Seuils transfusionnels en 2016

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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

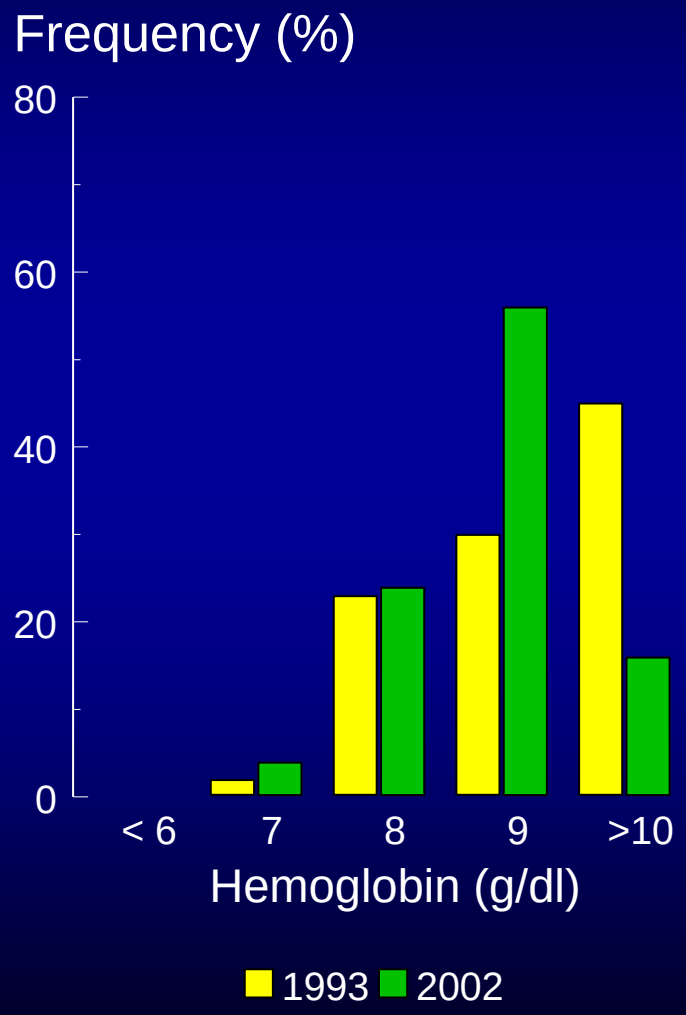
CSL Behring GmbH

Janssen-Cilag SA

Transfusion Practices in Critically Ill Patients

Myocardial infarction

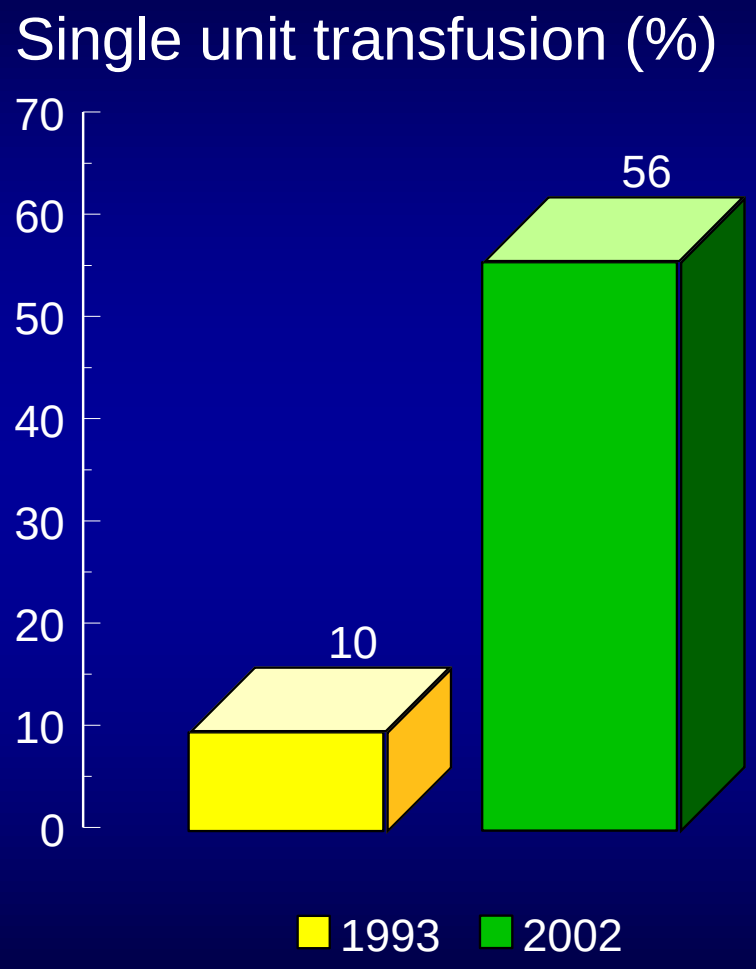
- 55-year-old man
- Major vascular surgery (AAA)
- POD4: retrosternal chest pain
- ECG: anterior wall myocardial infarction: ICU admission
- No other complication
- No evidence of a volume deficit



From Hébert PC et al Crit Care Med 33:7-12, 2005.

P VdL

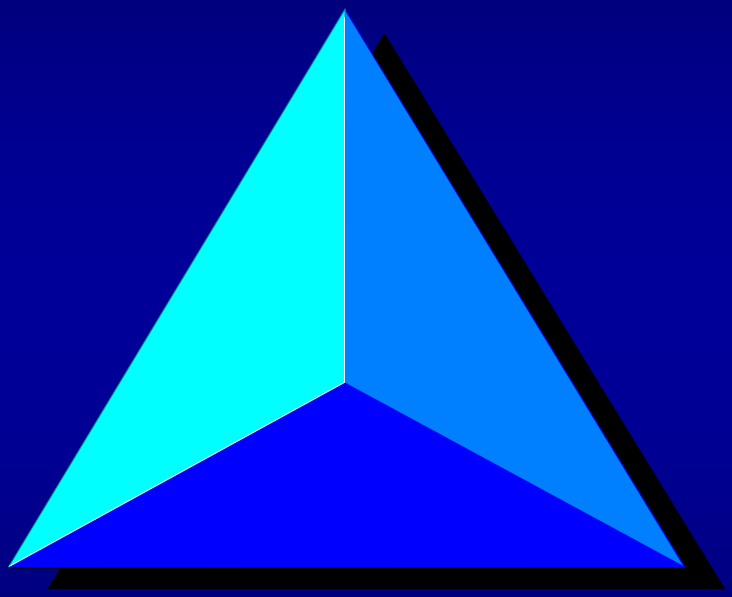
Transfusion Practices in Critically Ill Patients



From Hébert PC et al Crit Care Med 33:7-12, 2005.

