Transfusion en chirurgie cardiaque: hétérogénéité des pratiques Comment y remédier?

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Conflict of Interest Disclosure

In the past 5 years, I have received honoraria or travel support for consulting or lecturing from the following companies:

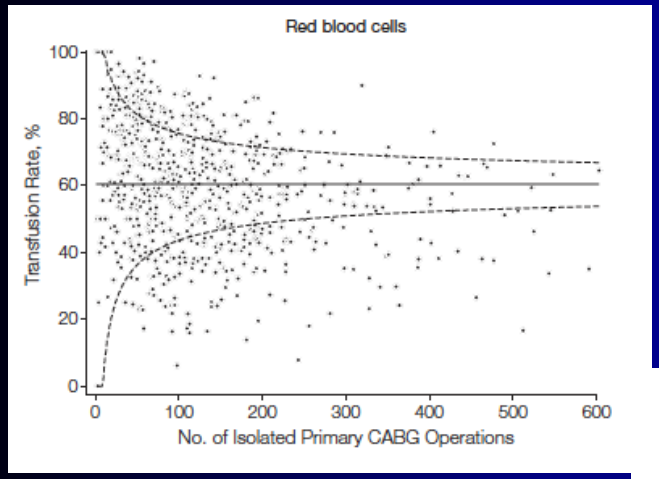
Fresenius-Kabi GmbH

CSL Behring GmbH

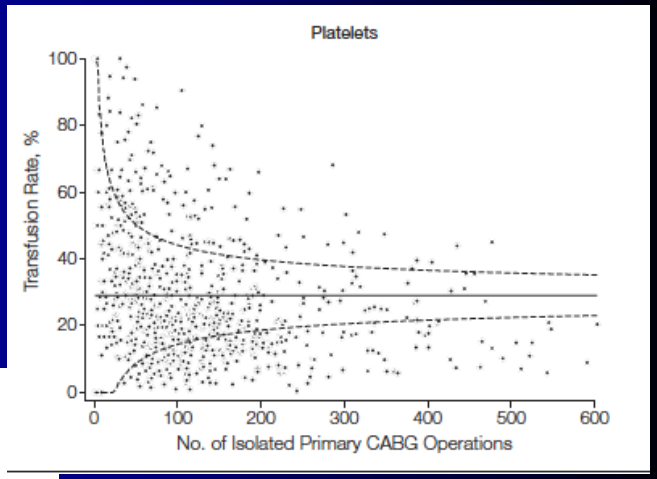
Janssen-Cilag SA

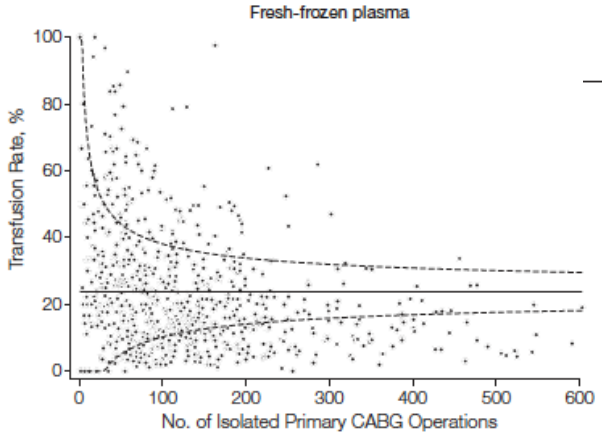
Blood Transfusion in CABG Surgery

✓ Observational cohort study of 102,470 patients undergoing primary CABG under cardiopulmonary bypass in 2008 (798 sites < STS Adult Cardiac Surgery Database)



Hospital specific transfusion rate:
RBC: 8-93%
FFP: 0-98%
Plts: 0-90%





From Bennett-Guerrero E et al. JAMA 304:1568-75, 2010.

Blood Transfusion in CABG Surgery

- ✓ Observational cohort study of 102,470 CABG patients (year 2008; 798 sites< STS Adult Cardiac Surgery Database)
- ✓ Multivariate analysis after adjustment for patient-level risks factors revealed that hospital transfusion rates varied by geographic location, hospital volume and academic status
- ✓ These 3 hospital characteristics combined explained only 11.1% of the variation in hospital risk-adjusted RBC usage
- ✓ Case mix explained 20.1% of the variation between hospitals in RBC usage

From Bennett-Guerrero E et al. JAMA 304:1568-75, 2010.

Independent Predictors of Chest Tube Drainage After Transfusion Cardiac Surgery

- ✓ Retrospective observational cohort study of patients undergoing cardiac surgery with CPB (1/2002-2/2008: N=2,575)
- ✓ Independent chest tube drainage predictors identified through multivariate analysis: individual operating surgeon, internal mammary artery grafting, CPB time, urgency of surgery, tricuspid valve surgery, redo surgery, LV impairment, male gender, low BMI and higher preop Hb

From Dixon B et al. J Cardiothorac Vasc Anesth 28:242-6, 2014.

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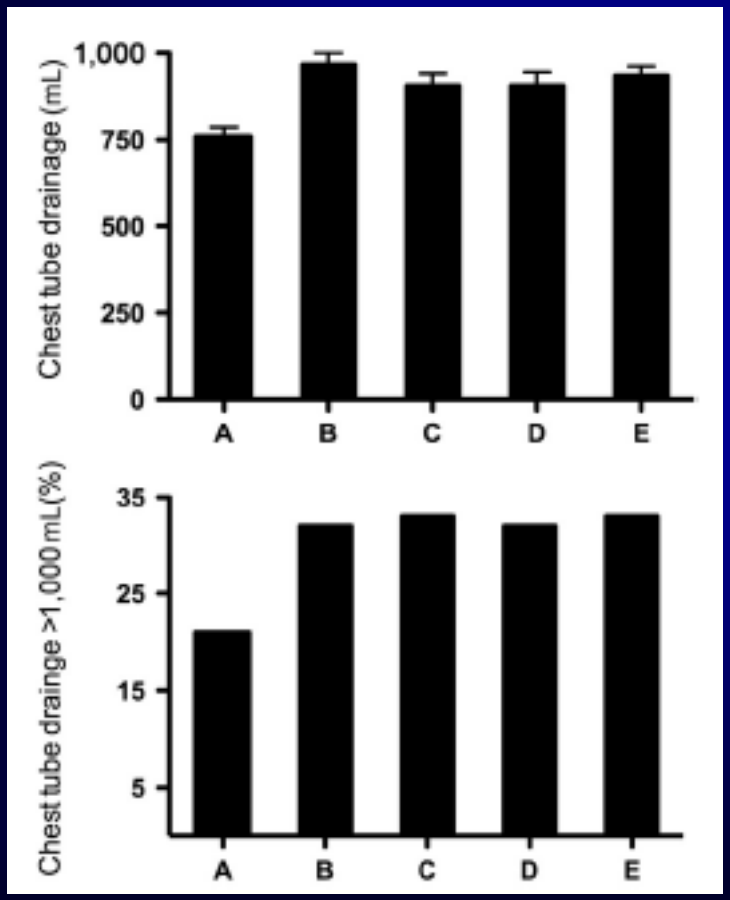
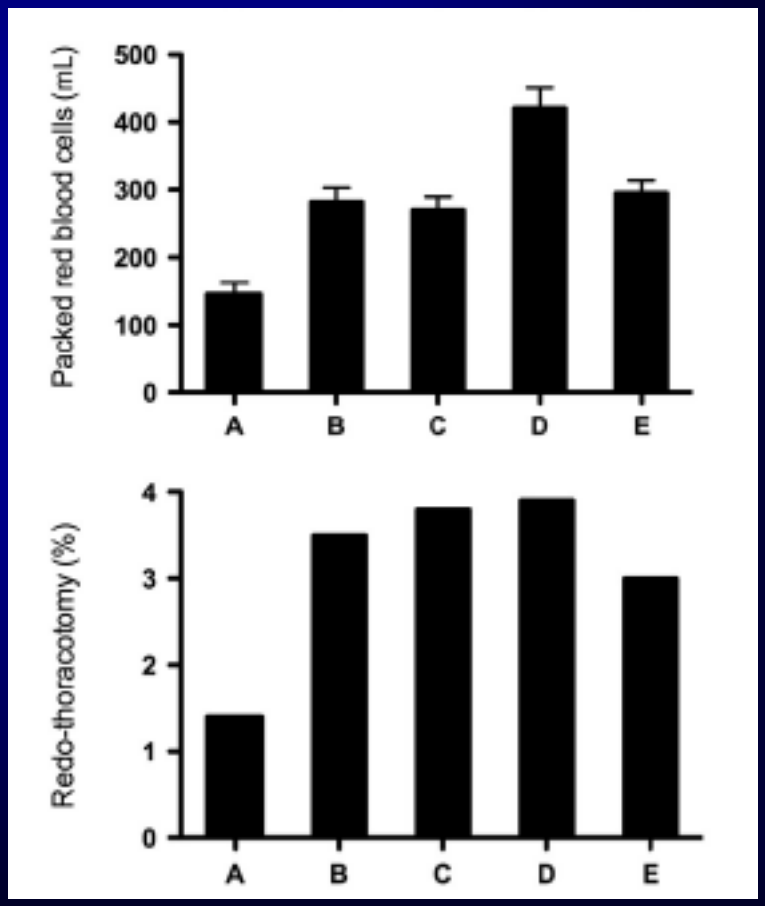




From Dixon B et al. J Cardiothorac Vasc Anesth 28:242-6, 2014.

