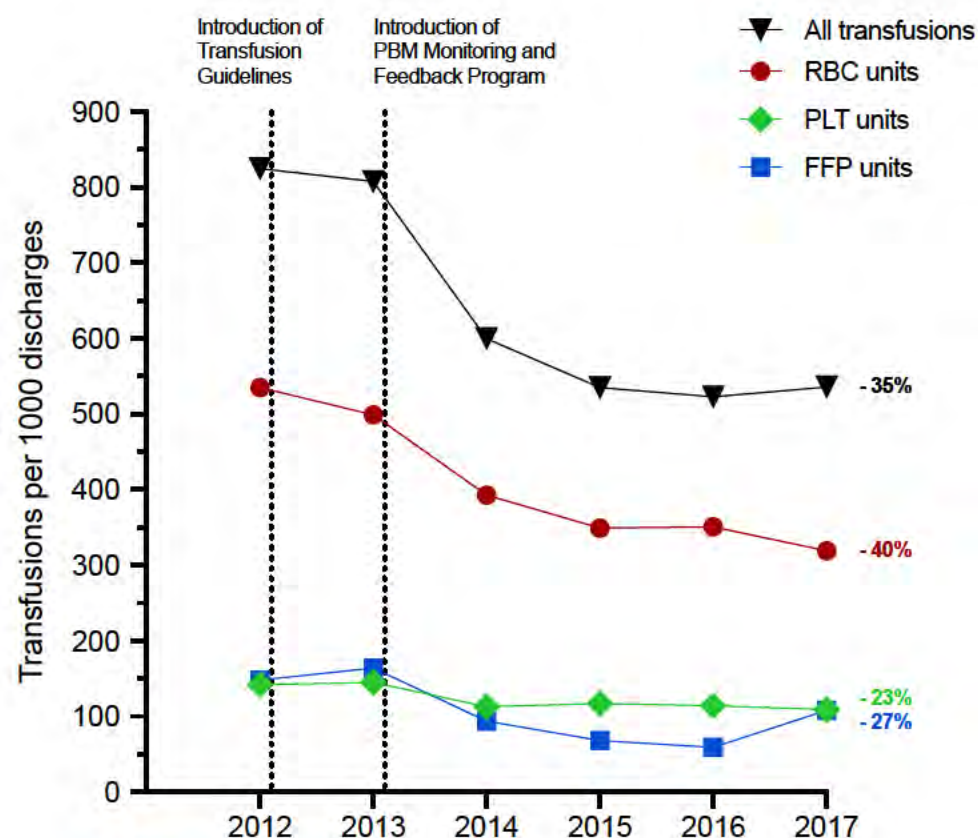
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## Original Article

# Impact of a Patient Blood Management monitoring and feedback programme on allogeneic blood transfusions and related costs

A. Kaserer,<sup>1</sup> J. Rössler,<sup>1</sup> J. Braun,<sup>2</sup> F. Farokhzad,<sup>3</sup> H.-C. Pape,<sup>4</sup> P. Dutkowski,<sup>5</sup> A. Plass,<sup>6</sup> T. Horisberger,<sup>7</sup> J. Volbracht,<sup>8</sup> M. G. Manz<sup>9</sup> and D. R. Spahn<sup>10</sup>