The “Transfusion” Dilemma

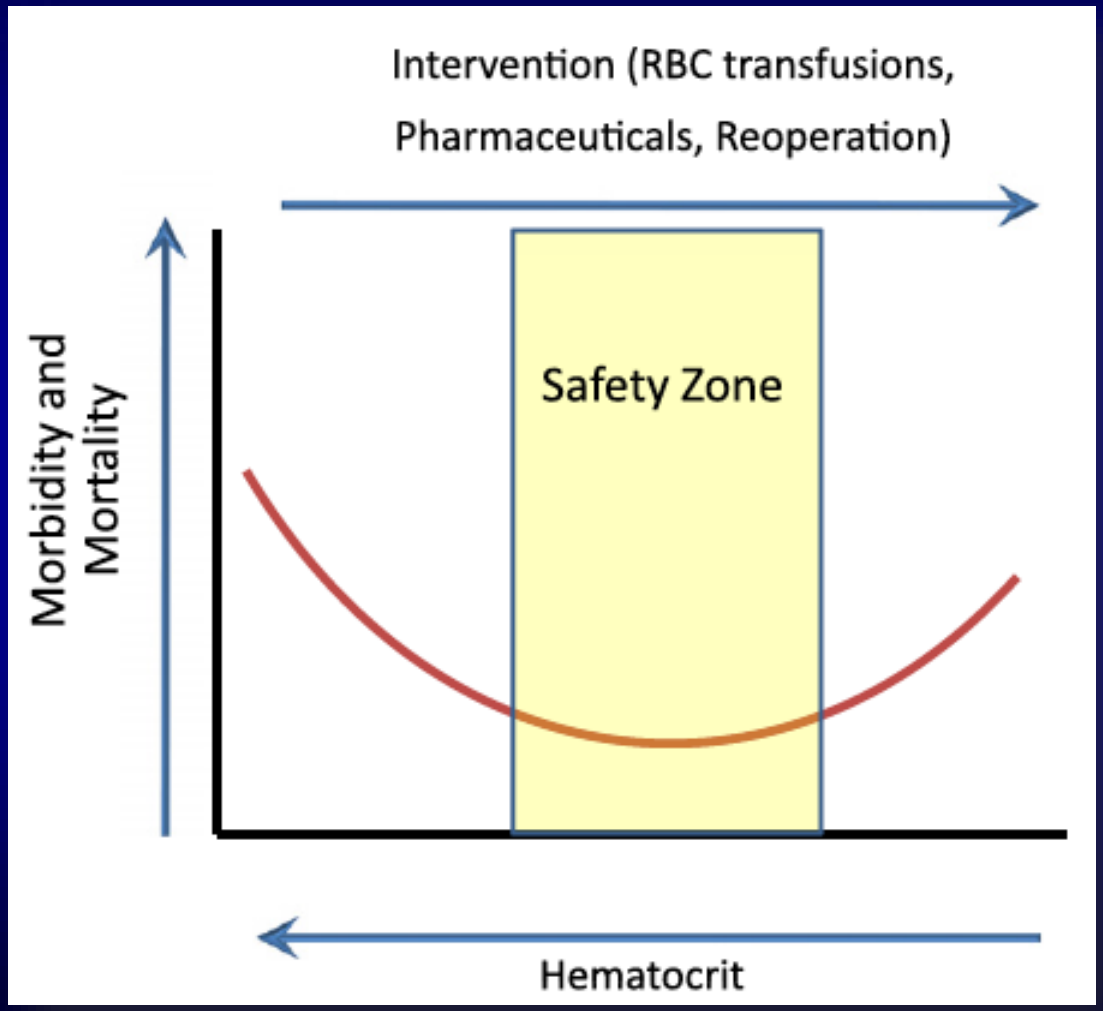
Risks associated with anemia



Effectiveness of blood transfusion

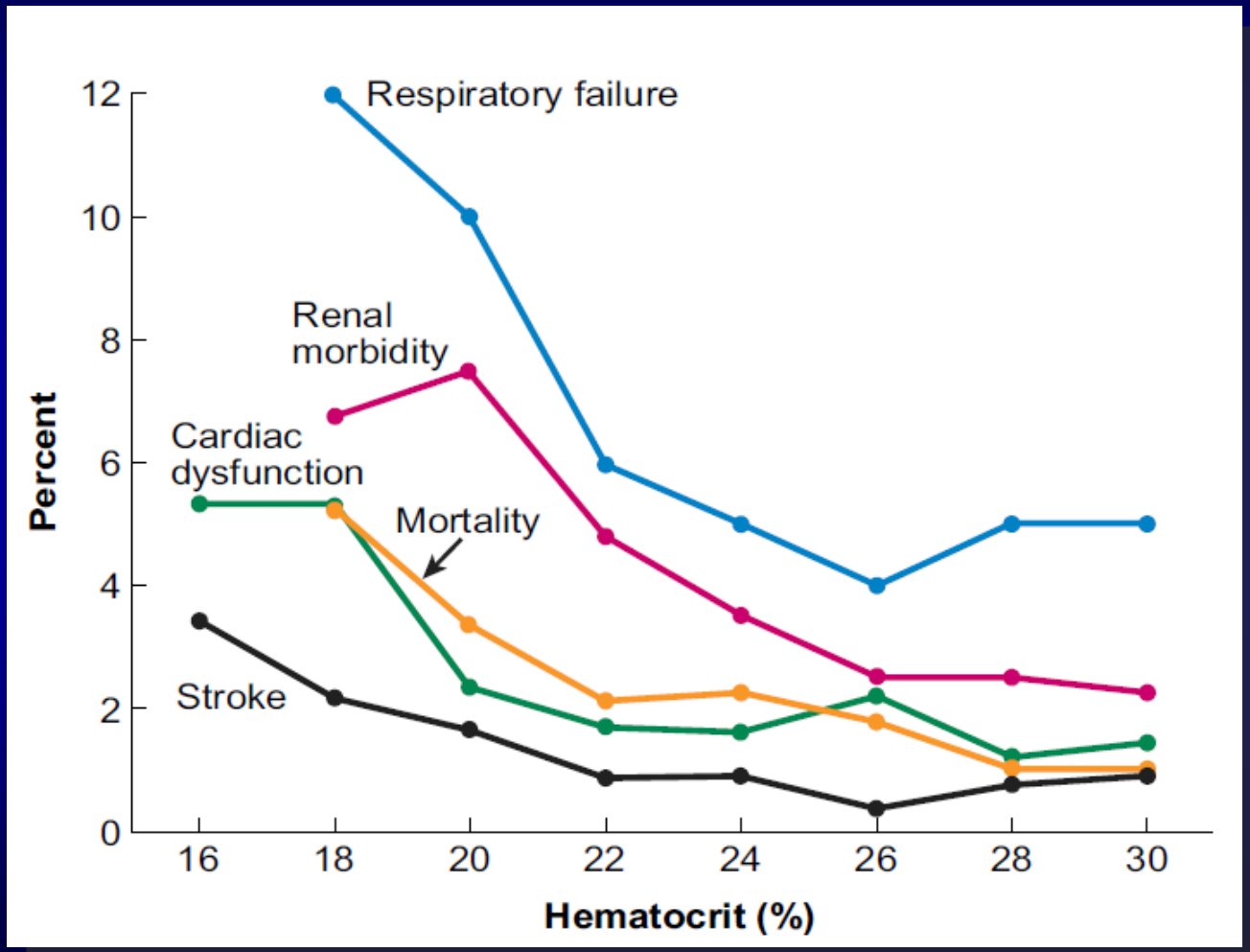
Risks associated with blood transfusion

Intraoperative Anemia & Postoperative Morbi-mortality After Cardiac Surgery



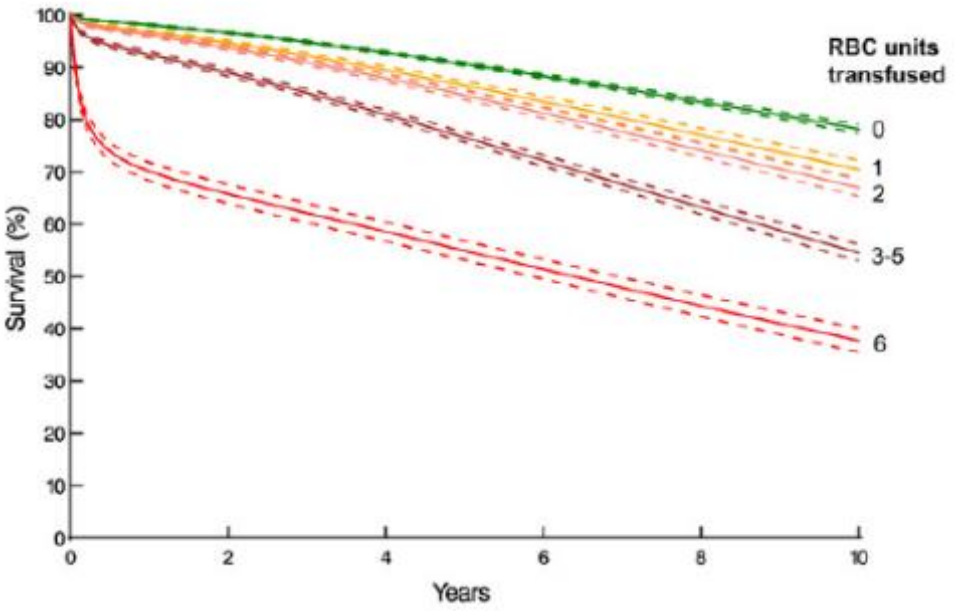
From Loor G et al. J Thorac Cardiovasc Surg 144:538-46, 2012.

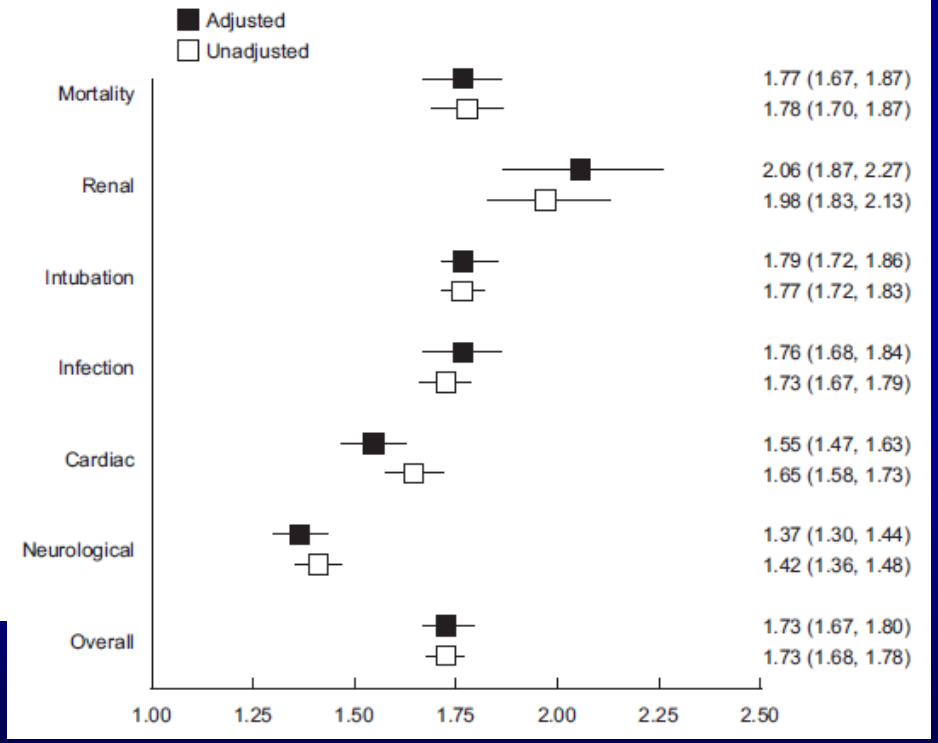
Intraoperative Anemia & Postoperative Morbi-mortality After Cardiac Surgery



From Loor G et al. J Thorac Cardiovasc Surg 144:538-46, 2012.

Blood Transfusion & Postoperative Morbi-Mortality After Cardiac Surgery





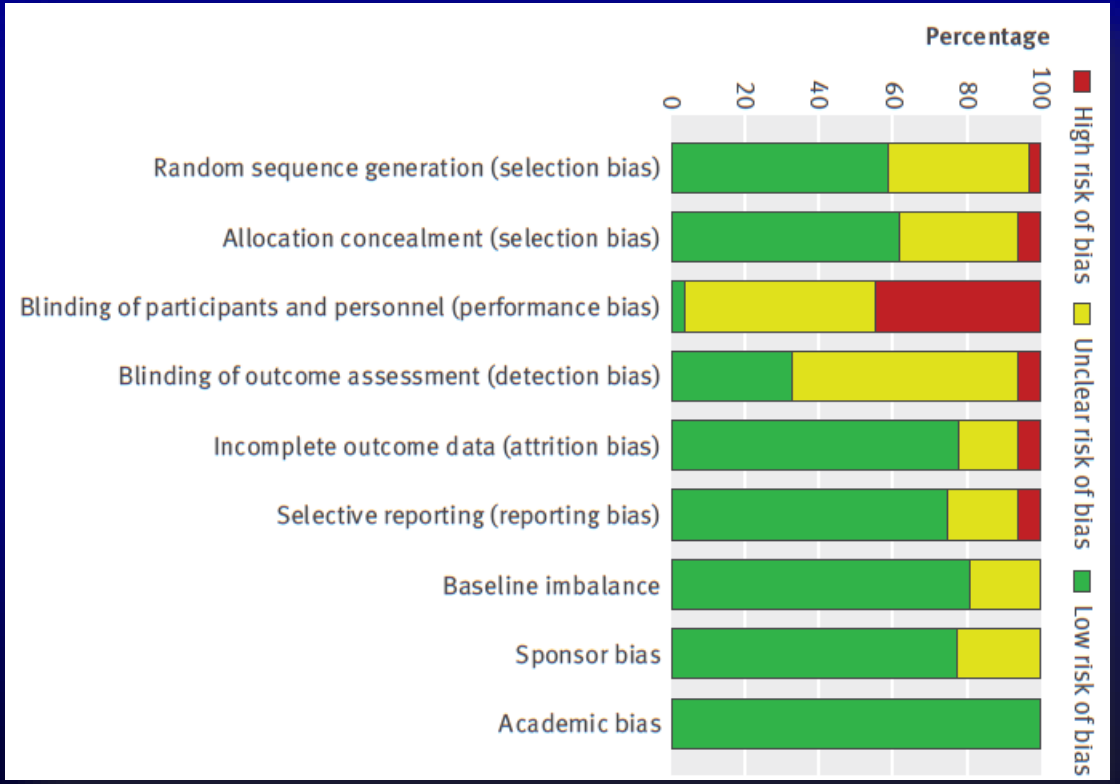
From Loor G et al. J Thorac Cardiovasc Surg 144:538-46, 2012.

Restrictive versus liberal transfusion strategy for red blood cell transfusion: systematic review of randomised trials with meta-analysis and trial sequential analysis

31 trials – 9,813 patients

✓Objectives:

To compare the benefit and harm of restrictive versus liberal transfusion strategies to guide RBCs transfusions



From Holst LB et al. BMJ 2015; 350: h1354.

Restrictive versus liberal transfusion strategy for red blood cell transfusion: systematic review of randomised trials with meta-analysis and trial sequential analysis

31 trials – 9,813 patients

✓ Results: restrictive transfusion strategies

- ⬇ risk of receiving RBC transfusion (RR: 0.54; 95% CI: 0.47 to 0.63)
- ⬇ volume of transfused RBCs (MD: -1.43; 95% CI: -2.01 to -0.86)
- No impact on mortality (RR:0.86; 95% CI: 0.74 to 1.01)
- No impact on morbidity (RR:0.98; 95% CI: 0.85 to 1.12)
- No impact on fatal or non-fatal MI (RR: 1.28; 95% CI: 0.66 to 2.49)

Results not affected by the inclusion of studies with unclear or high risk of bias

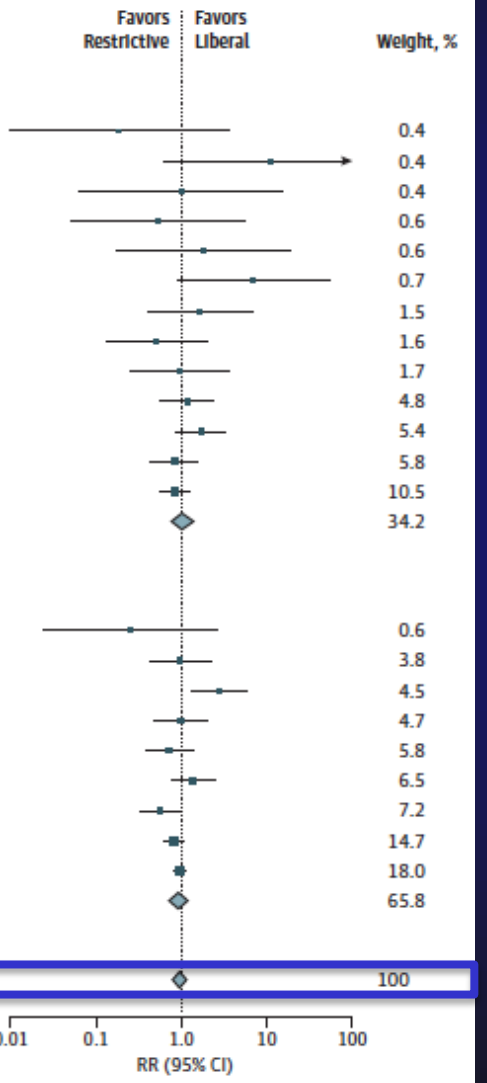
A 15% relative risk reduction or increase in overall morbidity with restrictive transfusion strategies could be excluded

From Holst LB et al. BMJ 2015; 350: h1354.

Red Blood Cell Transfusion Threshold & Storage

Transfusion threshold
31 RCTS
12,587 patients

Source	Restrictive Transfusion Threshold: No. of Deaths	Restrictive Transfusion Threshold: Total No.	Liberal Transfusion Threshold: No. of Deaths	Liberal Transfusion Threshold: Total No.	RR (95% CI)	Weight, %
Restrictive threshold, hemoglobin <8 to 9 g/dL						
Lotke et al,[75] 1999	0	62	0	65	Not estimable	
Blair et al,[53] 1986	0	26	2	24	0.19 (0.01-3.67)	0.4
Foss et al,[63] 2009	5	60	0	60	11.00 (0.62-194.63)	0.4
Carson et al,[58] 1998	1	42	1	42	1.00 (0.06-15.47)	0.4
Webert et al,[86] 2008	1	29	2	31	0.53 (0.05-5.58)	0.6
Cooper et al,[61] 2011	2	23	1	21	1.83 (0.18-18.70)	0.6
Carson et al,[56] 2013	7	55	1	55	7.00 (0.89-55.01)	0.7
Parker,[78] 2013	5	100	3	100	1.67 (0.41-6.79)	1.5
Bracey et al,[54] 1999	3	215	6	222	0.52 (0.13-2.04)	1.6
Bush et al,[55] 1997	4	50	4	49	0.98 (0.26-3.70)	1.7
Hajjar et al,[68] 2010	15	249	13	253	1.17 (0.57-2.41)	4.8
Gregersen et al,[64] 2015	21	144	12	140	1.70 (0.87-3.32)	5.4
Jairath et al,[72] 2015	14	257	25	382	0.83 (0.44-1.57)	5.8
Carson et al,[60] 2011	43	1009	52	1007	0.83 (0.56-1.22)	10.5
Subtotal	121	2321	122	2451	1.05 (0.78-1.40)	34.2
Heterogeneity: $\tau^2=0.02$; $\chi^2_{12}=13.14$; $P=.36$; $I^2=9\%$						
Tests for overall effect: z score $=0.31$; $P=.76$						
Restrictive threshold, hemoglobin <7 g/dL						
DeZern et al,[87] 2016	1	59	2	30	0.25 (0.02-2.69)	0.6
Hébert et al,[70] 1995	8	33	9	36	0.97 (0.42-2.22)	3.8
de Almeida et al,[79] 2015	23	101	8	97	2.76 (1.30-5.87)	4.5
Lacroix et al,[74] 2007	14	320	14	317	0.99 (0.48-2.04)	4.7
Walsh et al,[85] 2013	12	51	16	49	0.72 (0.38-1.36)	5.8
Murphy et al,[76] 2015	26	1000	19	1003	1.37 (0.76-2.46)	6.5
Villanueva et al,[84] 2013	19	416	34	417	0.56 (0.32-0.97)	7.2
Hébert et al,[69] 1999	78	418	98	420	0.80 (0.61-1.04)	14.7
Holst et al,[71] 2014	168	502	175	496	0.95 (0.80-1.13)	18.0
Subtotal	349	2900	375	2865	0.94 (0.74-1.19)	65.8
Heterogeneity: $\tau^2=0.05$; $\chi^2_8=16.09$; $P=.04$; $I^2=50\%$						
Tests for overall effect: z score $=0.53$; $P=.59$						
Overall	470	5221	497	5316	0.97 (0.81-1.16)	100
Heterogeneity: $\tau^2=0.04$; $\chi^2_{21}=29.75$; $P=.10$; $I^2=29\%$						
Tests for overall effect: z score $=0.29$; $P=.77$						
Tests for subgroup differences: $\chi^2_1=0.34$; $P=.56$; $I^2=0\%$						