Effects of Perioperative Blood Transfusion and Blood Conservation in Cardiac Surgery Clinical Practice Guidelines upon Clinical Practices

- ✓ Survey of cardiac anesthesiologists and perfusionists' clinical practice to determine the role the STS and SCA Guidelines had in changing these practices.
- ✓ 1402 surveys from 1061 institutions (32% response rate).
- ✓ 78% of anesthesiologists & 67% of perfusionists reporting having read all, part, or a summary of the Guidelines.

From Likosky DS et al. Anesth Analg 111:316-23, 2010.

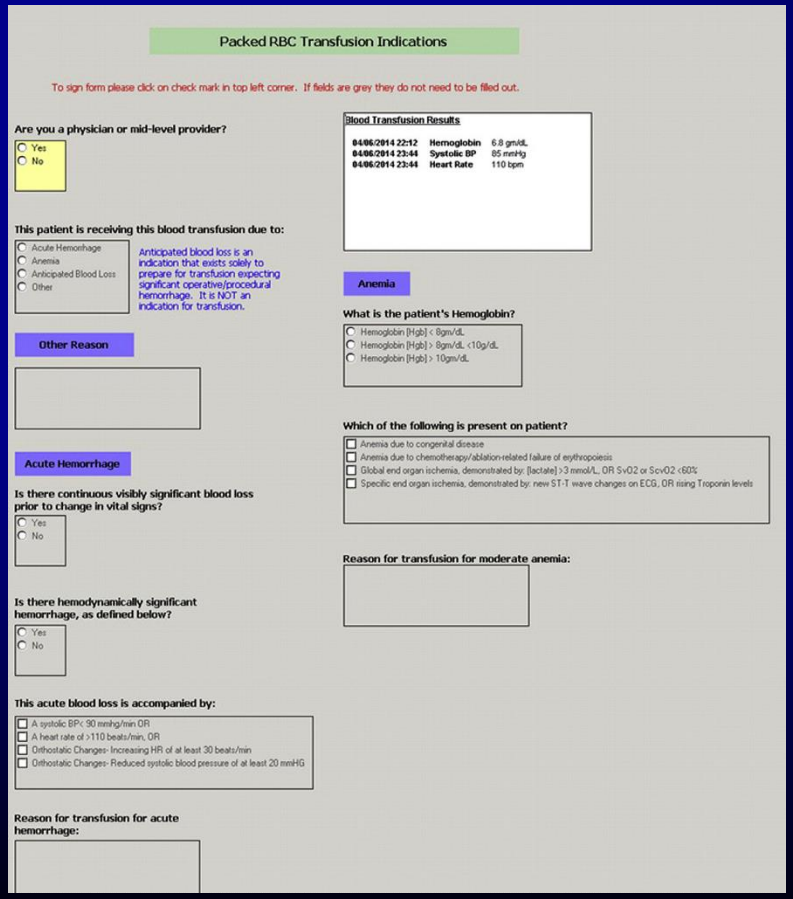
Effects of Perioperative Blood Transfusion and Blood Conservation in Cardiac Surgery Clinical Practice Guidelines upon Clinical Practices

- ✓ 20% of respondents reported that an institutional discussion had taken place and 14% that an institutional monitoring group had been formed
- ✓ 26% of respondents reported 1 or more practice changes in response to the Guidelines. The changes made were reported to be highly (9%) or somewhat (31%) effective in reducing overall transfusion rates
- ✓ 4/38 Guideline recommendations were reported by >5% of respondents to have been changed in response to the Guidelines.

From Likosky DS et al. Anesth Analg 111:316-23, 2010.

RBC Transfusion in Cardiac Surgery: Impact of a Novel Clinical Decision Support Tool

- ✓ Before and after study: implementation of a novel single-view clinical decision support tool within computerized provider order entry coupled with a provider feedback loop



From Razavi SA et al. J Am Coll Surg 219:1028-36, 2014.

RBC Transfusion in Cardiac Surgery: Impact of a Novel Clinical Decision Support Tool

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	Pre-intervention N=744	Post-intervention N=765	P value
Postop RBC transfusion (%)	50	41	<0.001
Postop RBC units	1.6 ± 2.9	1.25 ± 2.5	0.01
Pre-transfusion Hb level (g/dl)	8.1 ± 1.5	7.7 ± 1.4	<0.001

- ✓ No difference in intra-operative transfusions
- ✓ No difference in ICU length of stay and in-hospital mortality

From Razavi SA et al. J Am Coll Surg 219:1028-36, 2014.

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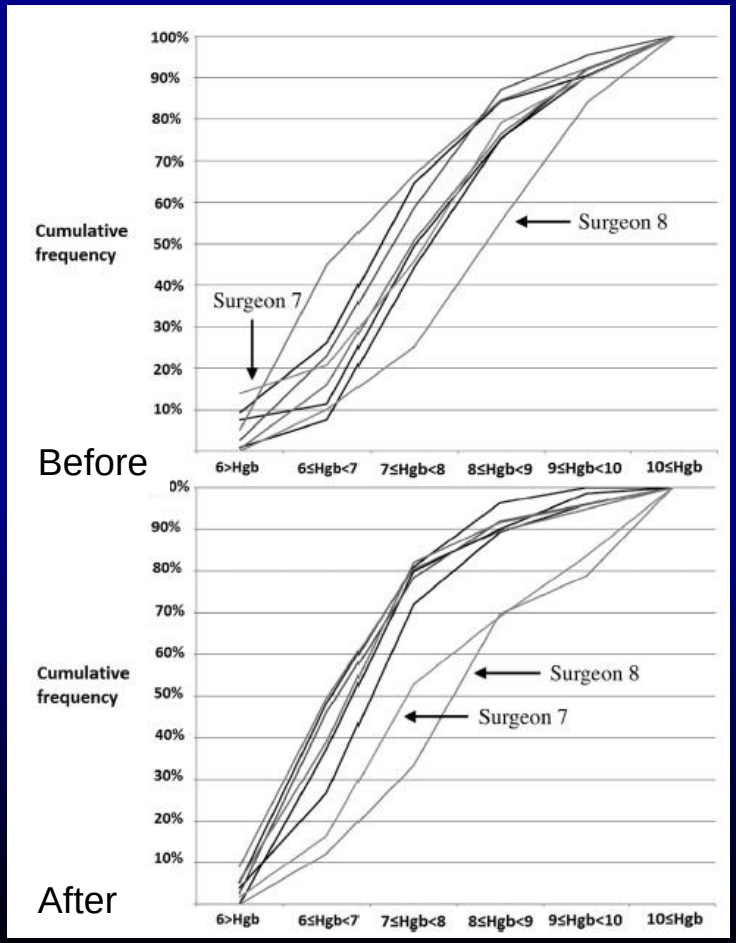
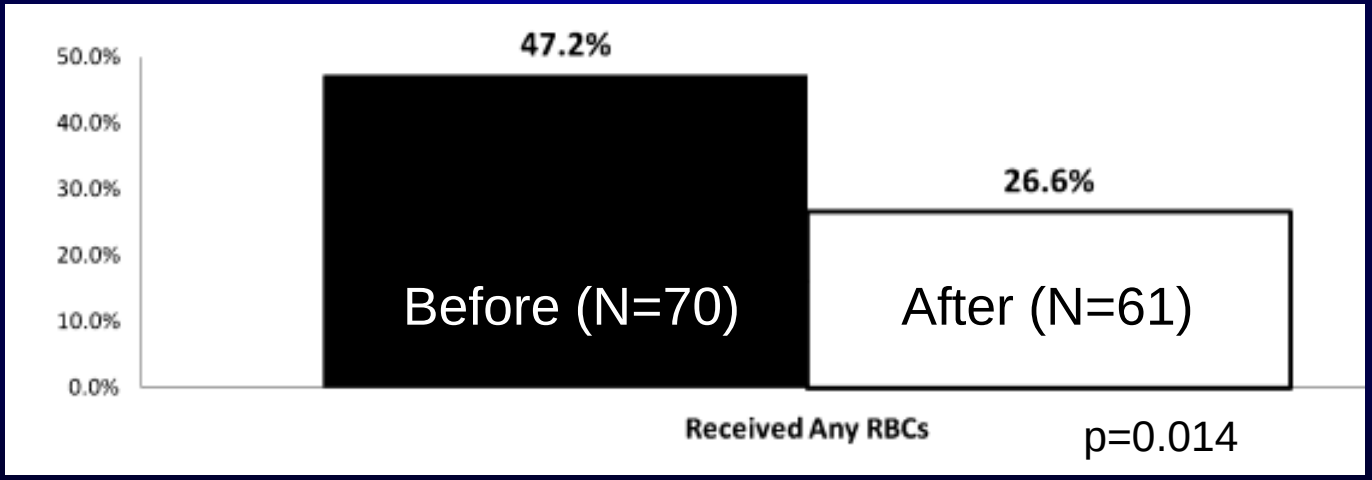


From Razavi SA et al. J Am Coll Surg 219:1028-36, 2014.

