Queen's University

RBC TRANSFUSION

Science not the Art of Medicine

Transfusion Camp: September 2023

DISCLOSURE

Research funding from CSL Behring, Octapharma, Defense Research and Development Canada, CIHR, Heart and Stroke, Kidney Foundation, and **Canadian Blood Services**

OUTLINE

Three Cases

- Case 1: Stable patient on the medicine ward
- Case 2: Patient with ischemic heart disease going to the OR
- Case 3: Patient with a gastrointestinal hemorrhage in the ED

RBC Basics

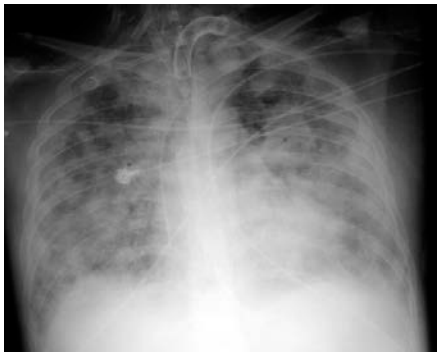
Risks of RBCs

When should you give RBCs?

Back to the three cases

[Note: massive hemorrhage, outpatient transfusions, and pediatric guidelines will be covered later/elsewhere]

WHY IS IT IMPORTANT THAT WE USE RBCS APPROPRIATELY?