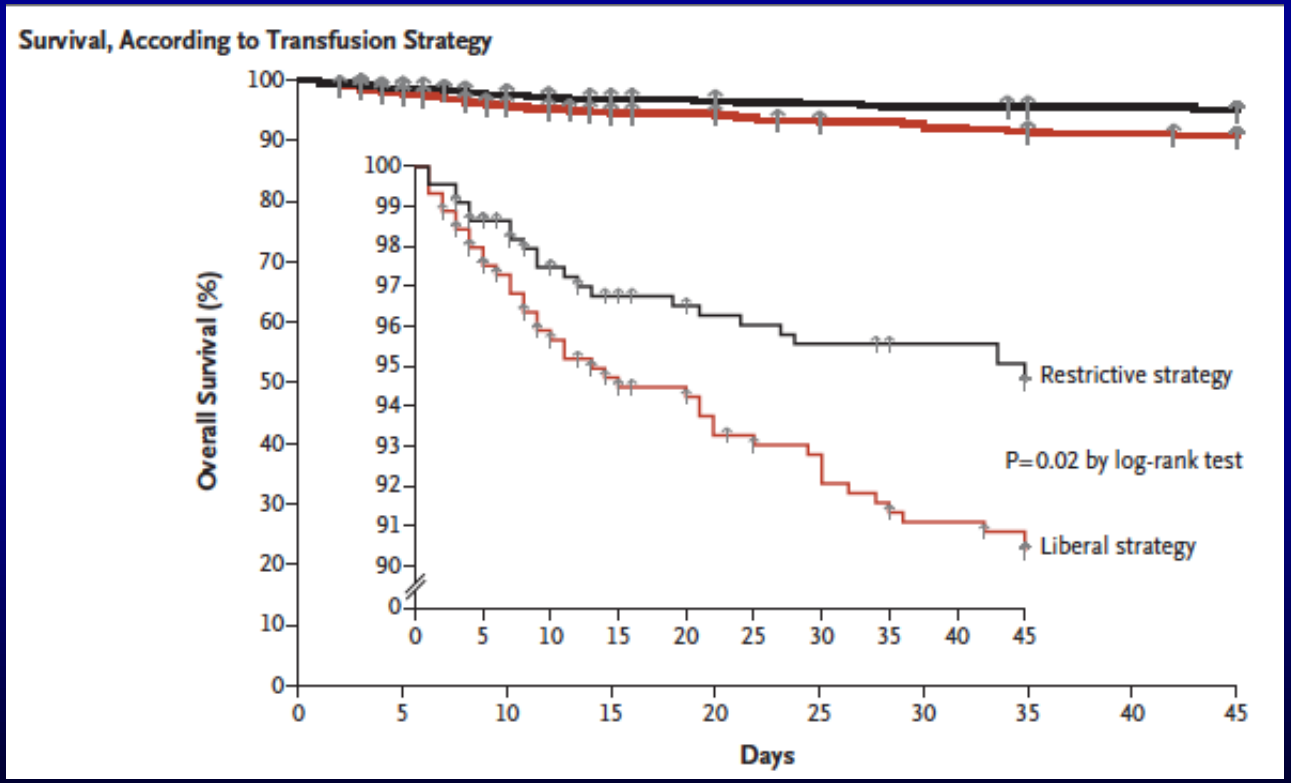
From Carson JL et al. JAMA 316: 2025-35, 2016.

Transfusion Strategies for Acute Upper Gastrointestinal Bleeding

- ✓Prospective randomized controlled trial:
  - Restrictive transfusion strategy: Hb < 7 g/dl (N=461)
  - Liberal transfusion strategy: Hb < 9 g/dl (N=460)

- ✓1 outcome:

45-day mortality



From Villanueva C et al. N Engl J Med 368:1:11-21, 2013.

Transfusion Strategies for Acute Upper Gastrointestinal Bleeding

✓Prospective randomized controlled trial:

- Restrictive transfusion strategy: Hb < 7 g/dl (N=461)
- Liberal transfusion strategy: Hb < 9 g/dl (N=460)

Outcome	Restrictive Strategy (N=444)	Liberal Strategy (N=445)	Hazard Ratio with Restrictive Strategy (95% CI)	P Value
Death from any cause within 45 days — no. (%)	23 (5)	41 (9)	0.55 (0.33–0.92)	0.02
Further bleeding — no. of patients/total no. (%)				
Overall	45/444 (10)	71/445 (16)	0.62 (0.43–0.91)	0.01
Adverse events — no. (%)†				
Any‡	179 (40)	214 (48)	0.73 (0.56–0.95)	0.02
Transfusion reactions	14 (3)	38 (9)	0.35 (0.19–0.65)	0.001
Fever	12 (3)	16 (4)	0.74 (0.35–1.59)	0.56
Transfusion-associated circulatory overload	2 (<1)	16 (4)	0.06 (0.01–0.45)	0.001
Allergic reactions	1 (<1)	6 (1)	0.16 (0.02–1.37)	0.12
Cardiac complications§	49 (11)	70 (16)	0.64 (0.43–0.97)	0.04
Acute coronary syndrome¶	8 (2)	13 (3)	0.61 (0.25–0.49)	0.27
Pulmonary edema	12 (3)	21 (5)	0.56 (0.27–1.12)	0.07

From Villanueva C et al. N Engl J Med 368:1:11-21, 2013.

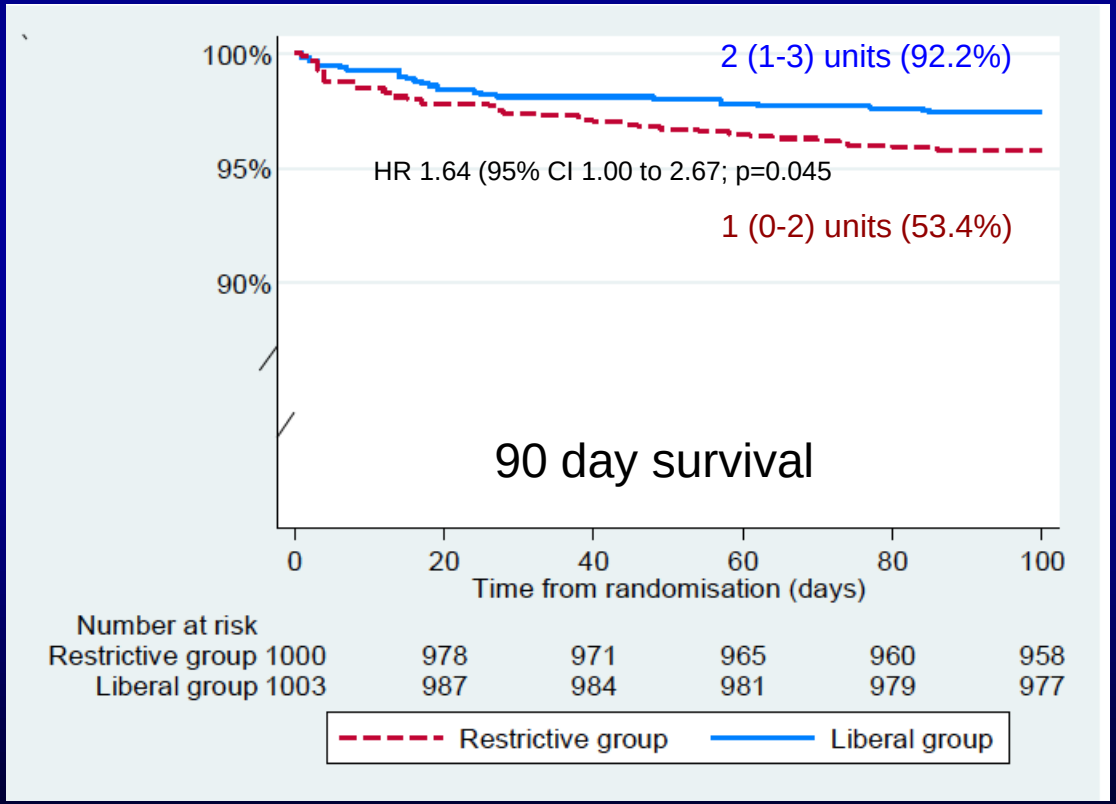
Liberal or Restrictive Transfusion after Cardiac Surgery

✓Multicenter parallel-group trial (postoperative period):

- Restrictive transfusion strategy: Hb < 7.5 g/dl (N=1000)
- Liberal transfusion strategy: Hb < 9 g/dl (N=1003)

Pre storage leukoreduced RBCs transfused unit by unit

✓1 outcome: 90-day mortality + morbidity



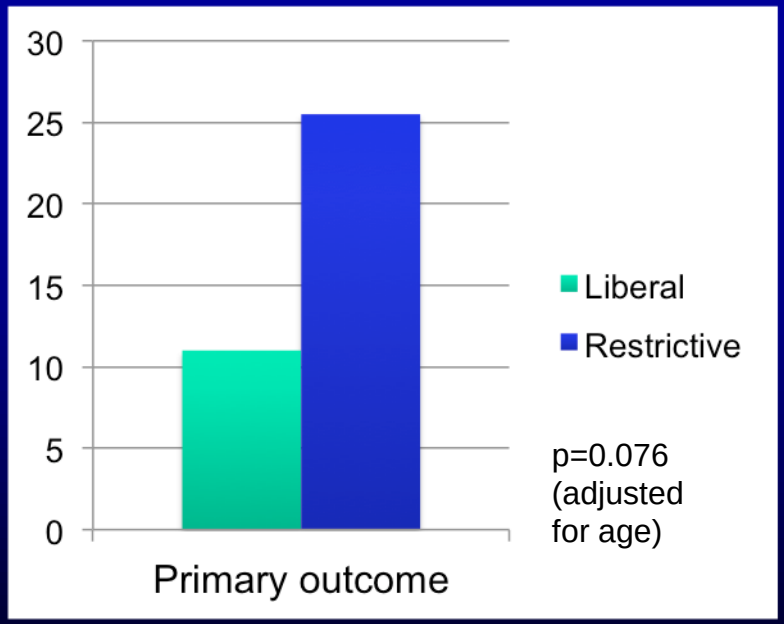
From Murphy GJ et al. N Engl J Med 372:997-1008, 2015.

Blood Transfusion Strategy in Patients With Symptomatic Coronary Artery Disease

✓Pilot trial: 110 ACS patients or stable angina undergoing cardiac catheterization and a Hb < 10 g/dl

- Liberal strategy: Hb < 10 g/dl (N=55)
- Restrictive strategy: symptoms of anemia or Hb < 8 g/dl (N=55)

✓Primary outcome: composite of death, MI or unscheduled revascularization 30 days post randomization



From Carson JL et al. Am Heart J 165:964-71, 2013.

Transfusion Medicine

Goodnough LT et al, NEJM 340:438-444,1999.

« It is unlikely that any level of hemoglobin can be used as a universal threshold for transfusion ».

Transfusion Thresholds

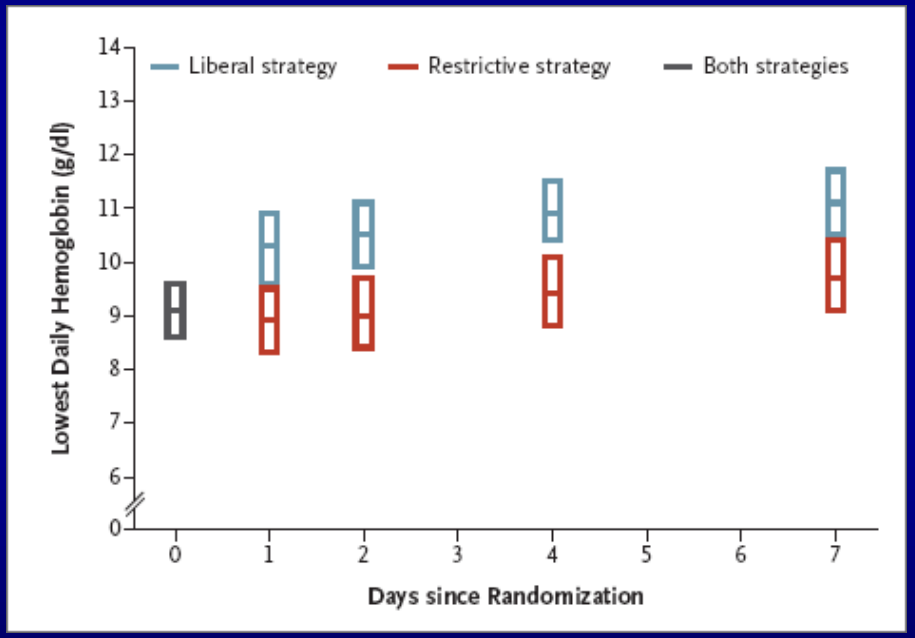
Barr PJ, Bailie KEM NEJM 365; 26: 2532-3, 2011.

« The decision to transfuse should be guided by an assessment of individual patient on the basis of a combination of symptoms, signs, lab measures and not by a single hemoglobin level ».