Intraoperative Hemoglobin Management in Cardiac Surgery: Impact on RBC Transfusion

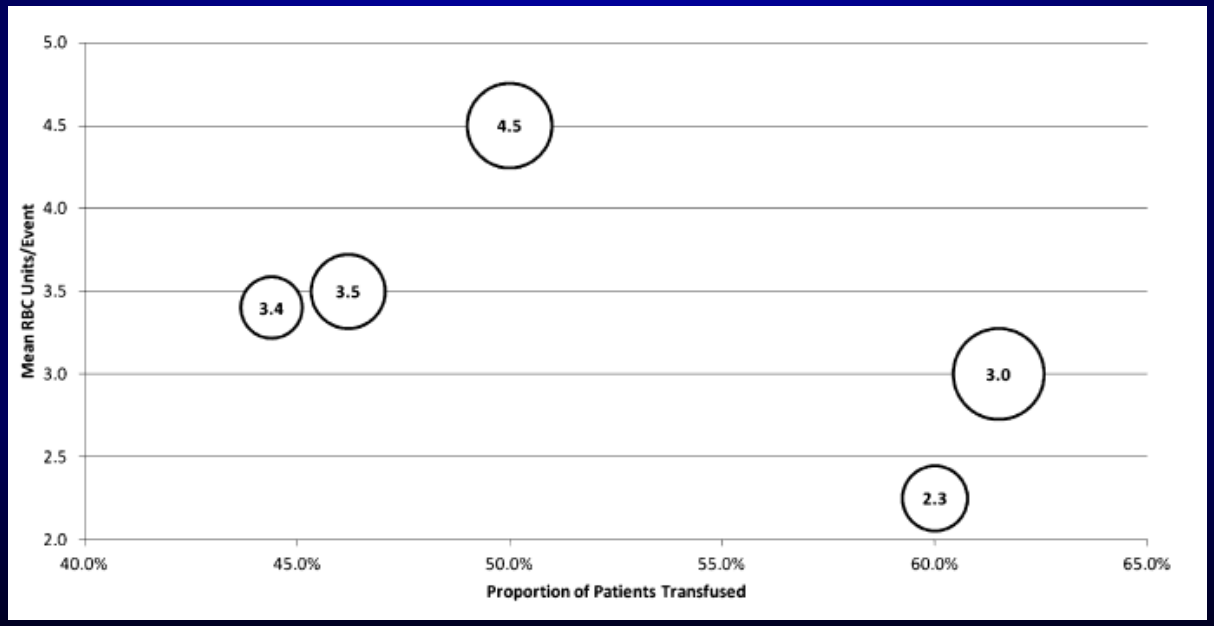
- ✓ Retrospective, before and after study: implementation of measures aiming at reducing hemodilution volume:
  - Decrease in intravenous fluid volume
  - Reduction of CPB circuit size
  - Use of retrograde autologous priming
- ✓ Total IV fluids reduced by 974 ml (672-1276): p<0.001
- ✓ Mean on-pump increase in Hct > 2%



From Tran MH et al. Transfusion 54:2769-74, 2014.

Intraoperative Hemoglobin Management in Cardiac Surgery: Impact on RBC Transfusion

- ✓ Retrospective, before and after study: implementation of measures aiming at reducing hemodilution volume:
  - Decrease in intravenous fluid volume
  - Reduction of CPB circuit size
  - Use of retrograde autologous priming
- ✓ Variability in transfusion rate among anesthesiologists



From Tran MH et al. Transfusion 54:2769-74, 2014.

Comparison of 2 Doses of Tranexamic Acid in Patients Undergoing Cardiac Surgery

- ✓ Multicenter double-blinded randomized study
- ✓ Patients stratified according to transfusion risk
  - Low-dose group: 10 mg/kg + 1 mg/kg.h (N=284)
  - High-dose group: 30 mg/kg + 16 mg/kg.h (N=285)

	Low Dose n = 284	High Dose n = 285	*P* Value
Transfusion during the first week; all patients			
Blood transfusion (yes)	180 (63.4)	170 (59.6)	0.3†
Packed erythrocyte transfusion (yes)	167 (58.8)	160 (56.1)	0.4†
FFP transfusion (yes)	74 (26.1)	53 (18.6)	0.03†
PC transfusion (yes)	64 (22.5)	43 (15.1)	0.02†
Fibrinogen (yes)	8 (2.8)	1 (0.4)	0.02†
Blood products (number of units)	4.10 ± 0.39	2.49 ± 0.38	0.02*
Packed erythrocytes (number of units)	2.14 ± 0.18	1.57 ± 0.18	0.07*
FFP (number of units)	1.07 ± 0.14	0.49 ± 0.14	0.02*
PC (number of units)	1.13 ± 0.15	0.50 ± 0.15	0.02*
Transfusion during the first week; patients transfused			
Packed erythrocytes (number of units)	3.61 ± 0.24	2.81 ± 0.25	0.08*
FFP (number of units)	4.99 ± 0.38	2.90 ± 0.45	0.04*
PC (number of units)	5.45 ± 0.42	4.34 ± 0.53	0.3*

From Sigaut S et al. Anesthesiology 120:590-600, 2014.

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- ✓ Multicenter double-blinded randomized study
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  - High-dose group: 30 mg/kg + 16 mg/kg.h (N=285)

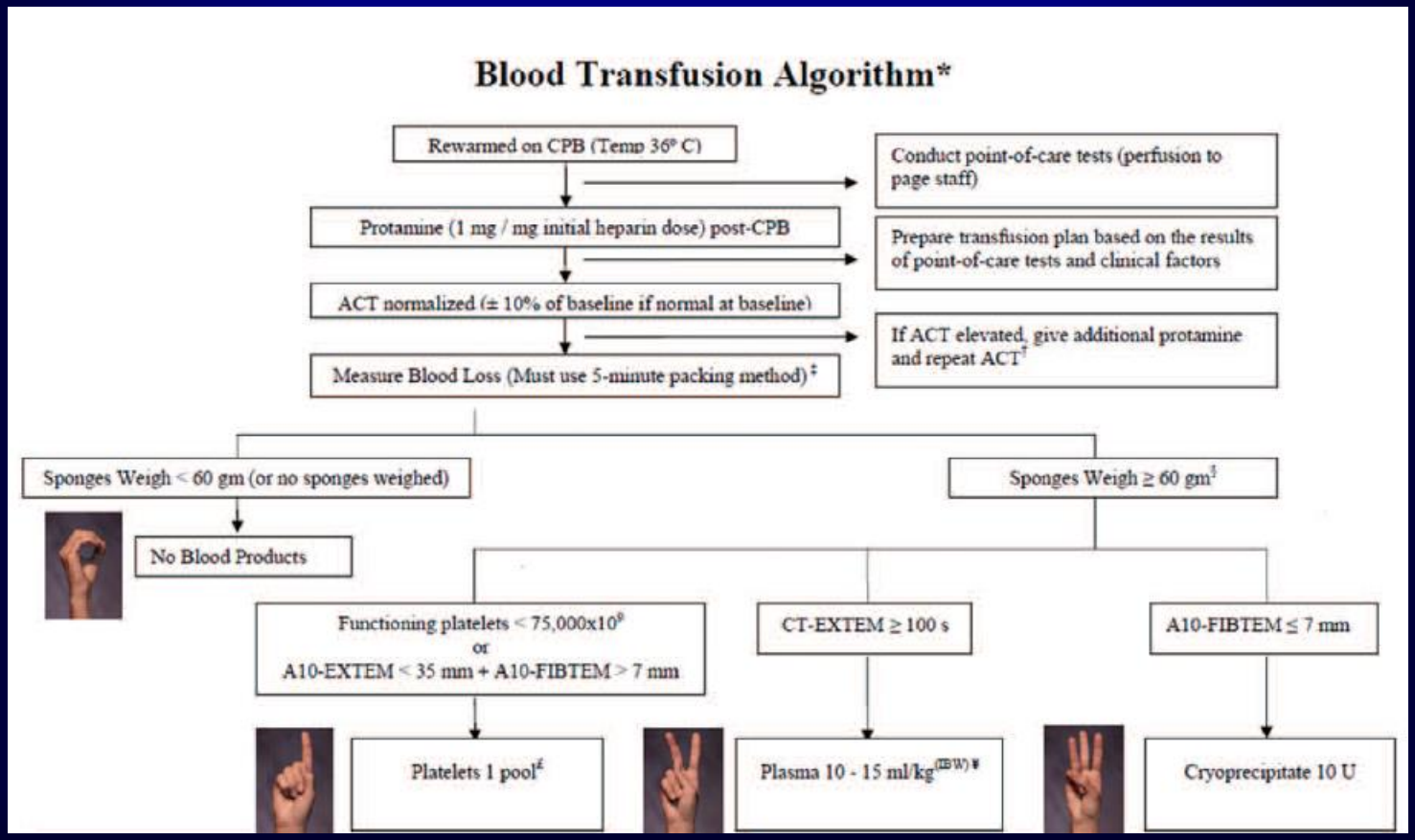
	Low Dose n = 284	High Dose n = 285	*P* Value
Blood loss during day 1 (ml)	820±50.7	590±50.4	0.01*
Return to surgery for hemostasis	17 (6.0)	7 (2.5)	0.03†
Mortality from day 0 to day 7	9 (3.2)	4 (1.4)	0.2†
Mortality from day 0 to day 28	14 (4.9)	8 (2.8)	0.2†

	Low Dose N = 284	High Dose N = 285	*P* Value
Renal dysfunction	57 (20.1)	58 (20.4)	>0.9
Seizures during the first week	2 (0.7)	4 (1.4)	0.7
Seizures up to 28 days	3 (1.1)	5 (1.8)	0.8
Pulmonary embolism	2 (0.7)	1 (0.4)	0.7
Deep venous thrombosis	2 (0.7)	1 (0.4)	0.7
Stroke	9 (3.2)	10 (3.5)	>0.9
Any complication	34 (12.0)	42 (14.7)	0.4

From Sigaut S et al. Anesthesiology 120:590-600, 2014.