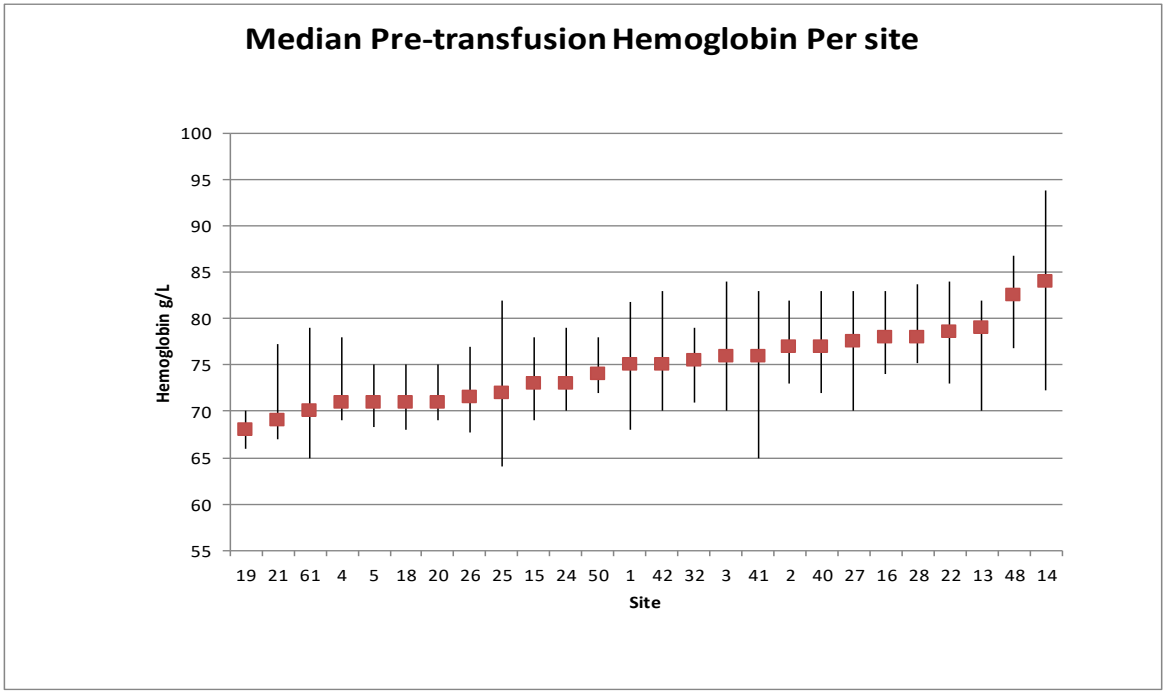


Safety

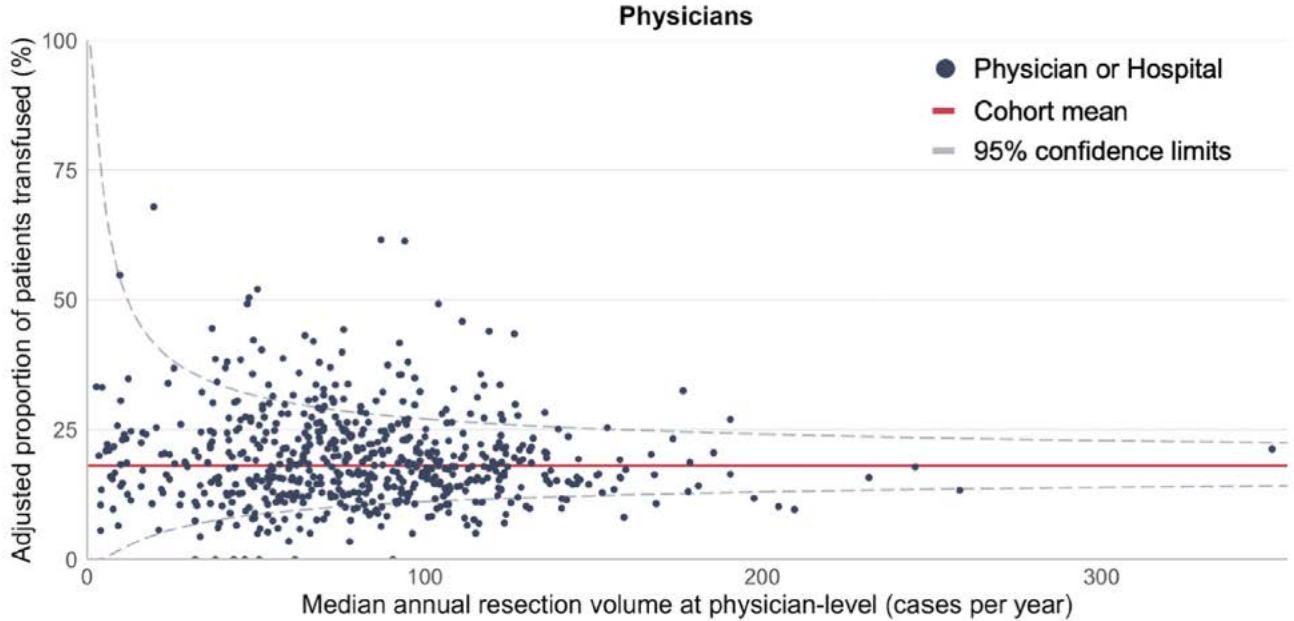
Supply
Donor iron deficiency

Cost

TRANSFUSION PRACTICE IS HIGHLY VARIABLE



INCLUDING IN SURGICAL PATIENTS



Surgery 173 (2023) 392–400

CASES

CASE 1: STABLE PATIENT ON THE MEDICINE WARD

78 year old man admitted with an exacerbation of heart failure and right leg cellulitis.

During admission the patient has been stabilized with adjustment of cardiac medications, diuretics, and antibiotics and is now day 10 post admission.

The hemoglobin has dropped from 122 g/L on admission to 78 g/L today.

The plan is for discharge home with home care in the next 2-3 days. He has no chest pain and his heart failure is stabilized.

CASE 2: PATIENT WITH IHD GOING TO THE OR

86 year old single woman without children with spontaneous hip fracture admitted through the ED.

Past history of ischemic heart disease with CABG 4 years ago.

Increasing difficulties with ADLs but living independently in an apartment.

3 months before admission hemoglobin 113 g/L, MCV 81, ferritin 5.

On list for OR tonight.

CBC shows hemoglobin 89 g/L, MCV 76.

Anemia is asymptomatic.

CASE 3: PATIENT WITH A GI HEMORRHAGE IN THE ED

62 year old man with a suspected upper GI bleed presents to the ED by ambulance with melena, dizziness, and pre-syncope

Past history of hypertension on two agents, including a B-blocker

On a DOAC for atrial fibrillation with last dose 6 hours before admission

HR 89, BP 86/42, in atrial fibrillation

Alert and oriented

2 Liters of crystalloid administered

Hemoglobin 95 g/L (6 months ago hemoglobin was 164 g/L at his routine check up)