Blood Transfusion Strategy in High-Risk Patients after Hip Fracture Surgery

✓Prospective randomized trial: patients ≥ 50 years of age with a history or risk factors for CVD with Hb < 10 g/dl after surgery

✓Transfusion strategy:
- Liberal Hb threshold of 10 g/dl
- Restrictive: symptoms of anemia or for Hb < 8g/dl

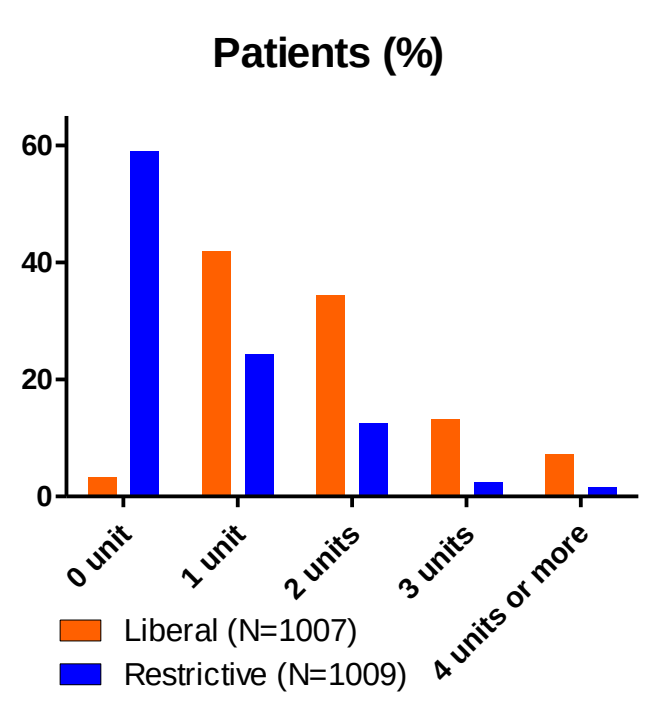


✓RBC transfused unit by unit

✓Primary outcome: death or inability to walk across room without human assistance on 60-day follow-up

From Carson JL et al. New Engl J Med 365:2453-62, 2011.

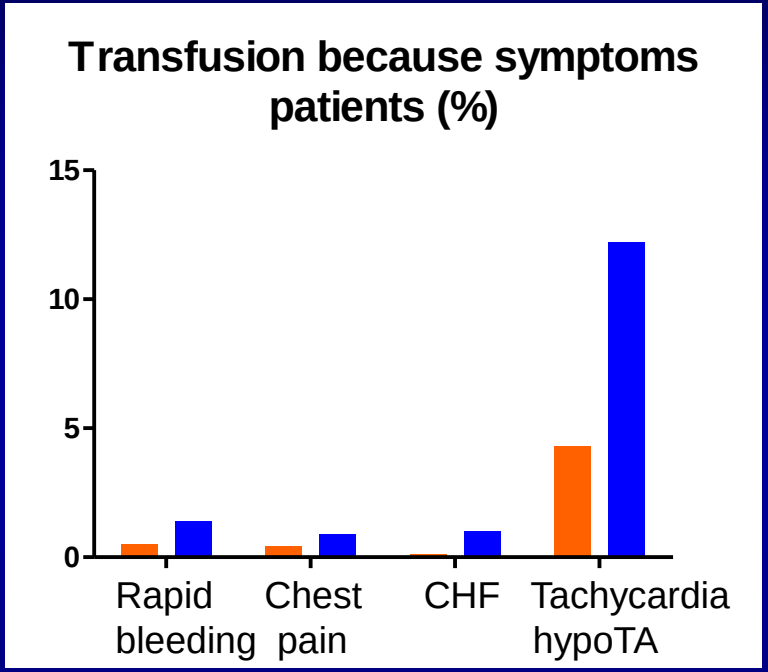
Blood Transfusion Strategy in High-Risk Patients after Hip Fracture Surgery



Age of the patients 82 ±10 y

Age of de blood: 22 ± 10 days

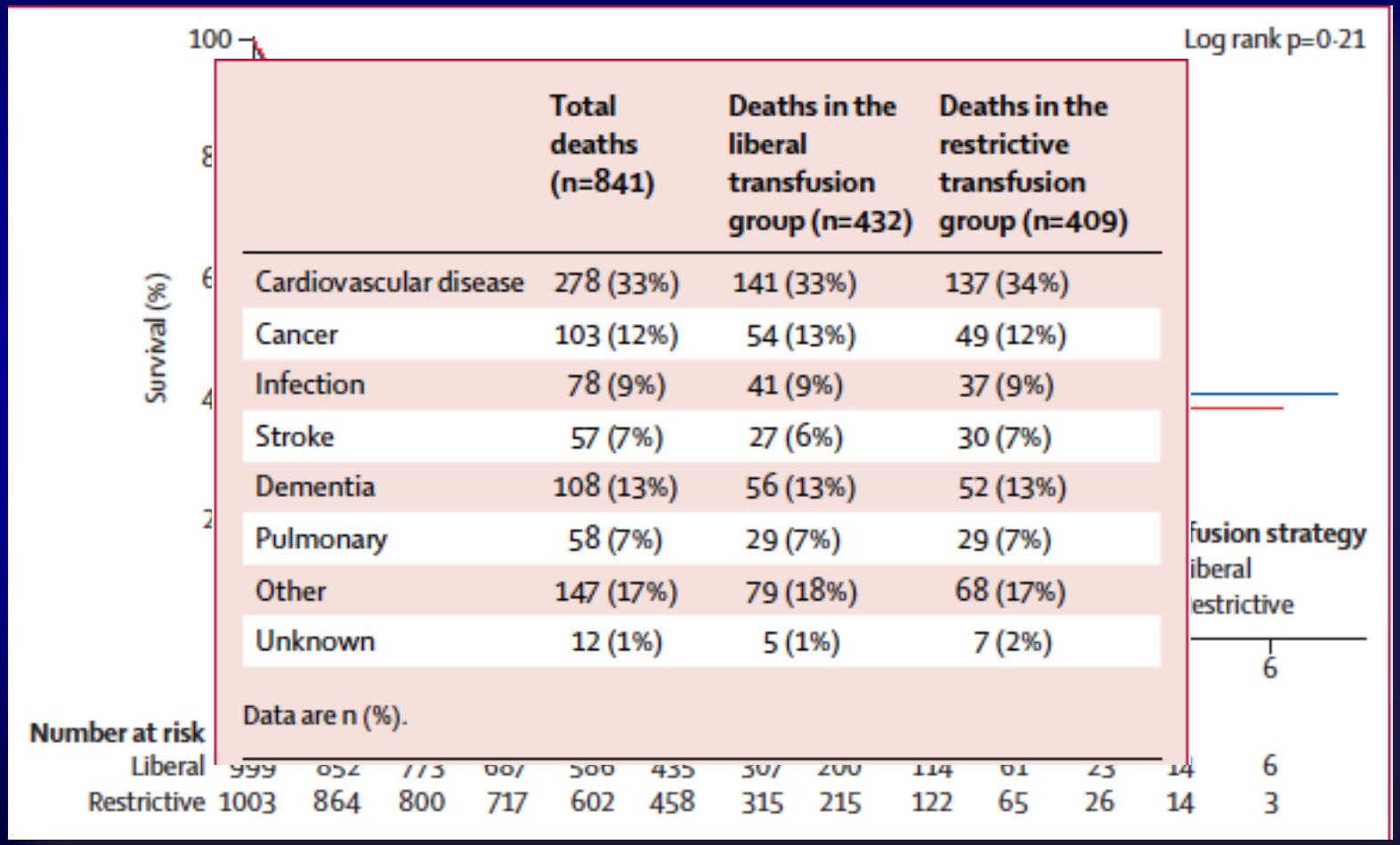
Leukoreduction: 90%



Primary outcome: death or inability to walk across room without human assistance on 60-day follow-up: 35,2 % vs 34,7%

From Carson JL et al. New Engl J Med 365:2453-62, 2011.

Blood Transfusion Strategy in High-Risk Patients after Hip Fracture Surgery: 3 Years Survival



	Total deaths (n=841)	Deaths in the liberal transfusion group (n=432)	Deaths in the restrictive transfusion group (n=409)
Cardiovascular disease	278 (33%)	141 (33%)	137 (34%)
Cancer	103 (12%)	54 (13%)	49 (12%)
Infection	78 (9%)	41 (9%)	37 (9%)
Stroke	57 (7%)	27 (6%)	30 (7%)
Dementia	108 (13%)	56 (13%)	52 (13%)
Pulmonary	58 (7%)	29 (7%)	29 (7%)
Other	147 (17%)	79 (18%)	68 (17%)
Unknown	12 (1%)	5 (1%)	7 (2%)

Data are n (%).

From Carson JL et al. Lancet 385:1183-9, 2015.

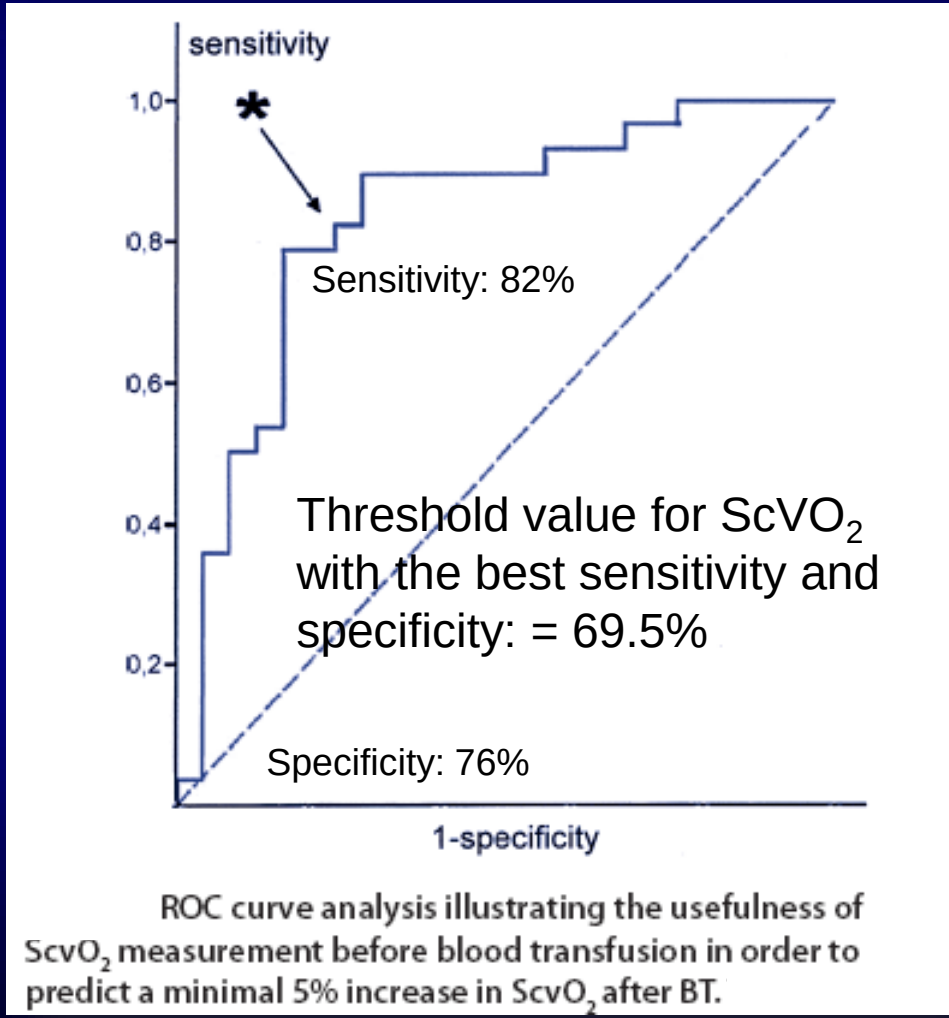
Transfusion Triggers

- Dyspnea
- Tachycardia
- Hypotension
- ST-T Abnormalities
- PvO_2, SvO_2, O_2ER
- Central venous O_2 saturation ?
- Others (lactate) ?

Central Venous O_2 Saturation as a Physiologic Transfusion Trigger

$O_2ER = VO_2 / DO_2$
$\approx (SaO_2 – SvO_2) / SaO_2$
$\approx 1 – SvO_2$

SvO_2 normal range: 68-77%
Central venous O2 saturation ($ScVO_2$): 5% above
Reinhart K et al. Intensive Care Med 30:1572-8, 2004.

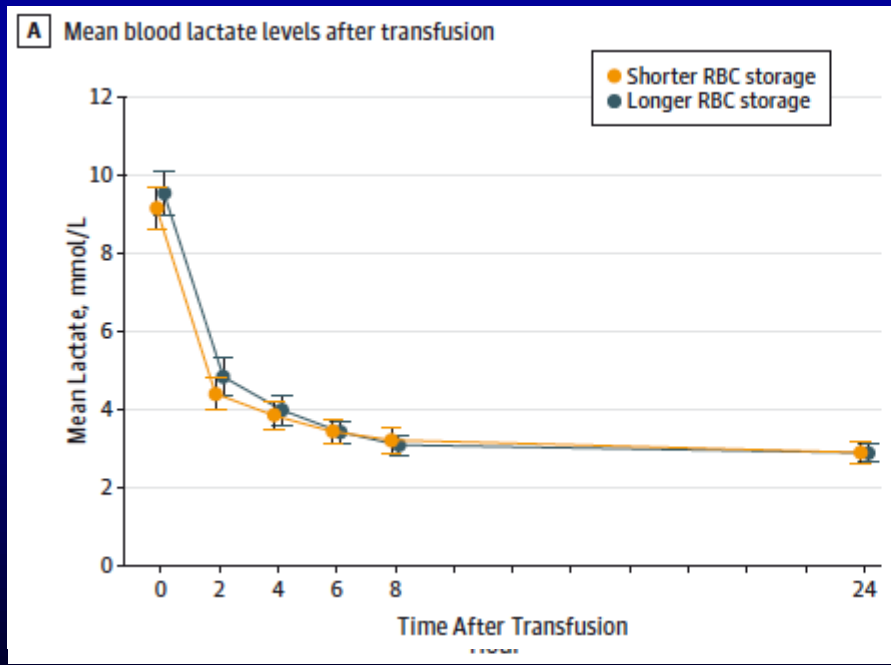


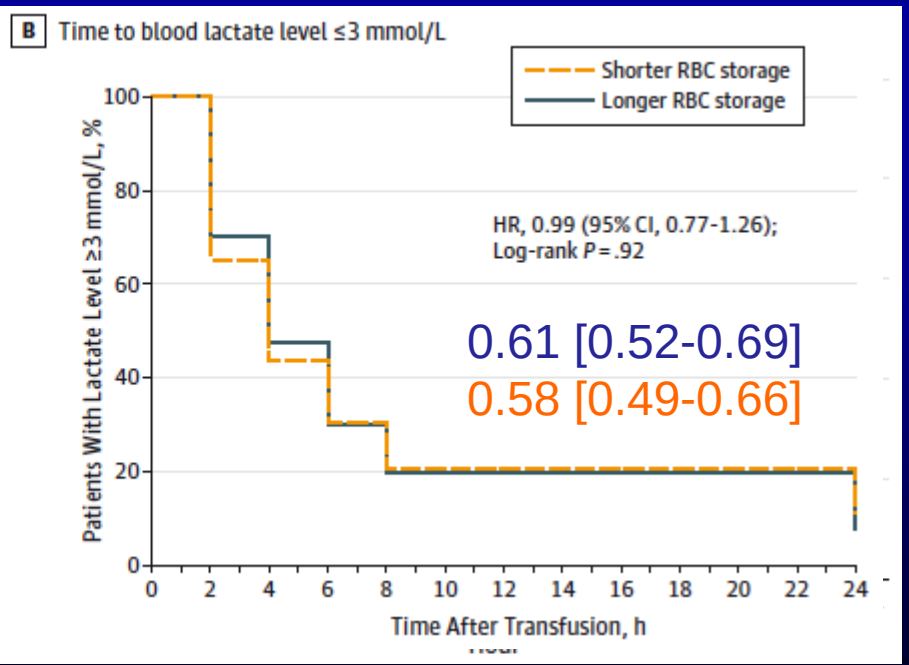
ROC curve analysis illustrating the usefulness of $ScvO_2$ measurement before blood transfusion in order to predict a minimal 5% increase in $ScvO_2$ after BT.