Transfusion Algorithm Based on Point-of-care Coagulation Assays in Cardiac Surgery

- ✓ Retrospective, before and after study: institution of a practical POC-based transfusion algorithm



From Karkouti K et al. Anesthesiology 122:560-70, 2015.

Transfusion Algorithm Based on Point-of-care Coagulation Assays in Cardiac Surgery

- ✓ Retrospective, before and after study: institution of a practical POC-based transfusion algorithm

		Prealgorithm (N = 1,311)		Postalgorithm (N = 1,170)	*P* Value
Effectiveness measures					
Erythrocyte transfusions (up to POD-7)	1,311	676 (52%)	1,170	476 (41%)	<0.001
Median number of units (IQR)	676	3 (2–5)	476	2 (1–4)	0.09
Platelet transfusions (up to POD-7)	1,311	448 (34%)	1,170	266 (23%)	<0.001
Median number of units (IQR)	448	5 (5–10)	266	5 (5–10)	0.83
Plasma transfusions (up to POD-7)	1,311	449 (34%)	1,170	167 (14%)	<0.001
Median number of units (IQR)	449	4 (2–6)	167	4 (2–6)	0.35
Cryoprecipitate or fibrinogen concentrate transfusions (up to POD-7)	1,311	53 (4%)	1,170	53 (5%)*	0.5
Prothrombin complex concentrate	1,311	19 (1%)	1,170	13 (1%)	0.5
Large-volume (≥4 units) erythrocyte transfusions (POD-0)	1,311	173 (13%)	1,170	80 (7%)	<0.001
Recombinant factor VIIa (up to POD-1)	1,311	45 (3%)	1,170	14 (1%)	<0.001

- ✓ No difference in outcome measures, except a lower incidence of surgical re-exploration in the postalgorithm group

From Karkouti K et al. Anesthesiology 122:560-70, 2015.

Transfusion Algorithm Based on Point-of-care Coagulation Assays in Cardiac Surgery

- ✓ Retrospective, before and after study: institution of a practical POC-based transfusion algorithm
- ✓ Results for subgroup analyses were consistent

	Erythrocyte Transfusions, OR (95% CI)	Platelet Transfusions, OR (95% CI)	Plasma Transfusions, OR (95% CI)	Large-volume Erythrocyte Transfusions, OR (95% CI)
All patients	0.50 (0.32–0.77)	0.22 (0.13–0.37)	0.20 (0.12–0.34)	0.23 (0.11–0.48)
High bleeding risk—yes	0.46 (0.23–0.95)	0.17 (0.08–0.34)	0.14 (0.08–0.27)	0.25 (0.12–0.50)
High bleeding risk—no	0.51 (0.30–0.86)	0.30 (0.15–0.60)	0.34 (0.18–0.78)	0.25 (0.02–0.34)
Anemia—yes	0.27 (0.11–0.67)	0.14 (0.05–0.37)	0.13 (0.04–0.37)	0.17 (0.06–0.49)
Anemia—no	0.57 (0.34–0.95)	0.26 (0.15–0.47)	0.21 (0.11–0.92)	0.27 (0.07–0.98)
Cell saver—yes	0.48 (0.27–0.86)	0.15 (0.07–0.29)	0.20 (0.10–0.40)	0.28 (0.12–0.66)
Cell saver—no	0.58 (0.31–1.10)	0.45 (0.32–0.94)	0.16 (0.06–0.41)	0.17 (0.04–0.81)
Desmopressin—yes	0.43 (0.18–1.00)	0.14 (0.06–0.31)	0.12 (0.05–0.27)	0.51 (0.19–1.37)
Desmopressin—no	0.60 (0.37–0.96)	0.35 (0.18–0.67)	0.29 (0.13–0.63)	0.08 (0.02–0.36)
±6 months*	0.60 (0.32–1.14)	0.29 (0.14–0.62)	0.25 (0.12–0.53)	0.31 (0.12–0.81)

From Karkouti K et al. Anesthesiology 122:560-70, 2015.

Incidence & Importance of Anemia in Patients Undergoing Cardiac Surgery in UK

- ✓ National service audit (2010-2012):12/35 UK cardiac surgery centers provided data
- ✓ 20% of the patients (4754/23,800) did not have preop Hb
- ✓ Incidence of anemia (WHO definition): 31% (23 to 45%):
- ✓ Regional variation remained an independent effect

- ✓ Independent association of anemia with transfusion, mortality, and hospital stay

A 10g/L ↓ in Hb was associated with a 43% ↑ in the risk of transfusion and a 16% ↑ in the risk of death (both $p<0.001$)

From Klein AA et al. Anaesthesia 71:627-35, 2016.

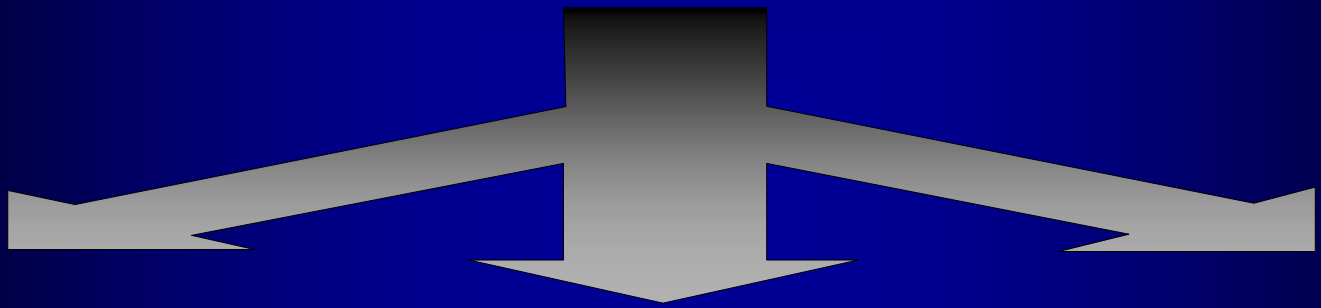
Patient Blood Management

✓ Defined as “the appropriate use of blood and blood components with a goal of minimized their use”.

✓ Encompasses an evidence-based medical and surgical approach that is multidisciplinary (transfusion medicine specialists, surgeons, anesthesiologists, and critical care specialists) and multiprofessional (physicians, nurses pump technologists and pharmacists)

From Goodnough LT and Shander A. Anesthesiology 116:1367-76, 2012.

Patient Blood Management Program



Preop
RBC mass

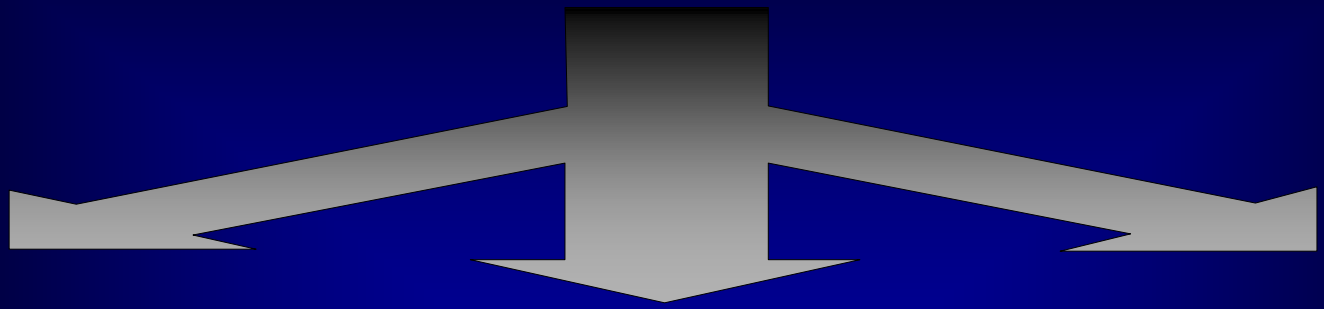
Periop
blood loss

Reduce the
Transfusion Trigger

Effect of a standardized multidisciplinary approach of blood conservation program on allogeneic transfusion exposure ?

From Van der Linden P et al. Can J Anesth 48:894-901, 2001.