HR 81, BP 91/45

We will come back to the cases…but first let's review the evidence

BASICS OF RBC

RBC BASICS

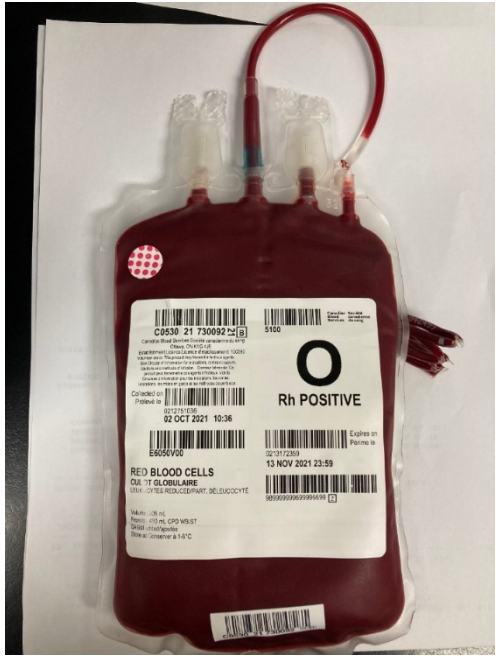
Regular

- Volume 300 mL, hematocrit 50-65%, SAG-M
- Each unit increases hemoglobin by 10 g/L
- Residual plasma – 2-30 mL (2 pack type with different processing)
- Acceptable for transfusion for 42 days from donation

Irradiated

- For immunocompromised patients at risk of TA-GVHD
- More potassium load and free hemoglobin

CMV-negative*



* The Canadian National Advisory Committee on Blood–IUT only

PATIENTS REQUIRING IRRADIATED BLOOD[146]

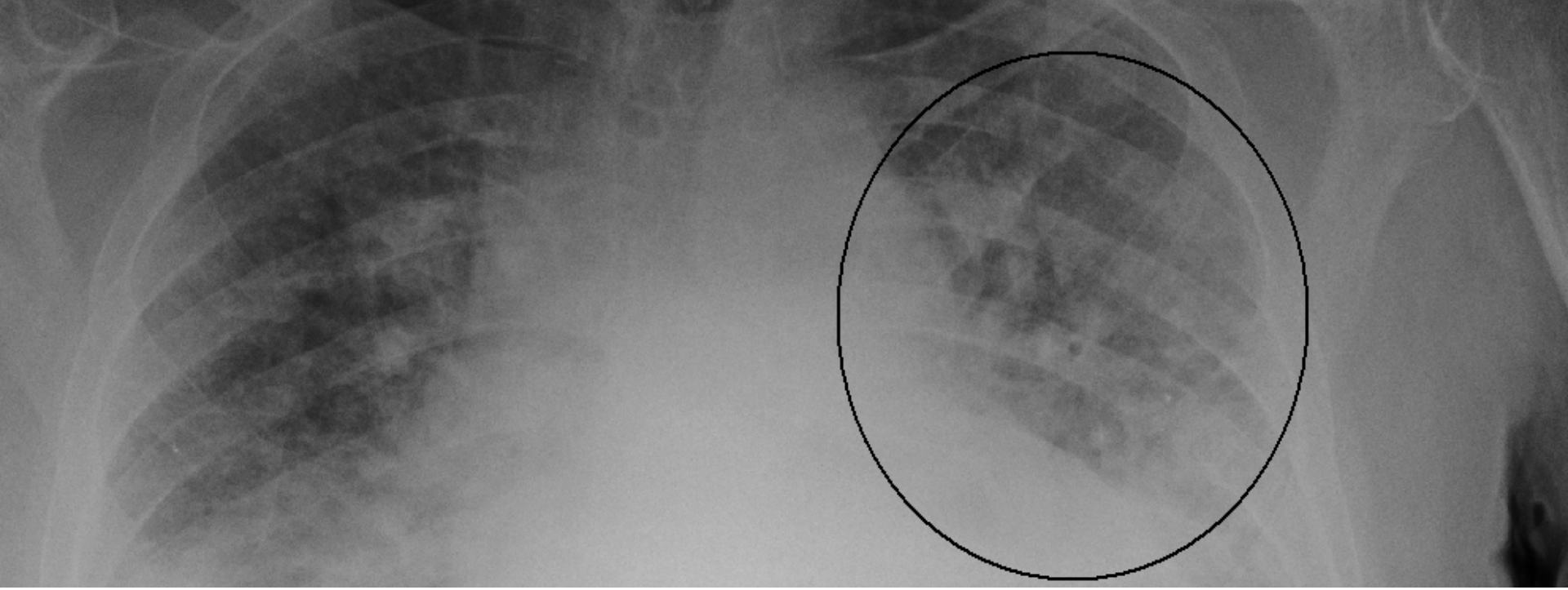
- First and second degree family members or HLA-selected donors.
- Intra-uterine or neonatal exchange transfusion.
- Congenital T-cell immunodeficiency.
- Autologous stem cell transplant recipients from 7 days prior to stem cell collection to 3 months post-transplant (6 months if total body irradiation is part of the conditioning regimen).
- Allogeneic stem cell transplant from initiation of conditioning regimen and continued until over 6 months post-transplant and lymphocyte count >1x10^9/L and patient free of chronic GvHD and off all immunosuppressive agents (otherwise continue indefinitely).
- CAR-T cell infusion from 7 days prior to collection and for 3 months after infusion.
- All patients with Hodgkin's Disease.
- Certain therapeutics in select patient populations (see box to right)