From Vallet B et al. Critical Care 14:213, 2010.

Effect of Transfusion of Red Blood Cells With Longer vs Shorter Storage Duration on Elevated Blood Lactate Levels in Children With Severe Anemia

- ✓ Randomized noninferiority trial: children with a Hb concentration ≤ 5 g/dL and a lactate level ≥ 5 mmol/L
- ✓ Pre-storage leukoreduced RBC transfusion (10-20 ml/kg)
  - Long storage RBC units (32 [30-34] days; N=145)
  - Short storage units (8 [7-9] days; N=145)





From Dhabangi A et al. JAMA doi:10.1001/jama.2015.13977

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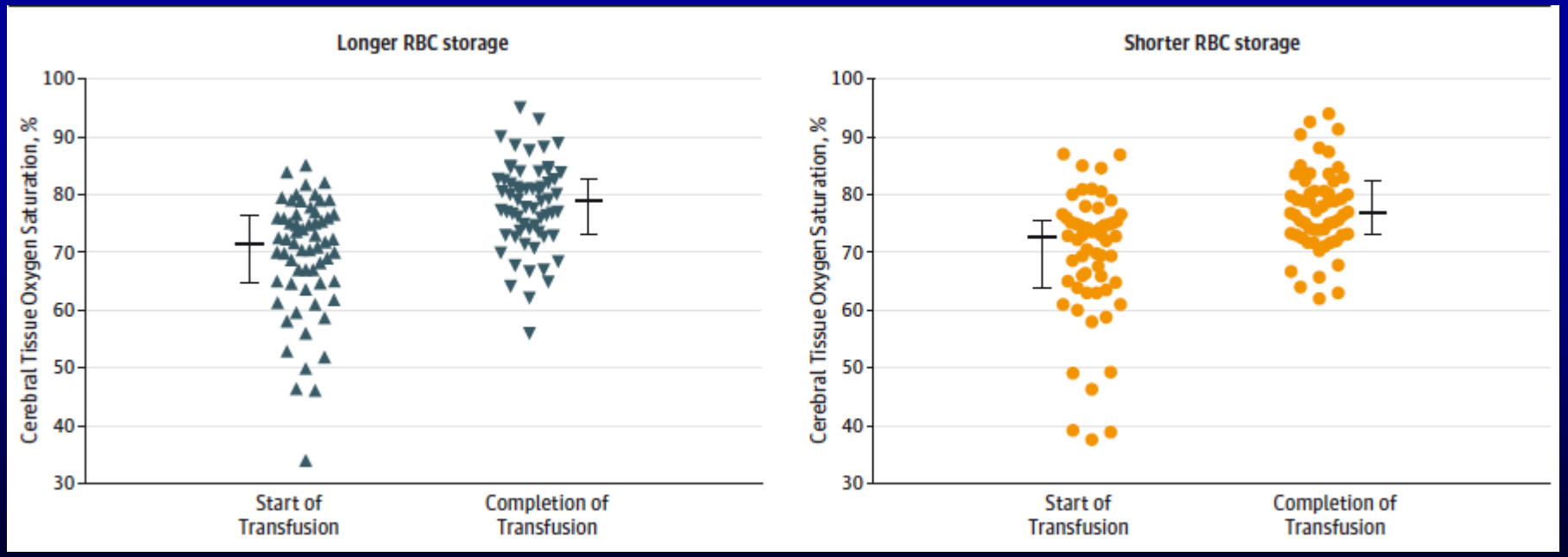
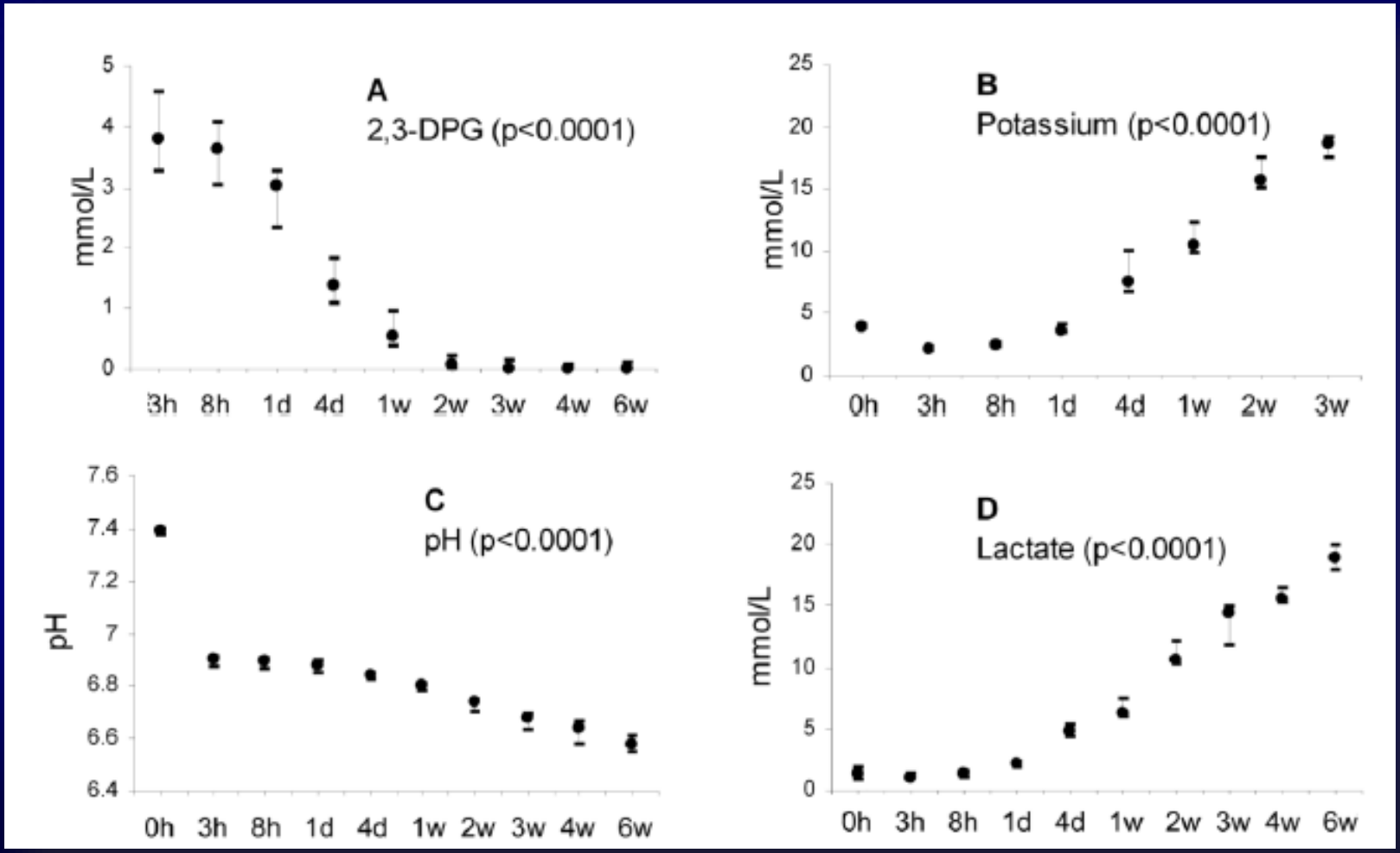


From Dhabangi A et al. JAMA doi:10.1001/jama.2015.13977

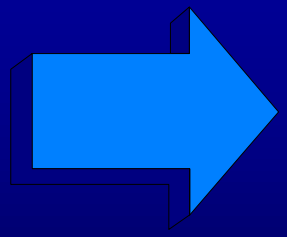
Change in Stored Red Blood Cell Characteristics Over Time



From Gilliss BM et al. Anesthesiology 115:635-49, 2011.

Blood Transfusion: "Storage Effects"

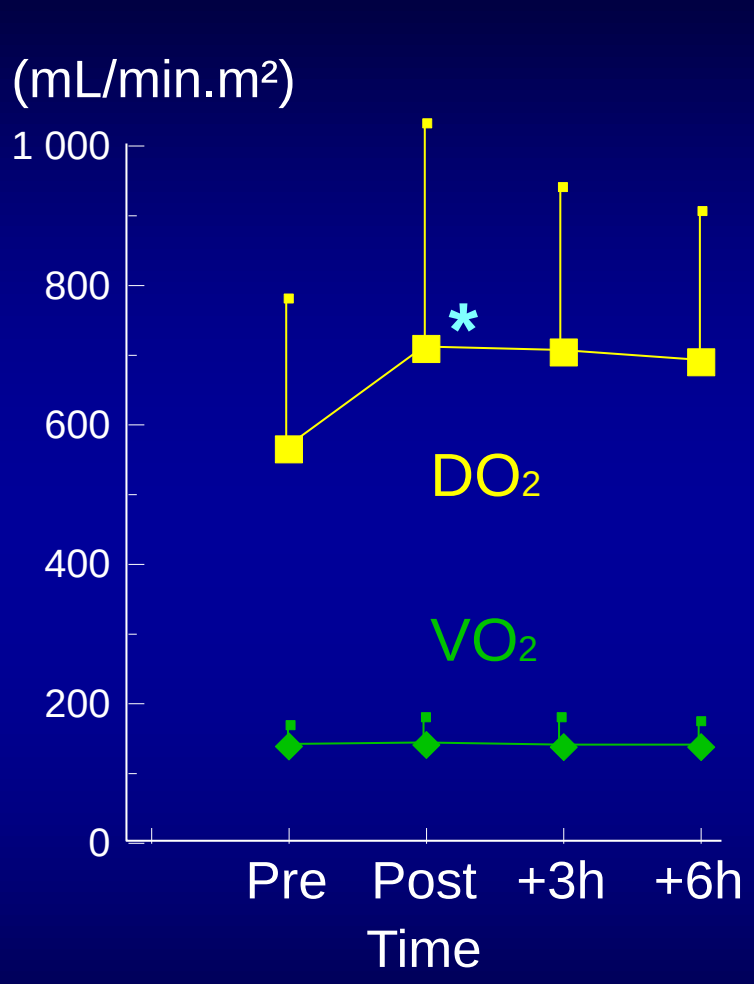
- Decreased 2, 3 - diphosphoglycerate (~ 0 after 15 days)
  - Increased affinity of hemoglobin for oxygen
- Decreased in red blood cell ATP
  - Change in RBC shape (discoid to spherocytic)
  - Reduced cellular deformability

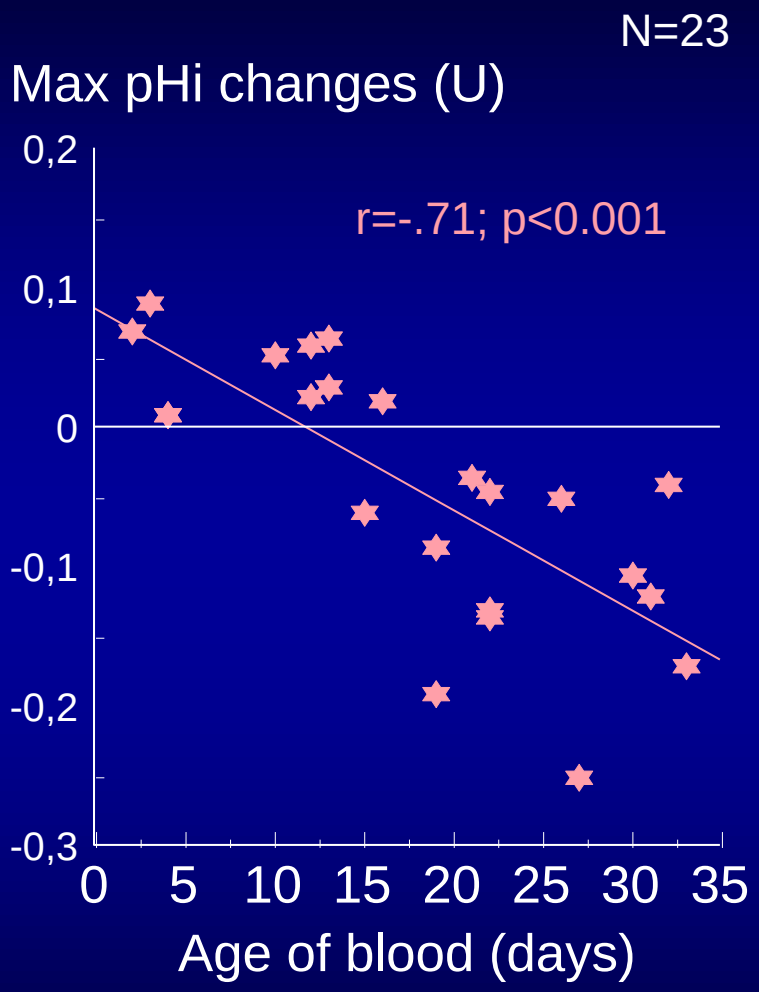


Decreased tissue oxygen availability

Endothelial swelling and tissue edema in sepsis reduce capillary luminal diameter