Perioperative Blood Conservation Strategy



Preop
RBC mass

Standardized
preop treatment
(antiplatelets, iron…)

Periop
blood loss

Standardized
blood conservation
programs

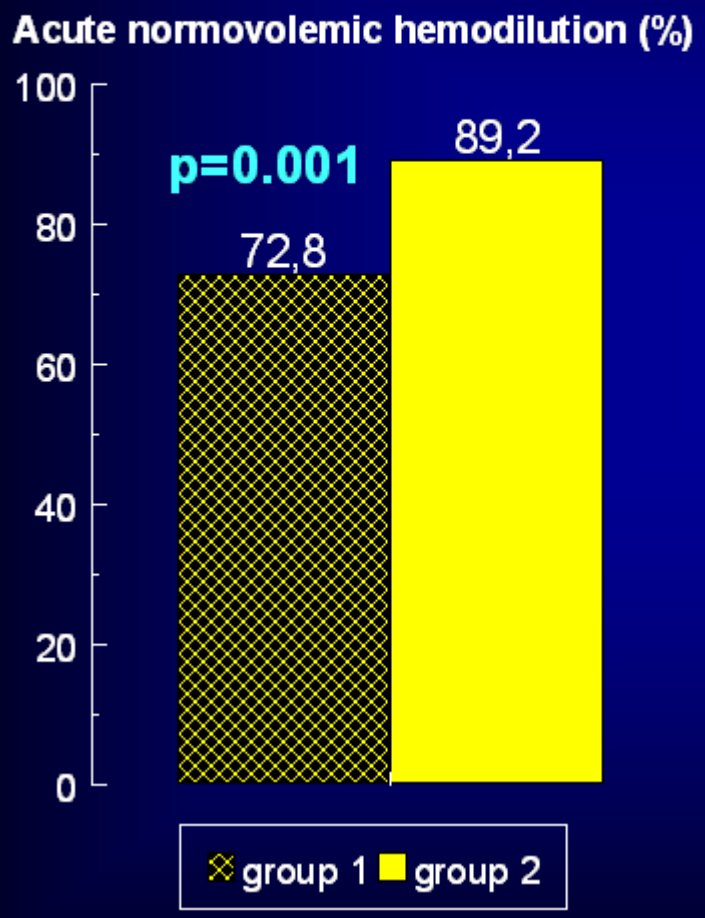
Reduce the
Transfusion Trigger

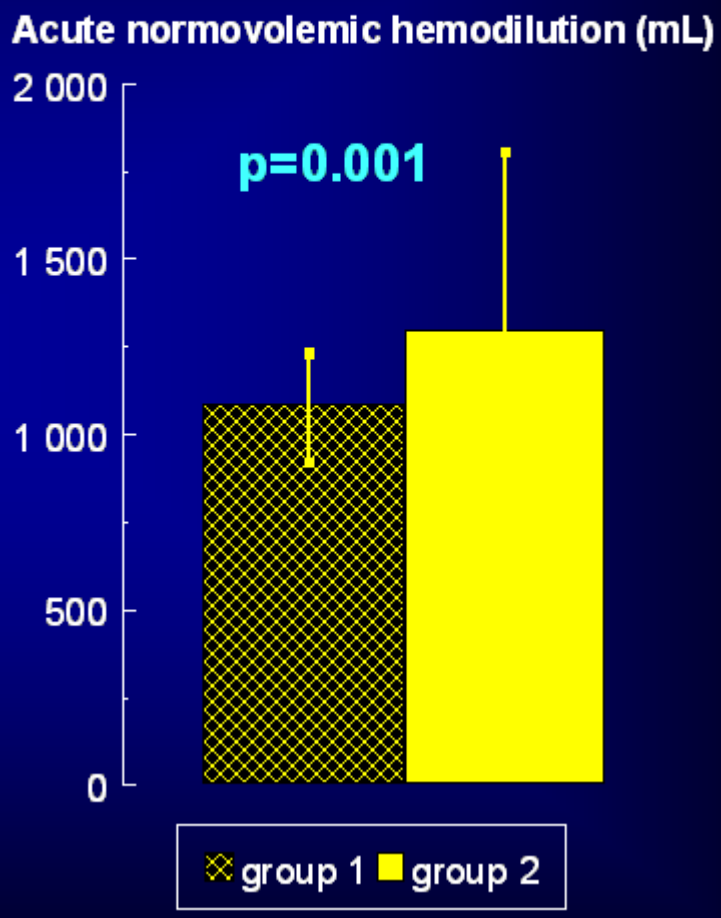
Standardized
transfusion
trigger

Standardized Blood Transfusion Strategy

- ✓ Control group: September 97 - August 98
  N= 321 (group 1)
- ✓ Treated group: September 98 - August 99
  N= 315 (group 2)
- ✓ Data analyzed using analysis of variance, Student's t test, χ^2, and Fisher's exact test where applicable
- ✓ Data expressed as percentage of the total or mean ± SD

Standardized Blood Transfusion Strategy





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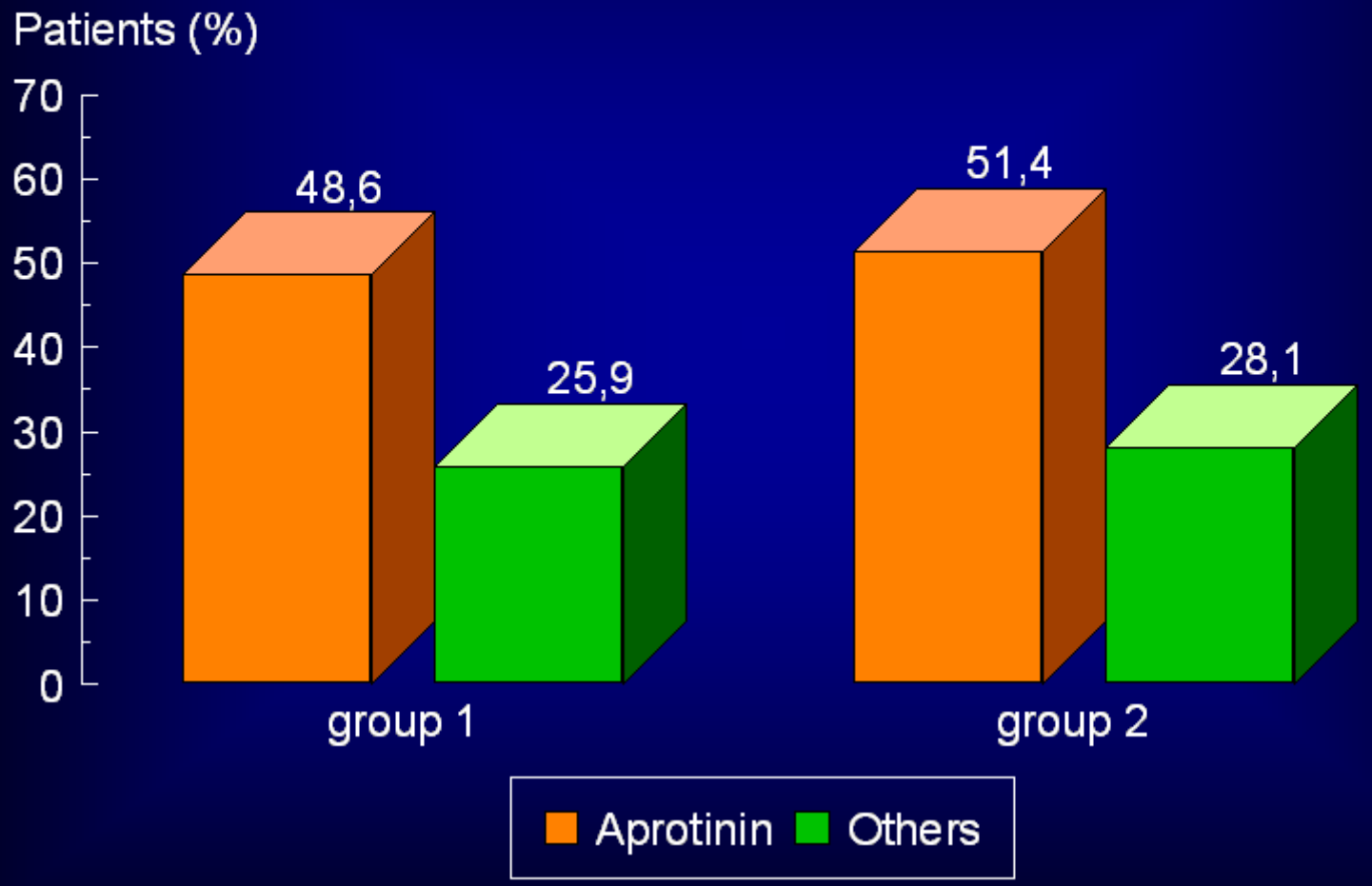