Alemtuzumab (anti-CD52)
Anti-thymocyte globulin (ATG)
Bendamustine
Cladribine (2-CDA)
Clofarabine
Deoxycoformicin
Fludarabine
Nelarabine

Pg. 67
Bloody Easy 5

[More on transfusion complications on day 2]

http://www.bcshguidelines.com/documents/irrad_bcsh_072010.pdf



THE RISKS OF RBCS

There is a potential risk for all patients

RISKS OF RBCS

Transfusion associated circulatory overload (TACO) – 1 in100
- *300 mL of RBCs is not the same as 300 mL of saline*

Transfusion-related acute lung injury (TRALI) – 1 in 10,000

Acute and delayed hemolytic transfusion reactions
- ABO-immune hemolysis (by mistake) – 1 in 354,000
- RBC alloantibodies - 1 in 13 (HDFN risk for patients of childbearing potential)
- Delayed hemolytic transfusion reactions - 1 in 2500

Anaphylaxis – 1 in 40,000

More bleeding (from GI bleeding trials)

HLA alloimmunization (leading to long waits for organ transplants)

Increased risk of thromboembolic complications

Association of ICH in recipients of donors who decades later had multiple ICH (cerebral amyloid angiopathy)

IT'S NOT BECAUSE OF A WORRY ABOUT HIV

<1 in 1,000,000	Transmission of West Nile Virus
1 in 2,000,000	Residual risk of hepatitis B per donation[85]
1 in 4,000,000	Transmission of Chagas disease per unit of component
1 in 12,900,000	Residual risk of human immunodeficiency virus (HIV) per donation[85]
1 in 27,100,000	Residual risk of hepatitis C per donation[85]
<1 in 1,000,000,000	Transmission of HTLV per unit of component[86]