Effects of Allogeneic Blood Transfusion on VO_2





3 units PRBCs: hemoglobin 9.0 ± 0.8 to 11.9 ± 0.9 g/dl

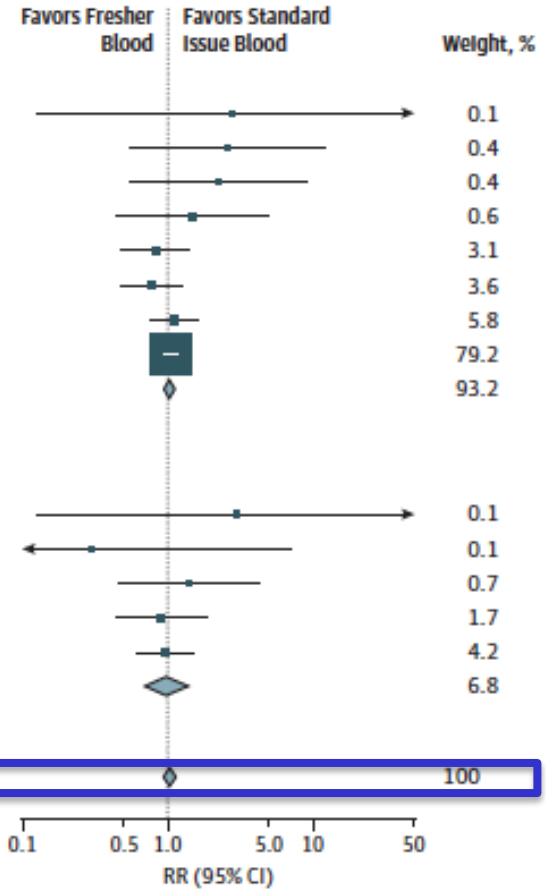
* p< 0.05 vs pre

From Marik PE and Sibbald WJ. JAMA 269:3024-3029, 1993.

Red Blood Cell Transfusion Threshold & Storage

- ✓ RBC storage duration:13 RCTS; 5,515 patients

Source	Fresher Blood No. of Deaths	Fresher Blood Total No.	Standard Issue Blood No. of Deaths	Standard Issue Blood Total No.	RR (95% CI)	Weight, %
Adults						
Bennett-Guerrero et al,[33] 2009	1	12	0	11	2.77 (0.12-61.65)	0.1
Aubron et al,[34] 2012	5	25	2	26	2.60 (0.55-12.19)	0.4
Schulman et al,[30] 2002	4	8	2	9	2.25 (0.55-9.17)	0.4
Hébert et al,[32] 2005	5	26	4	31	1.49 (0.45-4.98)	0.6
Steiner et al,[41] 2015	23	538	29	560	0.83 (0.48-1.41)	3.1
Kor et al,[37] 2012	17	50	22	50	0.77 (0.47-1.27)	3.6
Heddle et al,[36] 2012	35	309	61	601	1.12 (0.75-1.65)	5.8
Lacroix et al,[40] 2015	448	1211	430	1219	1.05 (0.94-1.17)	79.2
Subtotal	538	2179	550	2507	1.04 (0.95-1.15)	93.2
Heterogeneity: $\tau^2=0$; $\chi^2_7=5.47$; $P=.60$; $I^2=0\%$						
Tests for overall effect: z score = 0.85; $P=.40$						
Neonates, Infants, and Children						
Dhabangi et al,[38] 2013	1	37	0	37	3.00 (0.13-71.34)	0.1
Strauss et al,[29] 1996	0	21	1	19	0.30 (0.01-7.02)	0.1
Dhabangi et al,[39] 2015	7	143	5	143	1.40 (0.45-4.31)	0.7
Fernandes da Cunha et al,[31] 2005	9	26	10	26	0.90 (0.44-1.85)	1.7
Fergusson et al,[35] 2012	30	188	31	189	0.97 (0.61-1.54)	4.2
Subtotal	47	415	47	414	0.99 (0.69-1.42)	6.8
Heterogeneity: $\tau^2=0$; $\chi^2_4=1.46$; $P=.83$; $I^2=0\%$						
Tests for overall effect: z score = 0.06; $P=.96$						
Overall	585	2594	597	2921	1.04 (0.95-1.14)	100
Heterogeneity: $\tau^2=0$; $\chi^2_{12}=7.00$; $P=.86$; $I^2=0\%$						
Tests for overall effect: z score = 0.81; $P=.42$						
Tests for subgroup differences: $\chi^2_1=0.08$; $P=.78$; $I^2=0\%$						

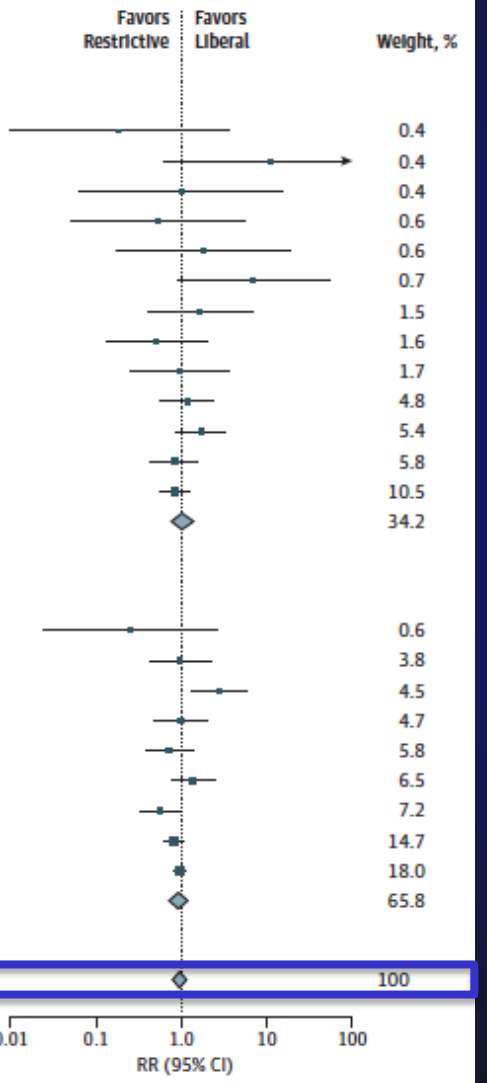


From Carson JL et al. JAMA 316: 2025-35, 2016.

Red Blood Cell Transfusion Threshold & Storage

Transfusion threshold
31 RCTS
12,587 patients

Source	Restrictive Transfusion Threshold: No. of Deaths	Restrictive Transfusion Threshold: Total No.	Liberal Transfusion Threshold: No. of Deaths	Liberal Transfusion Threshold: Total No.	RR (95% CI)	Weight, %
Restrictive threshold, hemoglobin <8 to 9 g/dL						
Lotke et al,[75] 1999	0	62	0	65	Not estimable	
Blair et al,[53] 1986	0	26	2	24	0.19 (0.01-3.67)	0.4
Foss et al,[63] 2009	5	60	0	60	11.00 (0.62-194.63)	0.4
Carson et al,[58] 1998	1	42	1	42	1.00 (0.06-15.47)	0.4
Webert et al,[86] 2008	1	29	2	31	0.53 (0.05-5.58)	0.6
Cooper et al,[61] 2011	2	23	1	21	1.83 (0.18-18.70)	0.6
Carson et al,[56] 2013	7	55	1	55	7.00 (0.89-55.01)	0.7
Parker,[78] 2013	5	100	3	100	1.67 (0.41-6.79)	1.5
Bracey et al,[54] 1999	3	215	6	222	0.52 (0.13-2.04)	1.6
Bush et al,[55] 1997	4	50	4	49	0.98 (0.26-3.70)	1.7
Hajjar et al,[68] 2010	15	249	13	253	1.17 (0.57-2.41)	4.8
Gregersen et al,[64] 2015	21	144	12	140	1.70 (0.87-3.32)	5.4
Jairath et al,[72] 2015	14	257	25	382	0.83 (0.44-1.57)	5.8
Carson et al,[60] 2011	43	1009	52	1007	0.83 (0.56-1.22)	10.5
Subtotal	121	2321	122	2451	1.05 (0.78-1.40)	34.2
Heterogeneity: $\tau^2=0.02$; $\chi^2_{12}=13.14$; $P=.36$; $I^2=9\%$						
Tests for overall effect: z score $=0.31$; $P=.76$						
Restrictive threshold, hemoglobin <7 g/dL						
DeZern et al,[87] 2016	1	59	2	30	0.25 (0.02-2.69)	0.6
Hébert et al,[70] 1995	8	33	9	36	0.97 (0.42-2.22)	3.8
de Almeida et al,[79] 2015	23	101	8	97	2.76 (1.30-5.87)	4.5
Lacroix et al,[74] 2007	14	320	14	317	0.99 (0.48-2.04)	4.7
Walsh et al,[85] 2013	12	51	16	49	0.72 (0.38-1.36)	5.8
Murphy et al,[76] 2015	26	1000	19	1003	1.37 (0.76-2.46)	6.5
Villanueva et al,[84] 2013	19	416	34	417	0.56 (0.32-0.97)	7.2
Hébert et al,[69] 1999	78	418	98	420	0.80 (0.61-1.04)	14.7
Holst et al,[71] 2014	168	502	175	496	0.95 (0.80-1.13)	18.0
Subtotal	349	2900	375	2865	0.94 (0.74-1.19)	65.8
Heterogeneity: $\tau^2=0.05$; $\chi^2_8=16.09$; $P=.04$; $I^2=50\%$						
Tests for overall effect: z score $=0.53$; $P=.59$						
Overall	470	5221	497	5316	0.97 (0.81-1.16)	100
Heterogeneity: $\tau^2=0.04$; $\chi^2_{21}=29.75$; $P=.10$; $I^2=29\%$						
Tests for overall effect: z score $=0.29$; $P=.77$						
Tests for subgroup differences: $\chi^2_1=0.34$; $P=.56$; $I^2=0\%$						

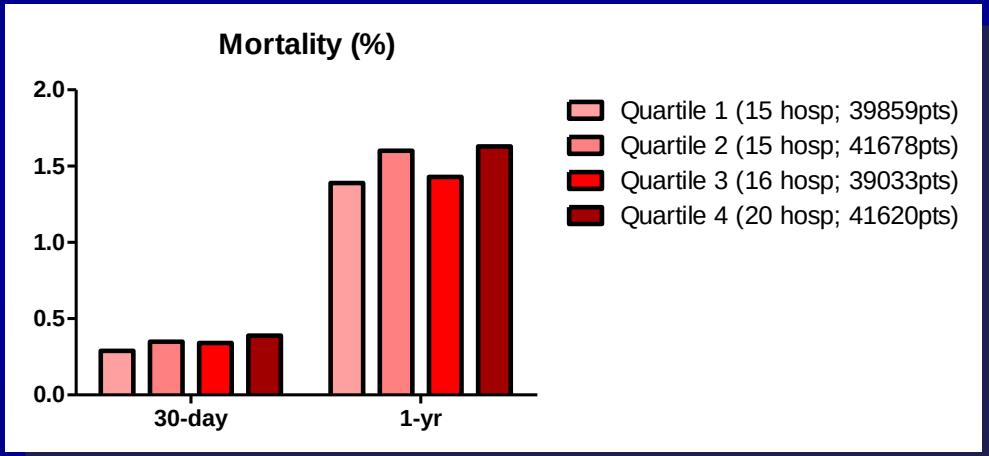


From Carson JL et al. JAMA 316: 2025-35, 2016.

Relationship of Erythrocyte Transfusion With Short & Long-term Mortality

✓ Population-based cohort study through analysis of administrative databases. Patients undergoing elective hip or knee surgery from 1999 to 2008 in Ontario (N=162,190 patients)

Transfusion rate:
Quartile 1: 12.7%
Quartile 2: 17.5%
Quartile 3: 23.7%
Quartile 4: 37.0%

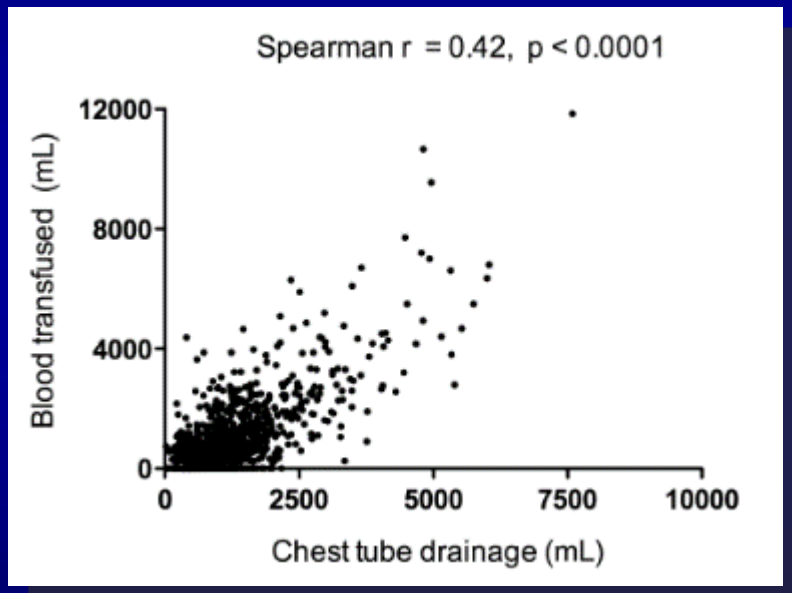


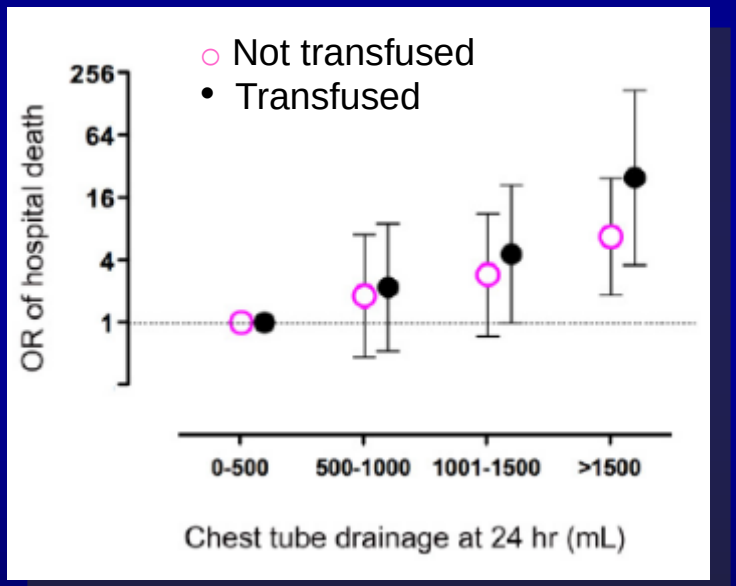
Hospital-specific Transfusion Quartile	30-day Mortality	1-yr Mortality
Quartile 1 (lowest)	Reference	Reference
Quartile 2	HR 1.06 (95% CI, 0.83–1.35; *P* = 0.66)	HR 1.05 (95% CI, 0.91–1.22; *P* = 0.50)
Quartile 3	HR 1.07 (95% CI, 0.81–1.40; *P* = 0.65)	HR 0.99 (95% CI, 0.87 –1.13; *P* = 0.88)
Quartile 4 (highest)	HR 1.11 (95% CI, 0.82–1.50; *P* = 0.50)	HR 1.02 (95% CI, 0.82–1.26; *P* = 0.88)

From Karkouti K et al. Anesthesiology 117:1175-83, 2012.