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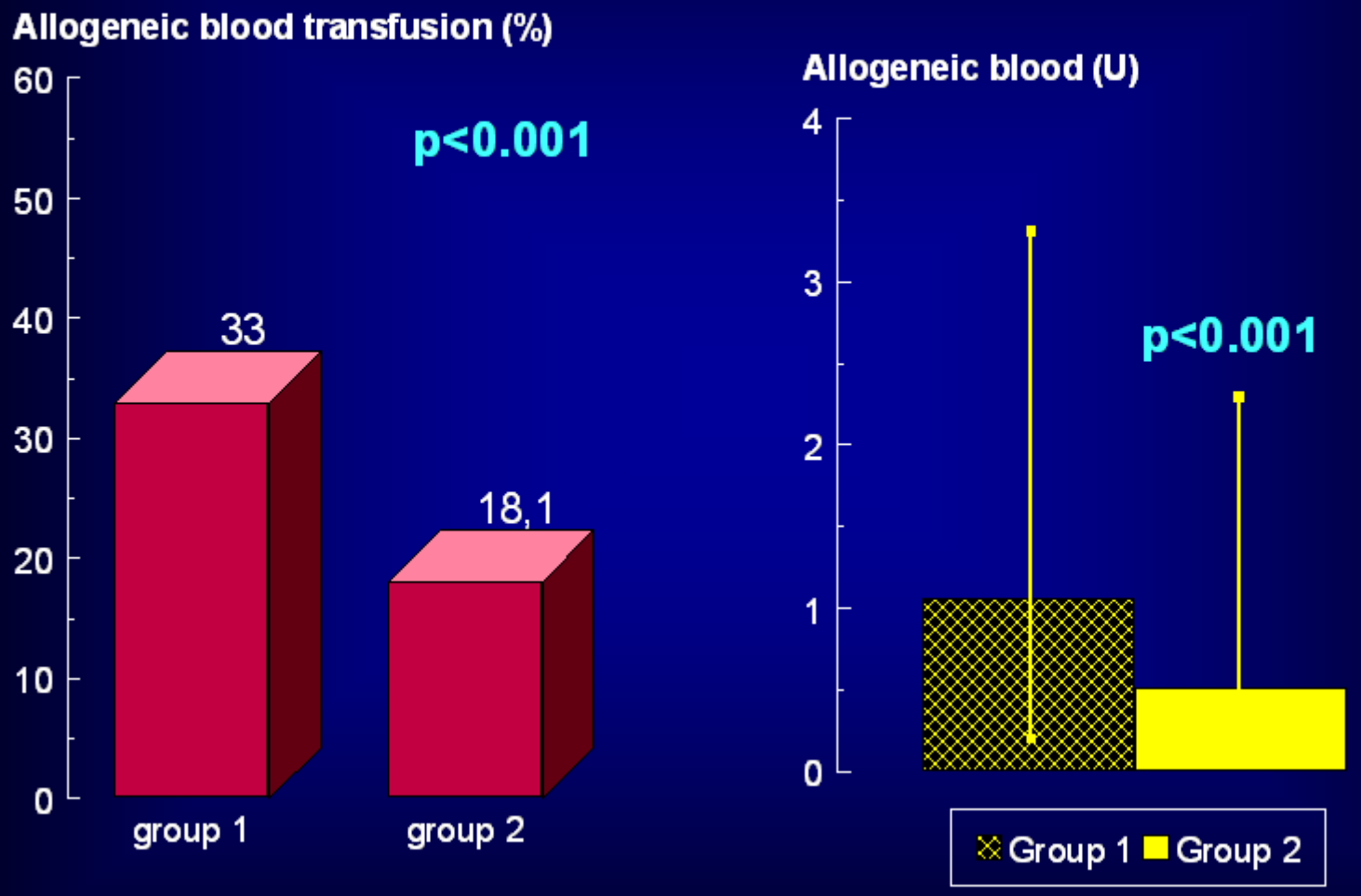
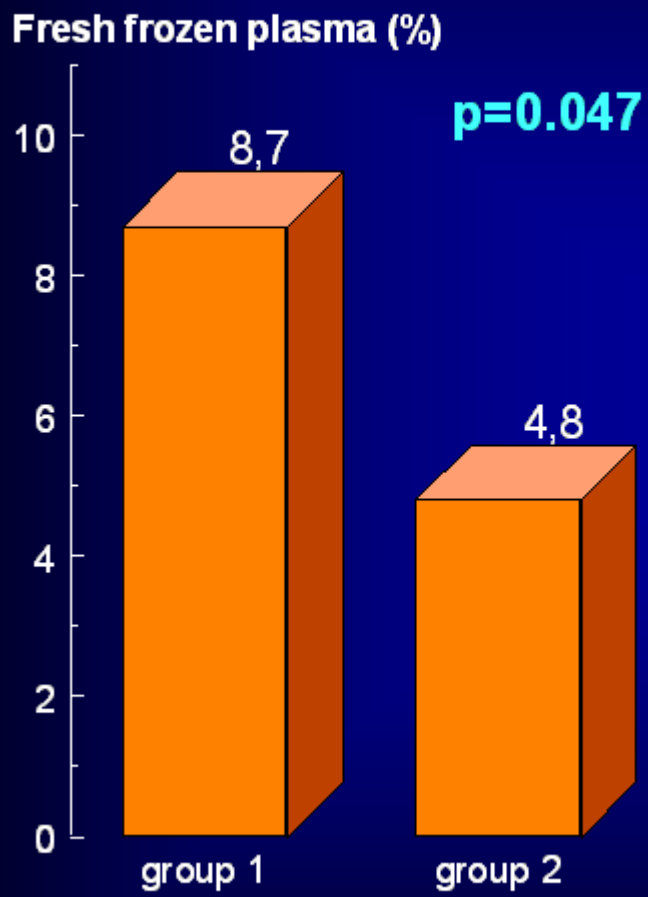
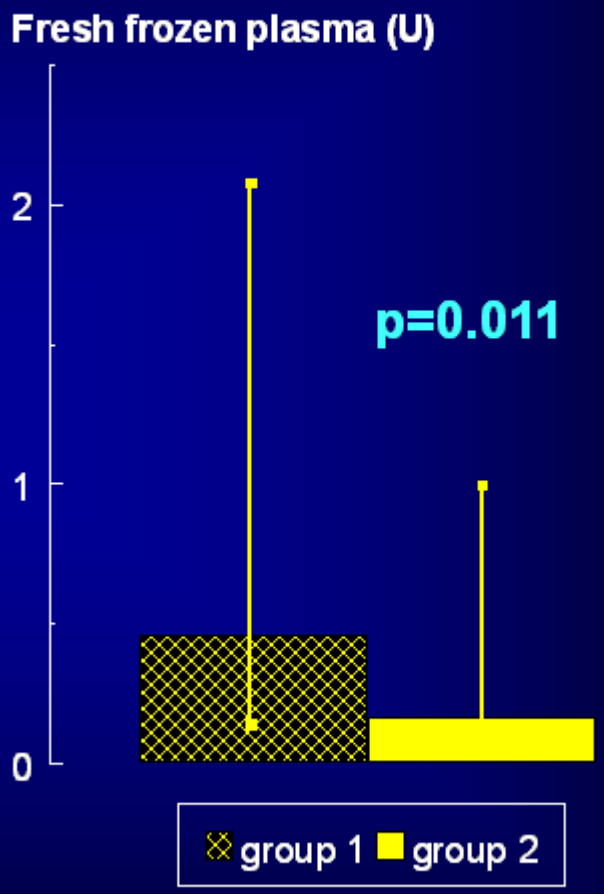