Bloody easy 5, Ontario Transfusion Handbook

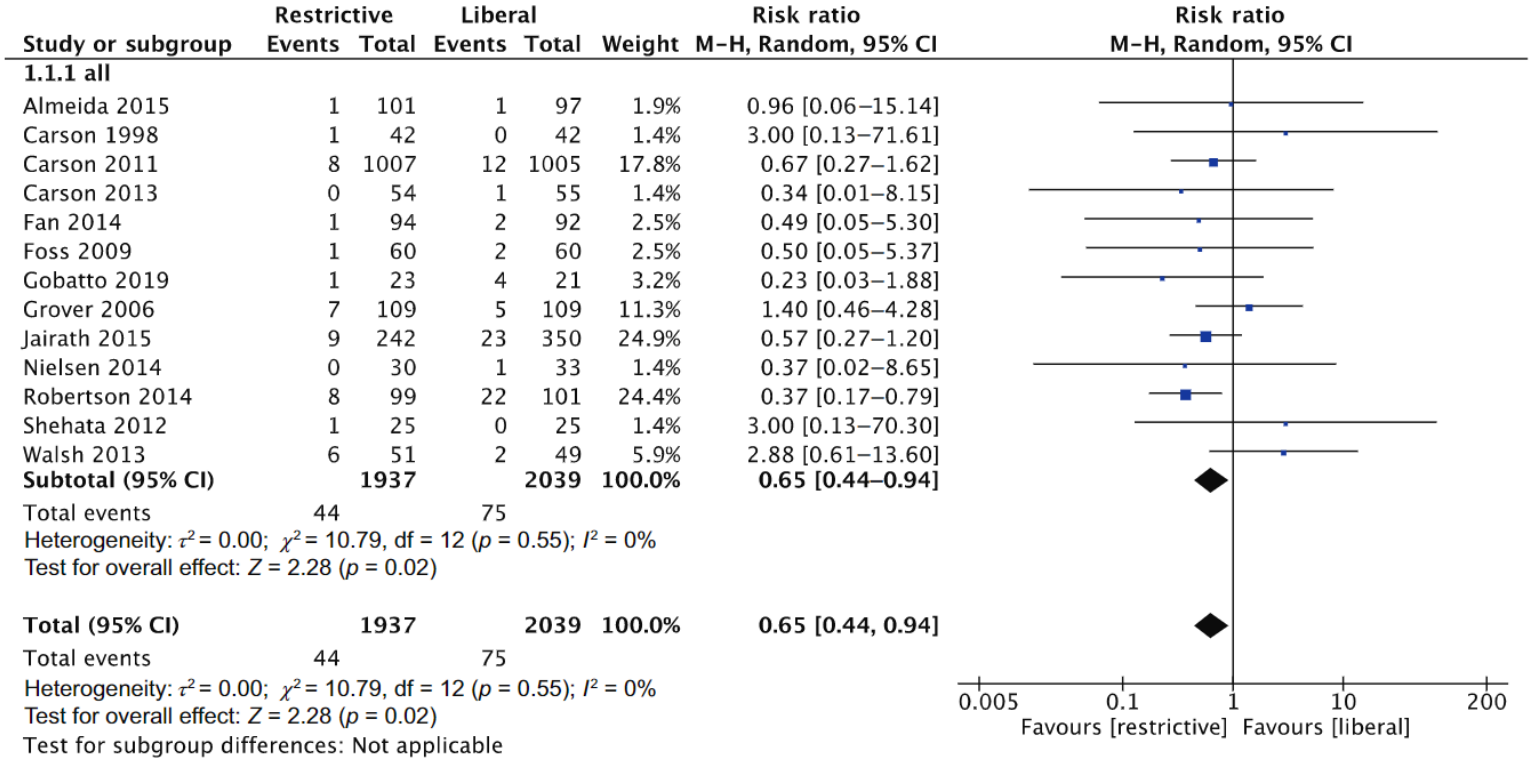


FIGURE 1 Comparison of thromboembolic events between restrictive and liberal transfusion strategies in randomized controlled trials (RCTs). Size of squares for risk ratio reflects weight of RCT in pooled analysis. Horizontal bars represent 95% confidence intervals (CIs). Risk ratio >1.0 favours liberal transfusion strategy. df, degrees of freedom; M–H, Mantel–Haenszel; Random, random-effects model

Maimaitiming M, et al. Vox Sang. 2022 Mar 25. doi: 10.1111/vox.13274.

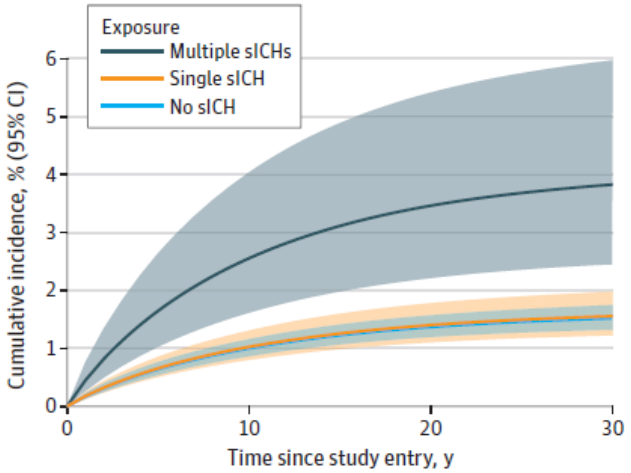
JAMA | Preliminary Communication

Intracerebral Hemorrhage Among Blood Donors and Their Transfusion Recipients

Jingcheng Zhao, MD, PhD; Klaus Rostgaard, MSc; Elsa Lauwers, PhD; Torsten Dahlén, MD, PhD; Sisse Rye Ostrowski, MD, PhD, DMSc; Christian Erikstrup, MD, PhD; Ole Birger Pedersen, MD, PhD; Bart de Strooper, MD, PhD; Robin Lemmens, MD, PhD; Henrik Hjalgrim, MD, PhD, DMSc; Gustaf Edgren, MD, PhD

- 760,000 and 330,000 recipients in Sweden and Denmark
- 862 and 448 were exposed to a donor who developed multiple ICH (median donor follow-up 22 years) – 1 in 1000 risk exposure
- HR 2.73 (1.72-4.35) at median follow-up of 8.2 years in Sweden
- HR 2.32 (1.04-5.19) at median follow-up of 5.0 years in Denmark
- Prion agent?