Association of Blood Transfusion With Mortality: Cause or Confounding?

- ✓ Retrospective study of patient data (2002-8; N=2599 patients)
- ✓ Risk factors associated with in-hospital mortality





✓Chest tube drainage was the strongest independent predictor of mortality while blood transfusion was not

From Dixon B et al. Transfusion 53:19-27, 2013.

Association Between Blood Transfusion & Morbi-Mortality After Major Surgery

Is transfusion the causal event leading to worse outcome or rather a marker for a sicker patient population that is more likely to undergo transfusion for many reasons?

Indications For Red Blood Cell Transfusion In Pediatric Cardiac Surgery: Effects on Outcome

✓ Indications for RBC transfusion:

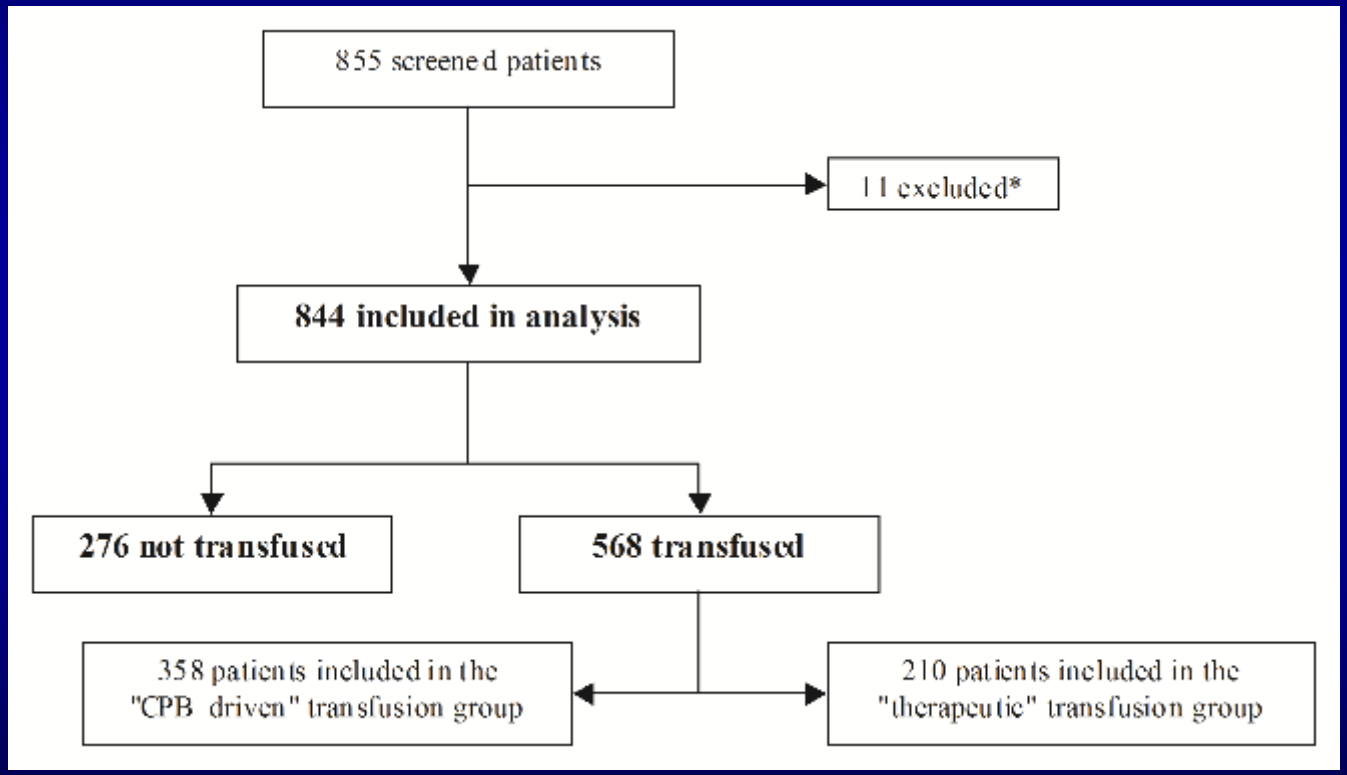
- To maintain a predefined hematocrit on bypass
- To treat perioperative blood loss and/or inadequate oxygen delivery

✓ Hypothesis: indication for RBC transfusion may impact the effects of transfusion on postoperative morbi-mortality in pediatric cardiac surgery

From Willems A et al. Eur J Cardiothorac Surg 45:1050-7, 2014.

Indications For Red Cell Transfusion In Pediatric Cardiac Surgery: Effects on Outcome

✓ Retrospective cohort study (2006-2009; N=855)



* Excluded patients were moribund (ASA5) or Jehovah's witness patients

From Willems A et al. Eur J Cardiothorac Surg 45:1050-7, 2014.

Indications For Red Cell Transfusion In Pediatric Cardiac Surgery: Effects on Outcome

- ✓ Retrospective cohort study (2006-2009; N=855)
- ✓ Transfused children (N=568)
  - Maintenance on-bypass hct of 24% (CPB driven: N=358)
  - Hemorrhage or O_2 delivery increase (therapeutic: N= 210)

  Hematocrit ≥ 24%, depending on clinical conditions: degree of hemorrhage, arterial hypoxemia, low cardiac output syndrome…

- ✓Standardized anesthetic, CPB and surgical techniques

From Willems A et al. Eur J Cardiothorac Surg 45:1050-7, 2014.

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- ✓ Primary outcome: composite measure including either hospital death and/or the presence of at least 2 of the following events:
  - Pulmonary failure (mechanical ventilation duration > 75th percentile)
  - Prolonged inotropic support (inotropes > 5 µg/kg.min for more than 48h)
  - Renal failure (reduction of postop creat clearance ≥ 75% from baseline)

From Willems A et al. Eur J Cardiothorac Surg 45:1050-7, 2014.

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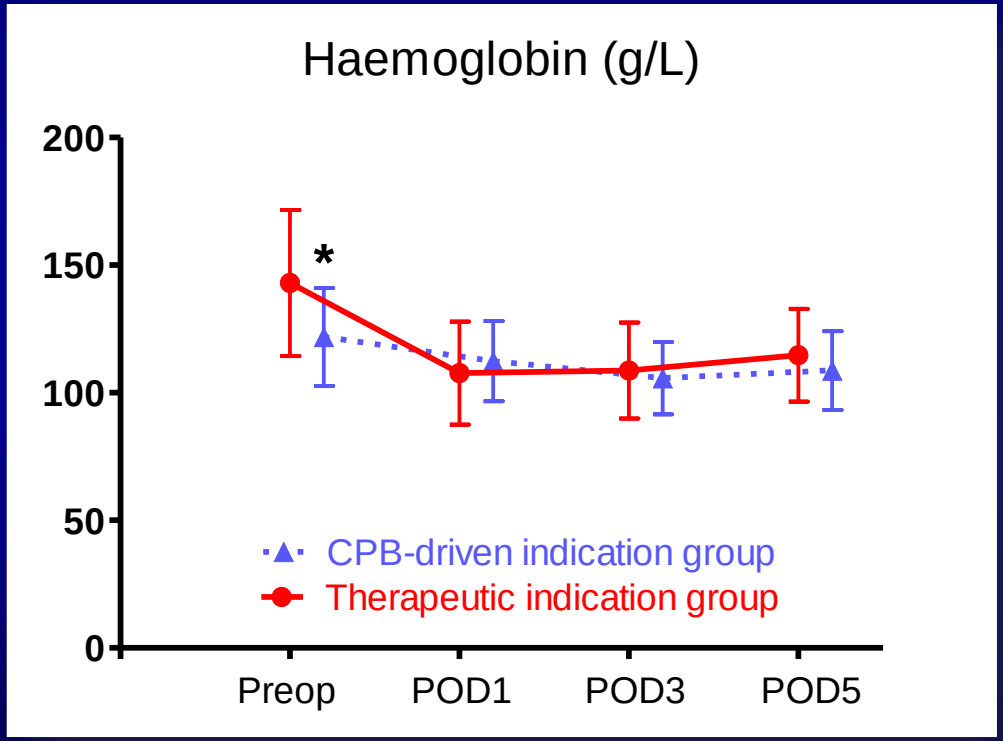

* p<0.05 CPB versus therapeutic transfusion group

From Willems A et al. Eur J Cardiothorac Surg 45:1050-7, 2014.

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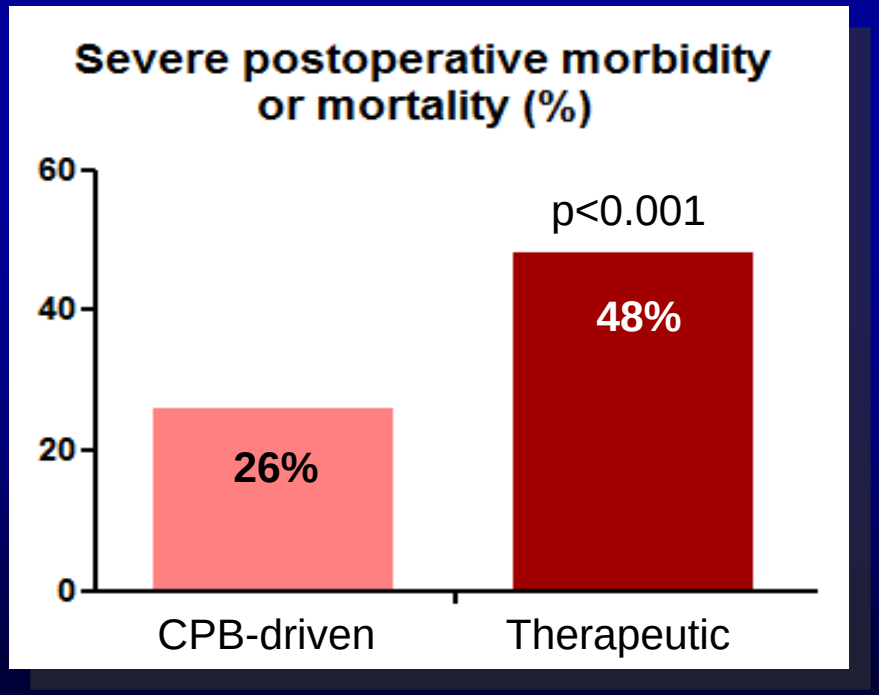

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  - Maintenance on-bypass hct of 20% (CPB driven: N=358)
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- ✓Adjusted multivariate analysis (age, gender, preop weight, redo-surgery, RACHS-1 score, and RBC transfusion volume)

Variable	OR (95% CI)	p value
ASA score	3.06 [1.50-6.23]	0.002
Indication for transfusion	1.90 [1.13-3.19]	0.016
PRISM II score	1.09 [1.04-1.13]	<0.001
Preoperative SaO2 (%)	1.03 [1.01-1.05]	0.006
Total intraoperative blood loss (ml/lkg)	1.01 [1.00-1.02]	0.002
CPB time (min)	1.01 [1.00-1.02]	0.014
Total blood loss (ml/kg)	1.01 [1.00-1.01]	0.021

Indications For Red Cell Transfusion In Pediatric Cardiac Surgery: Effects on Outcome

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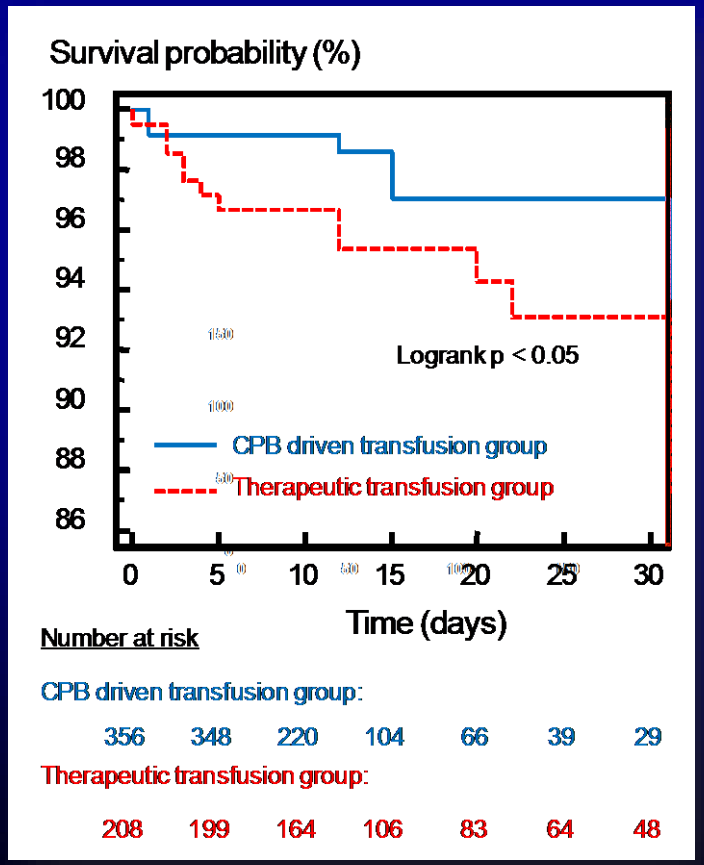


From Willems A et al.
Eur J Cardiothorac Surg
45:1050-7, 2014.