Group 1: 340 units in 108 patients; Group 2: 161 units in 57 patients

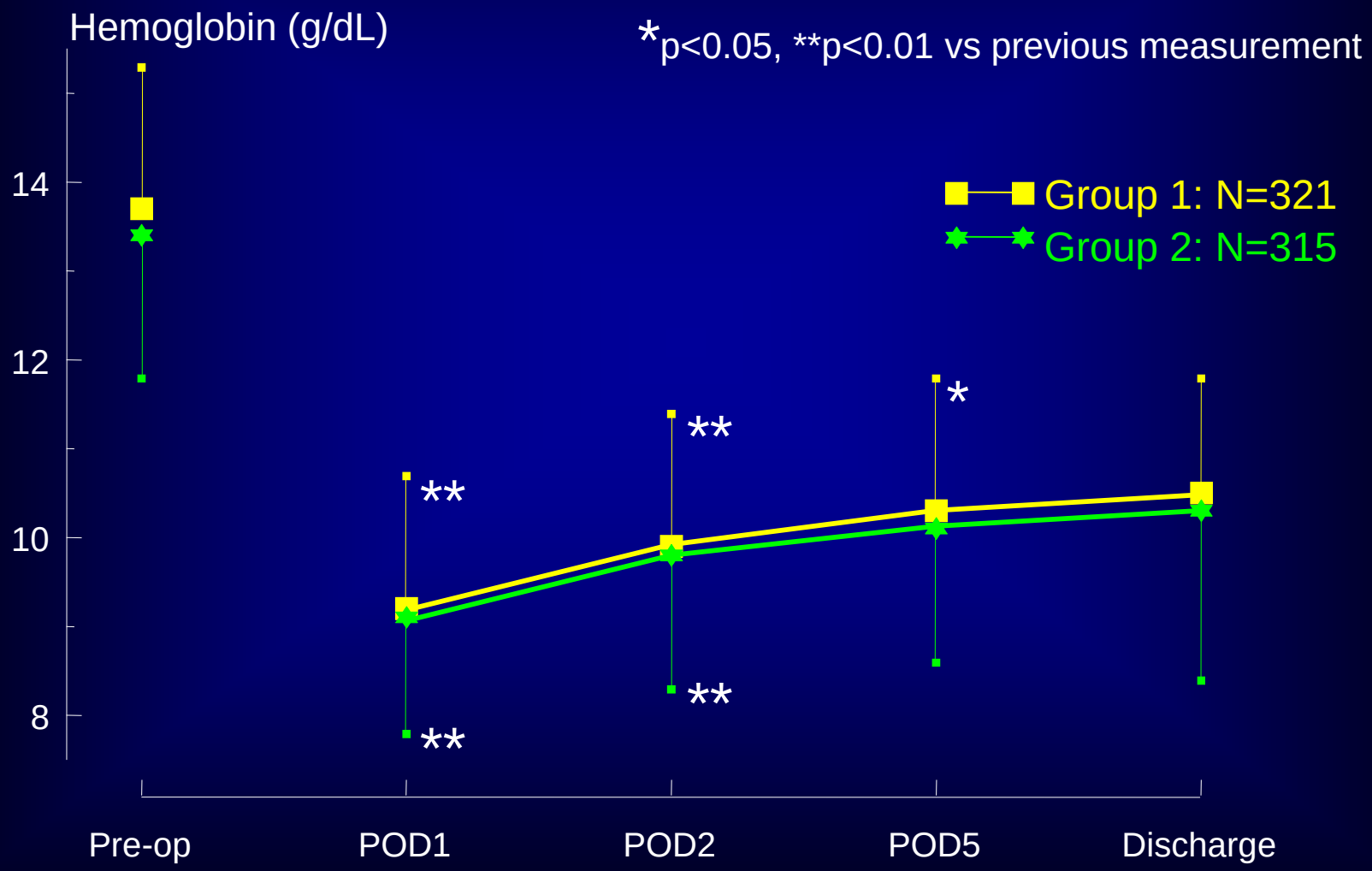
Standardized Blood Transfusion Strategy



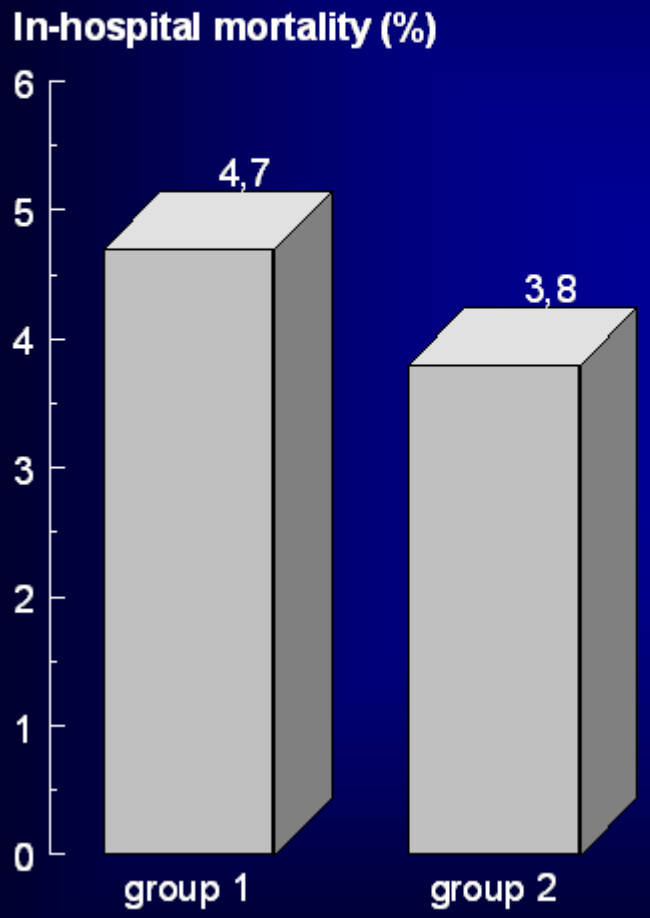


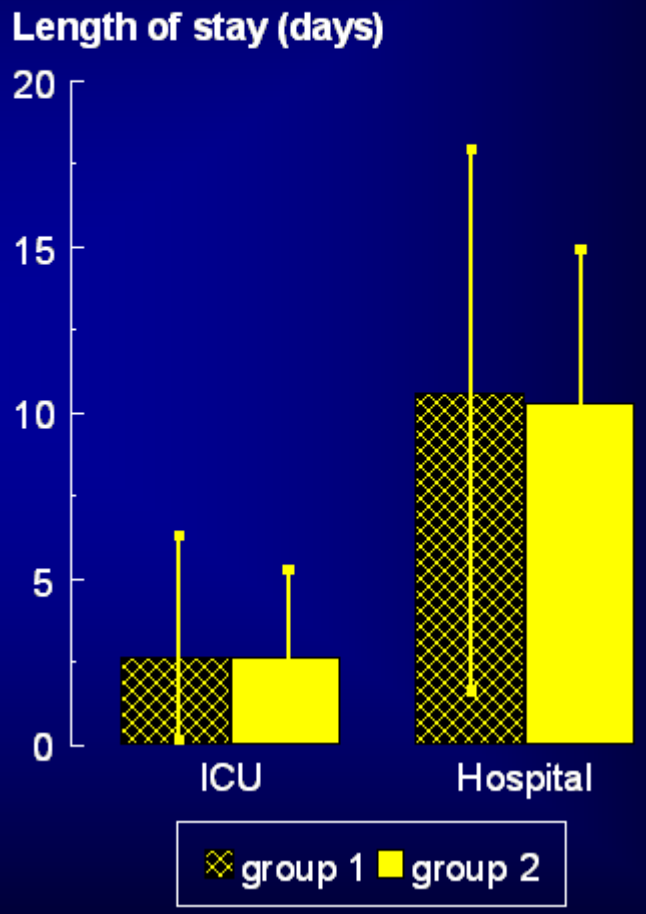
Group 1: 145 units in 28 patients; Group 2: 54 units in 15 patients

Perioperative Hemoglobin Level



Standardized Blood Transfusion Strategy





Developing a Blood Conservation Strategy

- ✓ Reliable data base
- ✓ Choice of alternative techniques
  - Surgical procedure and technique
  - Patients limitations
  - Health Care environment
  - Immediate and long term costs
- ✓ Continuous monitoring
- ✓ Multidisciplinary approach: anesthesiologists, surgeons, blood bankers...

From Baele P & Van der Linden P. Acta Anaesthesiol Belg 53:129-136, 2002.

Blood Use in Elective Cardiac Surgery: The 2 Austrian Benchmark Studies

- ✓ Prospective observational multicenter studies
- ✓ April 04–February 05 (N=777) / July 09–August 10 (N=714)
- ✓ Less women, longer surgery and higher use of platelets inhibitors in the 2nd study

	1st benchmark	2nd benchmark	P value
Preop anemia (%)	24	treated in 1 % of patients	
Preop Hb (%)	108 ± 12	106 ± 12	0.001
Lowest postop Hb (%)	79 ± 9	76 ± 10	<0.001
POD5 Hb (%)	84 ±10	81 ± 11	<0.001

From Gombotz H et al. Transfusion 54:2646-57, 2014.

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	1st benchmark	2nd benchmark	P value
Lost RBC volume (%)	45	43	0.515
Transfusion rate (%)	55	57	0.465
Median units transfused (IQR)	2 (2)	2 (2)	0.878
One unit transfusion (%)	11.7	11.3	0.914

From Gombotz H et al. Transfusion 54:2646-57, 2014.