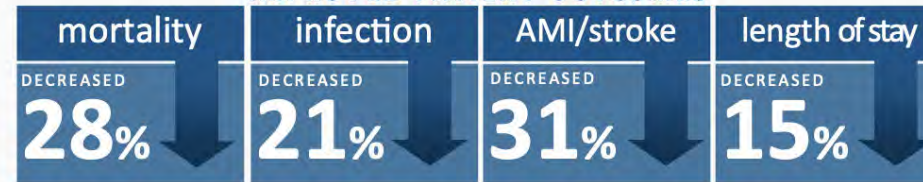




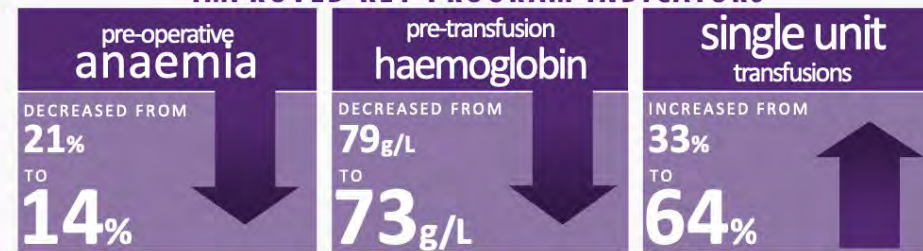
# WESTERN AUSTRALIA PATIENT BLOOD MANAGEMENT PROGRAM

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

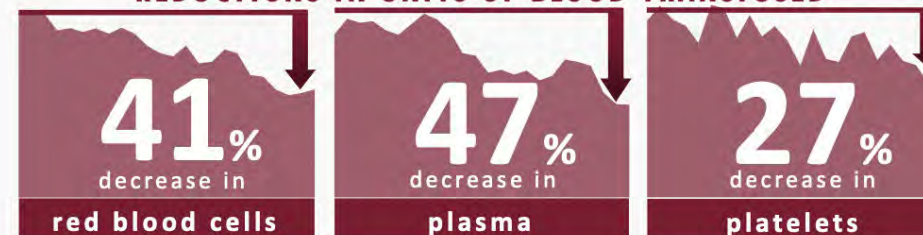
## IMPROVED PATIENT OUTCOMES



## IMPROVED KEY PROGRAM INDICATORS



## REDUCTIONS IN UNITS OF BLOOD TRANSFUSED



## PRODUCT COST SAVINGS

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

**\$18.5M**

## ACTIVITY BASED COST SAVINGS

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

**\$80M – \$100M**

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

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

## *A Systematic Review and Meta-analysis*

- ♦ Meta-Analyse von 17 Studien mit **235,779** Patienten

- ⇒ Pre-PBM: 100,886 Patienten

- ⇒ PBM: 134,893 Patienten

- ♦ Outcomes:

- ⇒ RBC transfusion rate

- ⇒ RBC units transfused

- ⇒ Hospital LOS

- ⇒ Adverse outcomes

- ⇒ Mortality

**TABLE 1.** Benefits of Patient Blood Management

	Change	P	Number of Patients
Transfusion rate	−39%	<0.00001	207,006
RBC unit per patient	−0.43 unit	<0.00001	216,657
Hospital LOS	−0.45 day	<0.00001	219,850
Major complications	−20%	<0.00001	214,298
Acute renal failure	−26%	<0.00001	166,955
Infection rate	−9%	<0.03	192,987
Thromboembolic events	−25%	<0.00001	170,189
Mortality	−11%	<0.02	221,528

LOS indicates length of stay.

# Take Home Messages

- Patient Blood Management (PBM) ist ein multimodales, hoch effizientes Konzept
- PBM muss implementiert werden, um die individuellen und kombinierten nachteiligen Auswirkungen von Anämie, Eisenmangel, Blutverlust und RBC-Transfusionen zu vermeiden
- Die prä- und postoperative Behandlung von Anämie und/oder Eisenmangel mit intravenösem Eisen und Epoetin alpha ist ein Schlüsselement des PBM
- Präoperative Zielwerte der Patienten aus der Fokusgruppe (Transfusionsrate >10% oder erwarteter BV >500 ml): Hämoglobinwert von > 130 g/L (bei Männern und Frauen), Ferritin  $\geq$  100 mg/l und TSAT  $\geq$  20%



An aerial night photograph of a city, likely Zurich, showing several large, multi-story buildings with many lit windows. The scene is illuminated by warm yellow and orange lights from the buildings and streetlights. A large, semi-transparent blue circle is overlaid on the left side of the image, containing white text. The overall atmosphere is urban and vibrant.

**Vielen Dank für die  
Aufmerksamkeit!**

[alexander.kaserer@usz.ch](mailto:alexander.kaserer@usz.ch)