Indications For Red Cell Transfusion In Pediatric Cardiac Surgery: Effects on Outcome

The indication for transfusion per se influences the effect of RBC transfusion on postoperative morbi-mortality. This parameter should be considered in further research on the effects of blood transfusion on outcome

Does RBC Transfusion Transfused on Bypass Affect Outcome In Pediatric Cardiac Surgery

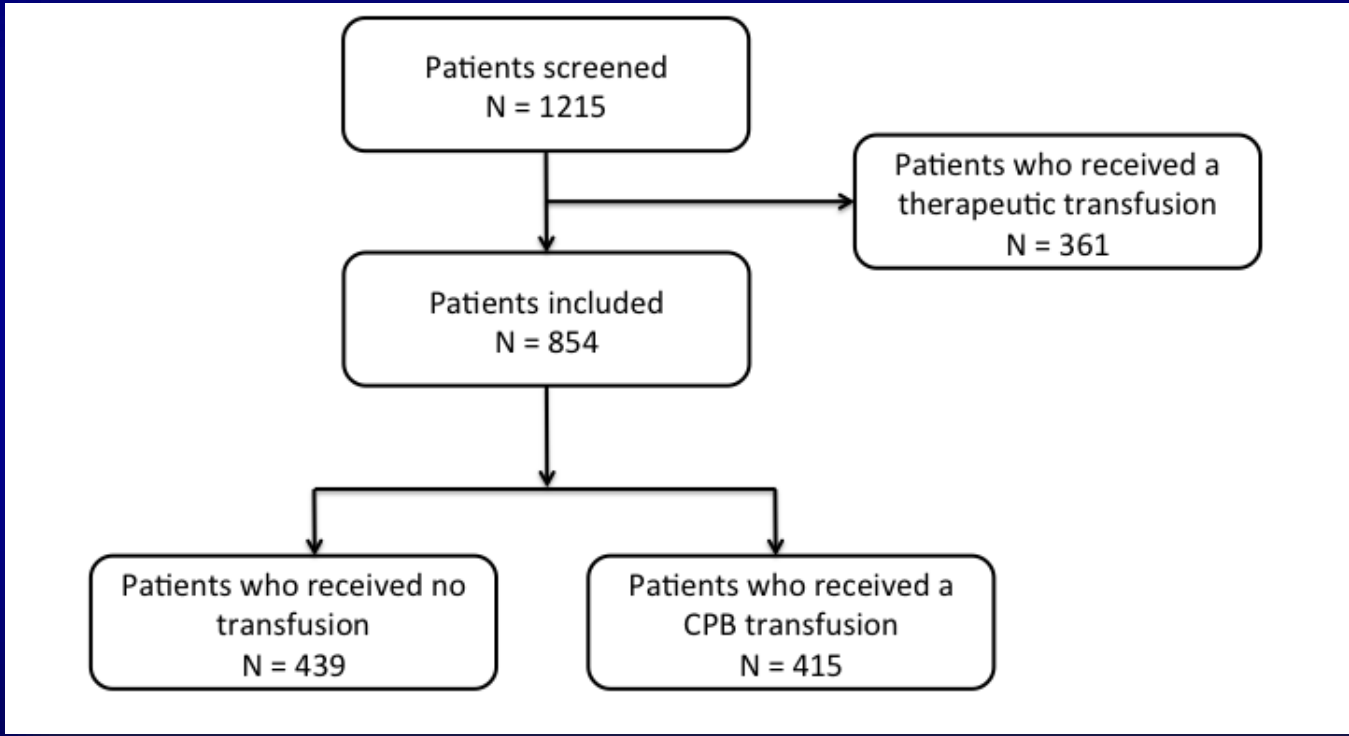
- ✓ RBC transfusion during CPB to maintained a predefined hct

- ✓ Hypothesis: on-bypass RBC transfusion does not affect postoperative morbi-mortality in pediatric cardiac surgery

From Willems A et al. Anesth Analg 123:420-9, 2016.

Does RBC Transfusion Transfused on Bypass Affect Outcome In Pediatric Cardiac Surgery

- ✓ Retrospective cohort study (2006-2012; N=1215)



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From Willems A et al. Anesth Analg 123:420-9, 2016.

Does RBC Transfusion Transfused on Bypass Affect Outcome In Pediatric Cardiac Surgery

- ✓ Retrospective cohort study (2006-2012; N=1215)
- ✓ Studied population (N=854)
  - No transfusion (N=439)
  - Transfused to maintain an on-bypass hct of 24% (N= 415)

- ✓ Primary outcome: composite measure including either hospital death and/or the presence of at least 2 of the following events:
  - Pulmonary failure (mechanical ventilation duration > 75th percentile)
  - Prolonged inotropic support (inotropes > 5 µg/kg.min for more than 48h)
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- ✓ Statistics: a propensity score analysis, using genetic matching followed by a logistic regression for binary outcomes variables and weighted least squares linear regression for continuous outcomes

From Willems A et al. Anesth Analg 123:420-9, 2016.

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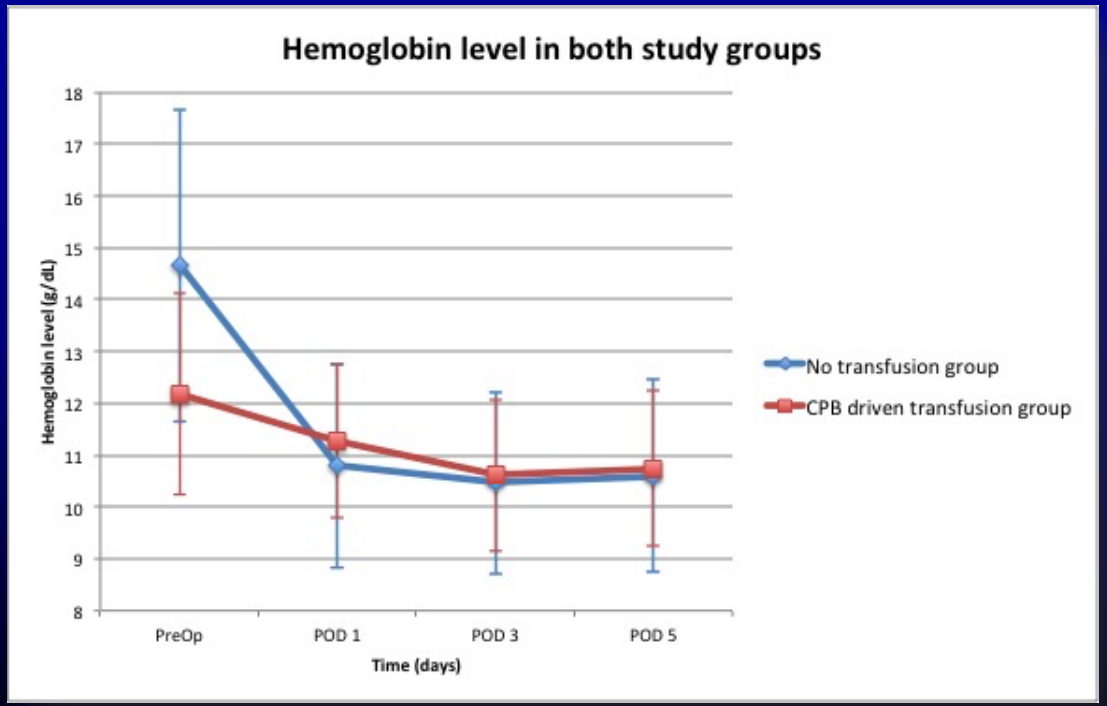

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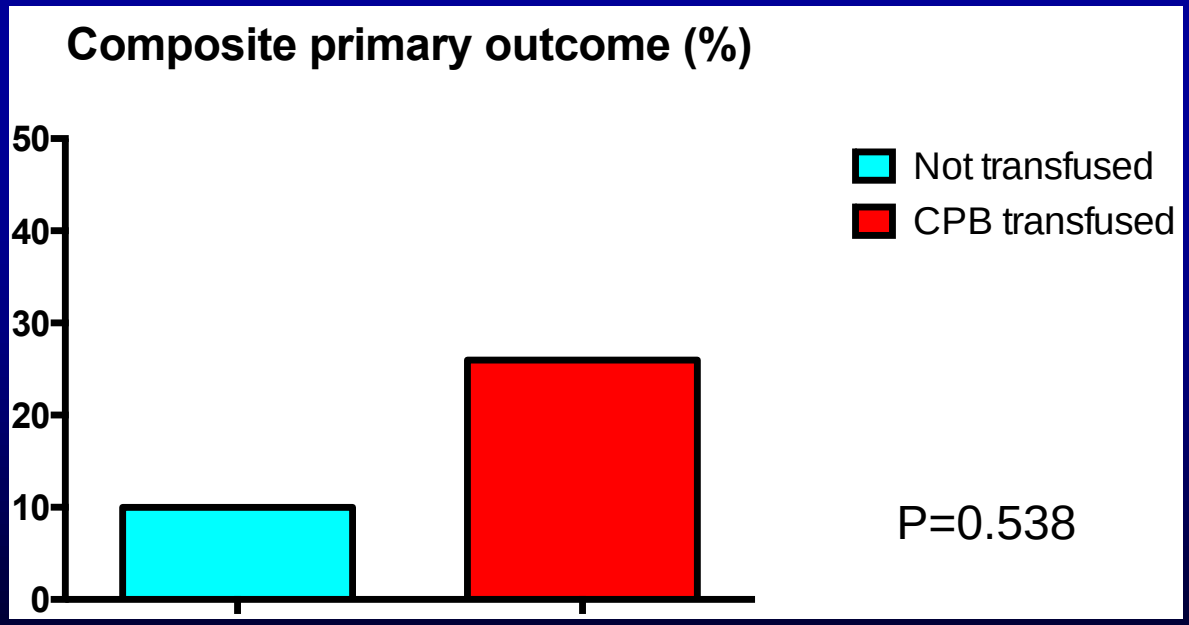


From Willems A et al. Anesth Analg 123:420-9, 2016.

Does RBC Transfusion Transfused on Bypass Affect Outcome In Pediatric Cardiac Surgery

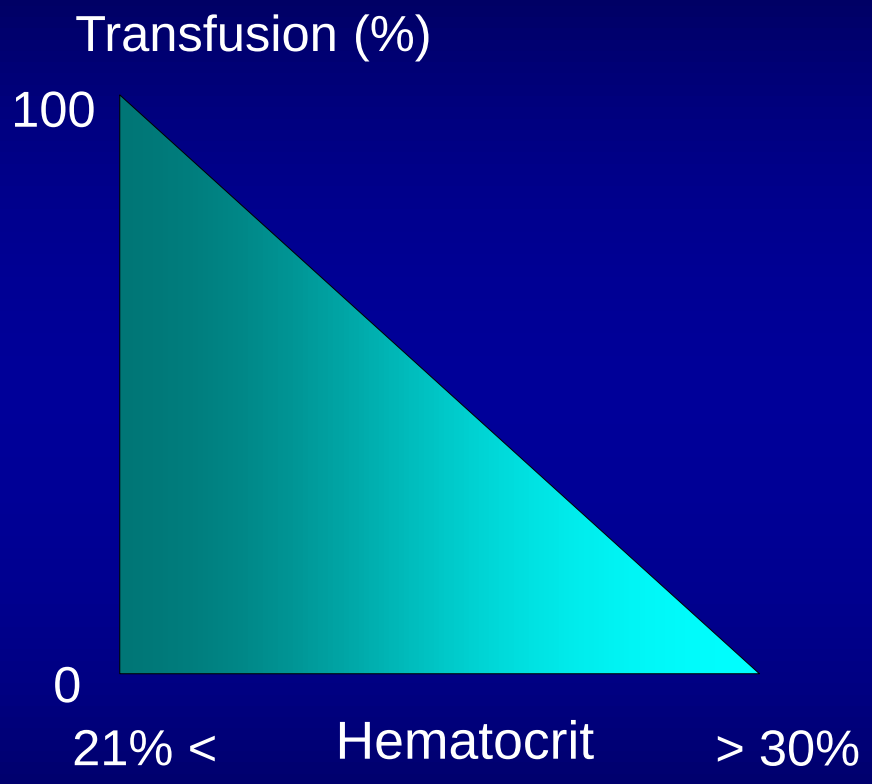
There is no evidence that on-bypass RBC transfusion affect outcome in pediatric cardiac surgery.

The real impact of RBC transfusion on postoperative morbi-mortality remains to be determined.

Perioperative Transfusion Trigger

✓ Transfusion practice largely individualized for each patient

✓ Transfusion policy based on a “one by one unit” strategy



Development of a patient’s blood management program:

- Optimization of preoperative RBC mass
- “Restrictive” blood loss strategy

Merci de votre attention

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: Motivation

- ✓ Known (and unknown) risk associated with blood products
- ✓ Constraints from escalating costs
- ✓ Preservation of the national blood inventory
  - Decreased donors' population
  - Increased demand of products

Aging of the population
Changes in travel pattern

  - Mismatch between recipients and donors regarding ABO blood groups

(i.e. sickle cell disease)

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