Figure 2. Cumulative Incidence of Single Spontaneous Intracerebral Hemorrhage (sICH) Using a 180-Day Exposure Assessment Window (Main Swedish Cohort)

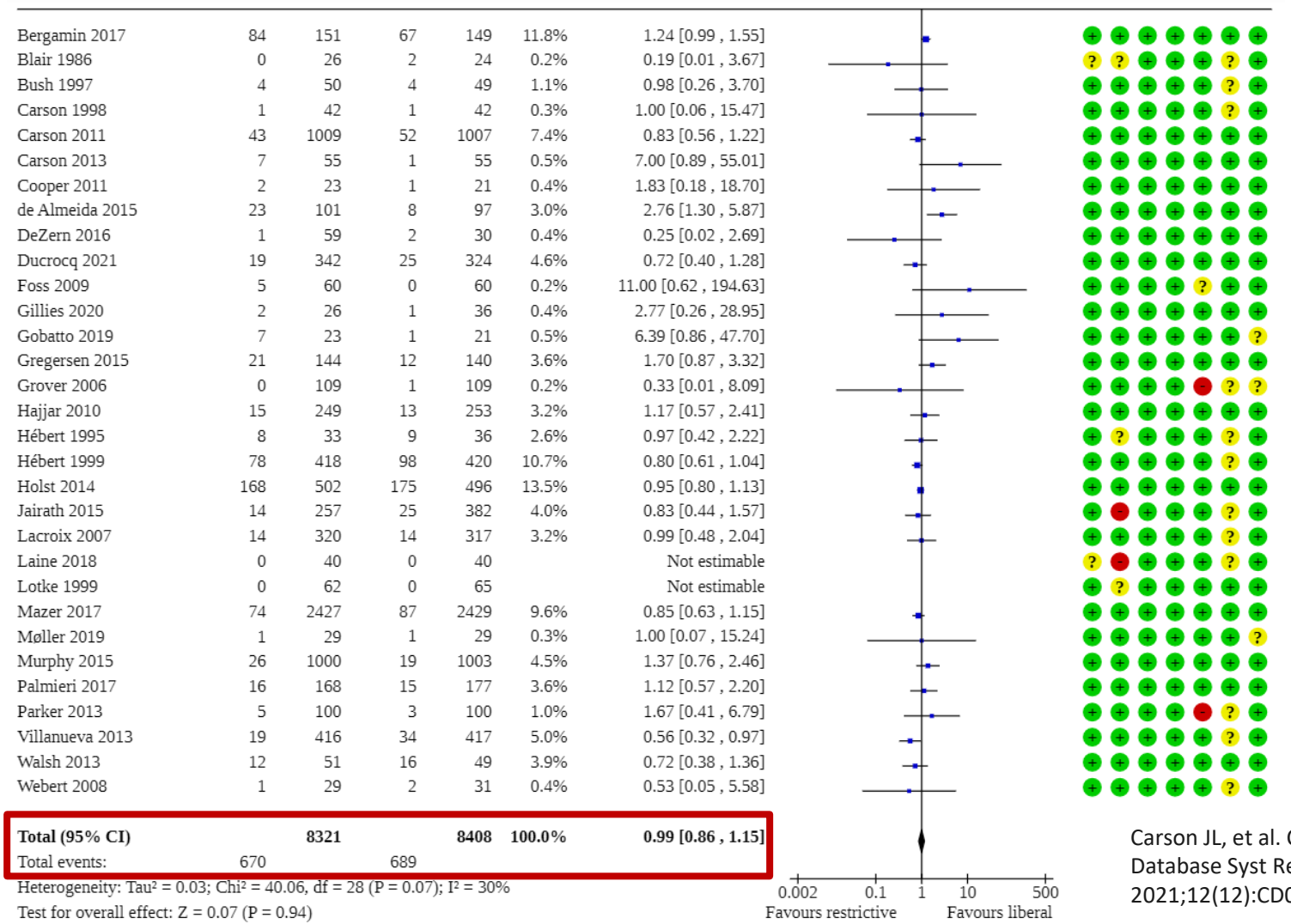


JAMA. 2023;330(10):941-950. doi:10.1001/jama.2023.14445

47 RCTS WITH 20,967 PATIENTS

restrictive (70-75-80)
vs. liberal (90-95-100)

Clinical trials.gov – 14 ongoing studies that will add an additional 15,000 patients