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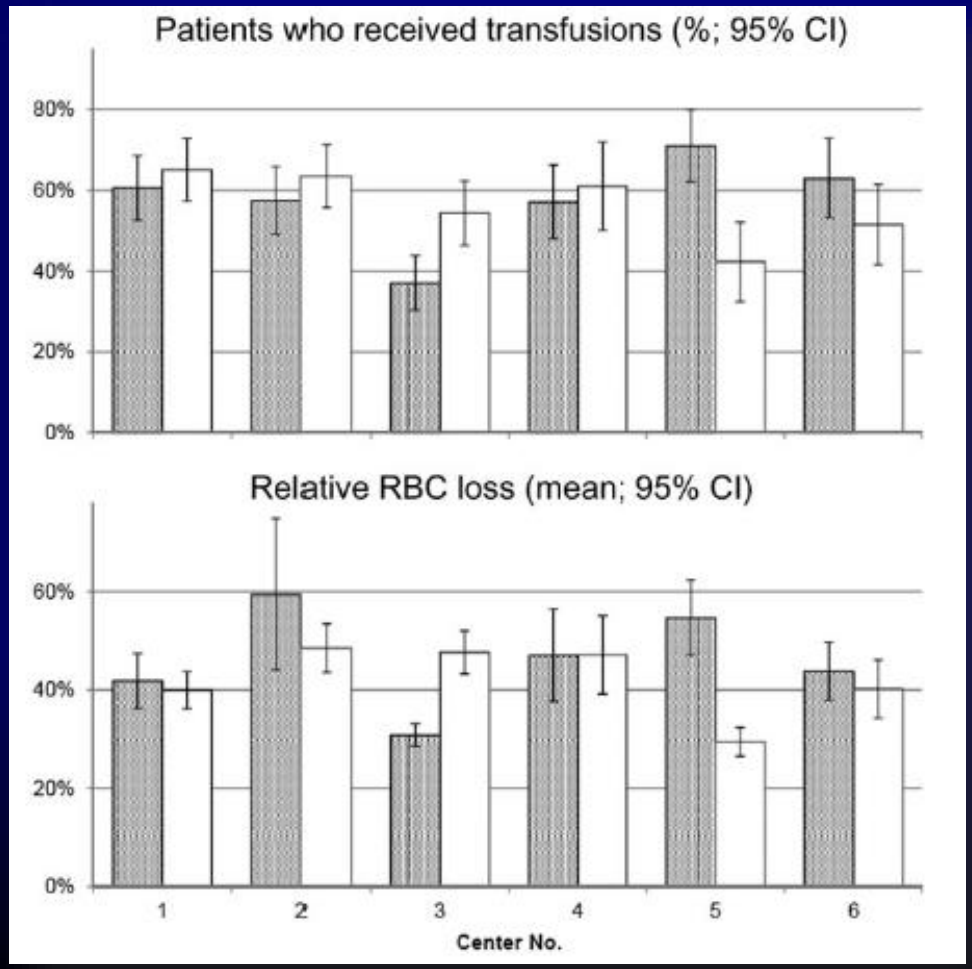
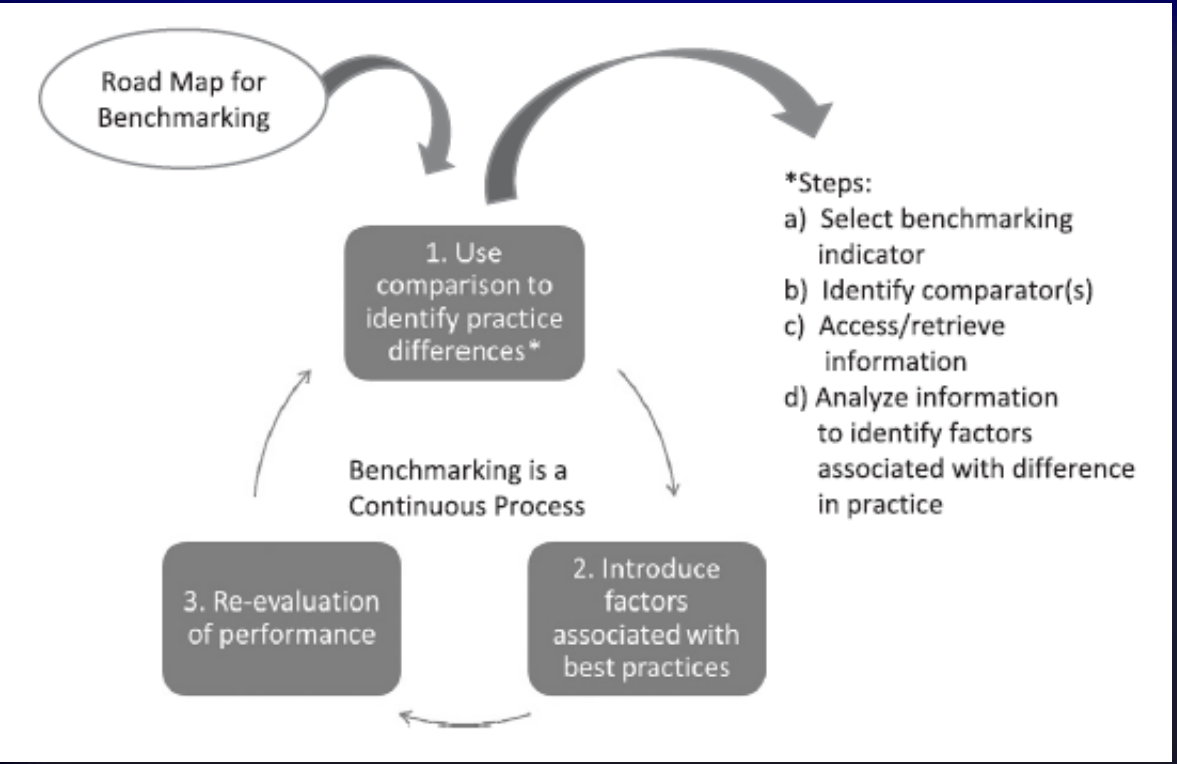


first (▨) and second (□) studies

Gombotz H et al.
Transfusion
54:2646-57, 2014.

Benchmark: Definition

« Benchmark is a structured continuous collaborative process in which comparisons for selected indicators are used to identify factors that, when implemented will improve transfusion practices »



From Apelseth TO et al: Transfus Med Rev 26:321-32, 2012.

The NATA Benchmark Project

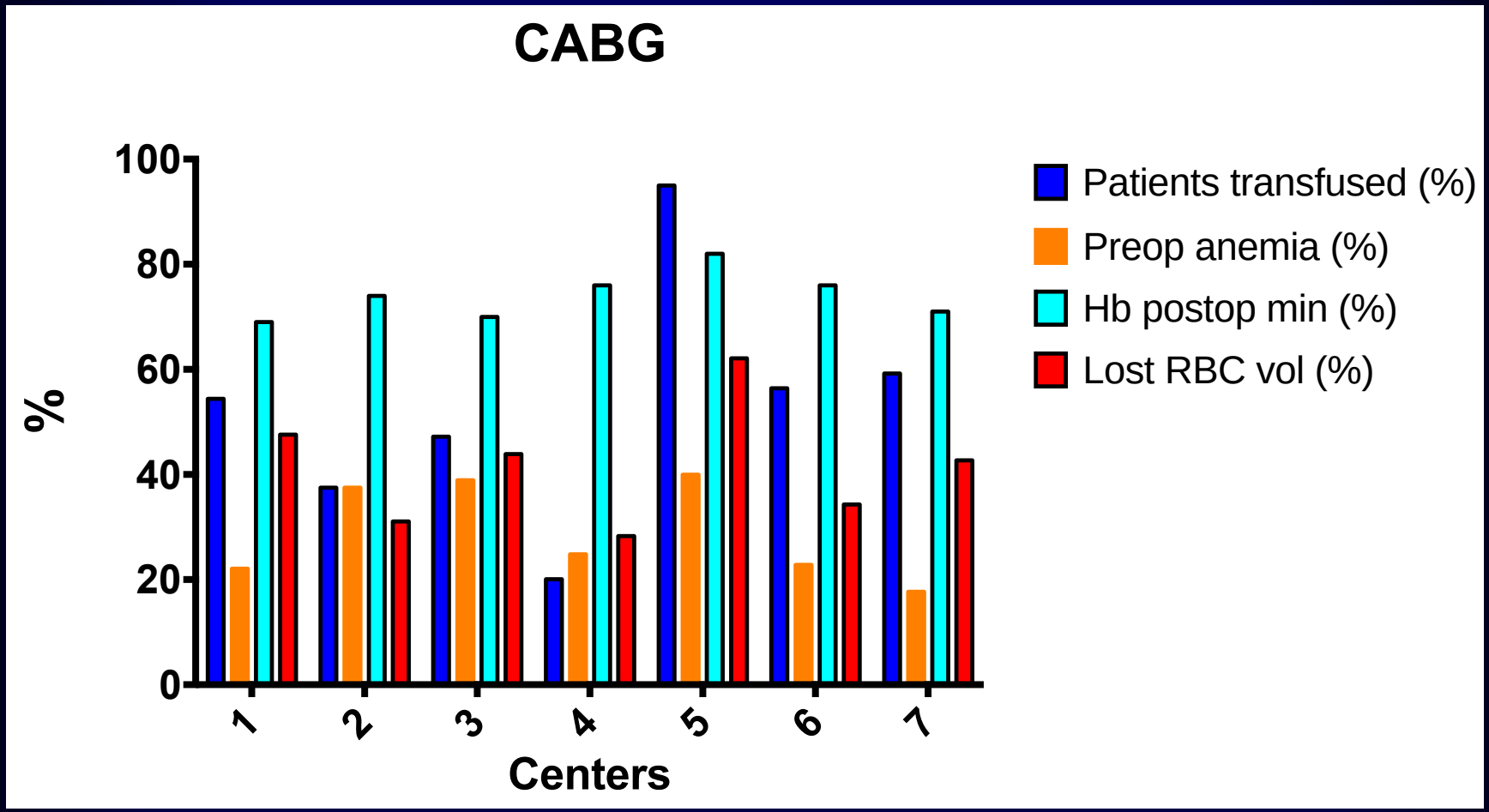
- ✓ Step 1: Evaluation of transfusion practices in different interested centers across Europe and Canada
- ✓ Step 2: Implementation of measures of improvement in these different centers according to their own results
- ✓ Step 3: Re-evaluation of the practices – development of “NATA centers of excellence“
- ✓ Step 4: Enlargement of the project to additional centers under the coordination of these centers of excellence

The NATA Benchmark Project

- ✓ Aim: Providing the basis for educational strategies to implement optimal PBM in participating centers
- ✓ Prospective observational study with online data collection (10 European centers and one Canadian)
- ✓ Incidence of transfusion and volume of RBC transfused significantly different between centers
- ✓ The relative importance of factors explaining RBC transfusion differs across institutions, some being patient related whereas others are related to the healthcare process

From Van der Linden P & Hardy JF. Eur J Anaesthesiol 33:913-21, 2016.

The NATA Benchmark Project



From Van der Linden P & Hardy JF. Eur J Anaesthesiol 33:913-21, 2016.

Developing a Patient Blood Management Program

- ✓ Reliable database
- ✓ Choice of strategies
  - Surgical procedures and techniques
  - Patients' limitations
  - Health care environment
  - Immediate and long term costs
- ✓ Multidisciplinary approach
- ✓ Continuous monitoring