Bergamin 2017	84	151	67	149	11.8%	1.24 [0.99 , 1.55]
Blair 1986	0	26	2	24	0.2%	0.19 [0.01 , 3.67]
Bush 1997	4	50	4	49	1.1%	0.98 [0.26 , 3.70]
Carson 1998	1	42	1	42	0.3%	1.00 [0.06 , 15.47]
Carson 2011	43	1009	52	1007	7.4%	0.83 [0.56 , 1.22]
Carson 2013	7	55	1	55	0.5%	7.00 [0.89 , 55.01]
Cooper 2011	2	23	1	21	0.4%	1.83 [0.18 , 18.70]
de Almeida 2015	23	101	8	97	3.0%	2.76 [1.30 , 5.87]
DeZern 2016	1	59	2	30	0.4%	0.25 [0.02 , 2.69]
Ducrocq 2021	19	342	25	324	4.6%	0.72 [0.40 , 1.28]
Foss 2009	5	60	0	60	0.2%	11.00 [0.62 , 194.63]
Gillies 2020	2	26	1	36	0.4%	2.77 [0.26 , 28.95]
Gobatto 2019	7	23	1	21	0.5%	6.39 [0.86 , 47.70]
Gregersen 2015	21	144	12	140	3.6%	1.70 [0.87 , 3.32]
Grover 2006	0	109	1	109	0.2%	0.33 [0.01 , 8.09]
Hajjar 2010	15	249	13	253	3.2%	1.17 [0.57 , 2.41]
Hébert 1995	8	33	9	36	2.6%	0.97 [0.42 , 2.22]
Hébert 1999	78	418	98	420	10.7%	0.80 [0.61 , 1.04]
Holst 2014	168	502	175	496	13.5%	0.95 [0.80 , 1.13]
Jairath 2015	14	257	25	382	4.0%	0.83 [0.44 , 1.57]
Lacroix 2007	14	320	14	317	3.2%	0.99 [0.48 , 2.04]
Laine 2018	0	40	0	40		Not estimable
Lotke 1999	0	62	0	65		Not estimable
Mazer 2017	74	2427	87	2429	9.6%	0.85 [0.63 , 1.15]
Møller 2019	1	29	1	29	0.3%	1.00 [0.07 , 15.24]
Murphy 2015	26	1000	19	1003	4.5%	1.37 [0.76 , 2.46]
Palmieri 2017	16	168	15	177	3.6%	1.12 [0.57 , 2.20]
Parker 2013	5	100	3	100	1.0%	1.67 [0.41 , 6.79]
Villanueva 2013	19	416	34	417	5.0%	0.56 [0.32 , 0.97]
Walsh 2013	12	51	16	49	3.9%	0.72 [0.38 , 1.36]
Webert 2008	1	29	2	31	0.4%	0.53 [0.05 , 5.58]
Total (95% CI)		**8321**		**8408**	**100.0%**	**0.99 [0.86 , 1.15]**
Total events:	670		689			

Heterogeneity: Tau² = 0.03; Chi² = 40.06, df = 28 (P = 0.07); I² = 30%

Test for overall effect: Z = 0.07 (P = 0.94)

MORTALITY

Carson JL, et al. Cochrane Database Syst Rev. 2021;12(12):CD002042.

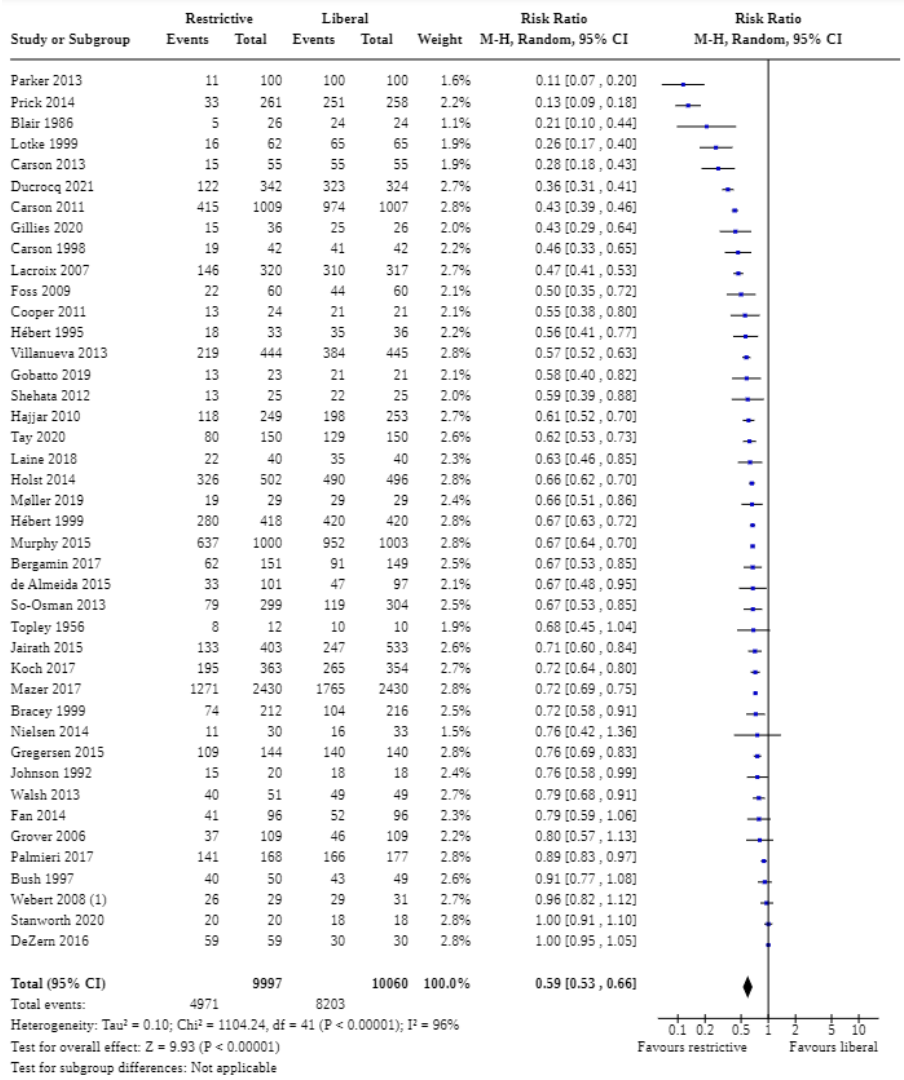
Restrictive thresholds:

Reduce the risk of transfusion

Relative Risk = 0.59 (0.53-0.66)

By -1.21 (-1.67 to -0.75) units

Each unit about $1000



Study or Subgroup	Restrictive Events	Restrictive Total	Liberal Events	Liberal Total	Weight	Risk Ratio M-H, Random, 95% CI
Parker 2013	11	100	100	100	1.6%	0.11 [0.07 , 0.20]
Prick 2014	33	261	251	258	2.2%	0.13 [0.09 , 0.18]
Blair 1986	5	26	24	24	1.1%	0.21 [0.10 , 0.44]
Lotke 1999	16	62	65	65	1.9%	0.26 [0.17 , 0.40]
Carson 2013	15	55	55	55	1.9%	0.28 [0.18 , 0.43]
Ducrocq 2021	122	342	323	324	2.7%	0.36 [0.31 , 0.41]
Carson 2011	415	1009	974	1007	2.8%	0.43 [0.39 , 0.46]
Gillies 2020	15	36	25	26	2.0%	0.43 [0.29 , 0.64]
Carson 1998	19	42	41	42	2.2%	0.46 [0.33 , 0.65]
Lacroix 2007	146	320	310	317	2.7%	0.47 [0.41 , 0.53]
Foss 2009	22	60	44	60	2.1%	0.50 [0.35 , 0.72]
Cooper 2011	13	24	21	21	2.1%	0.55 [0.38 , 0.80]
Hébert 1995	18	33	35	36	2.2%	0.56 [0.41 , 0.77]
Villanueva 2013	219	444	384	445	2.8%	0.57 [0.52 , 0.63]
Gobatto 2019	13	23	21	21	2.1%	0.58 [0.40 , 0.82]
Shehata 2012	13	25	22	25	2.0%	0.59 [0.39 , 0.88]
Hajjar 2010	118	249	198	253	2.7%	0.61 [0.52 , 0.70]
Tay 2020	80	150	129	150	2.6%	0.62 [0.53 , 0.73]
Laine 2018	22	40	35	40	2.3%	0.63 [0.46 , 0.85]
Holst 2014	326	502	490	496	2.8%	0.66 [0.62 , 0.70]
Møller 2019	19	29	29	29	2.4%	0.66 [0.51 , 0.86]
Hébert 1999	280	418	420	420	2.8%	0.67 [0.63 , 0.72]
Murphy 2015	637	1000	952	1003	2.8%	0.67 [0.64 , 0.70]
Bergamin 2017	62	151	91	149	2.5%	0.67 [0.53 , 0.85]
de Almeida 2015	33	101	47	97	2.1%	0.67 [0.48 , 0.95]
So-Osman 2013	79	299	119	304	2.5%	0.67 [0.53 , 0.85]
Topley 1956	8	12	10	10	1.9%	0.68 [0.45 , 1.04]
Jairath 2015	133	403	247	533	2.6%	0.71 [0.60 , 0.84]
Koch 2017	195	363	265	354	2.7%	0.72 [0.64 , 0.80]
Mazer 2017	1271	2430	1765	2430	2.8%	0.72 [0.69 , 0.75]
Bracey 1999	74	212	104	216	2.5%	0.72 [0.58 , 0.91]
Nielsen 2014	11	30	16	33	1.5%	0.76 [0.42 , 1.36]
Gregersen 2015	109	144	140	140	2.8%	0.76 [0.69 , 0.83]
Johnson 1992	15	20	18	18	2.4%	0.76 [0.58 , 0.99]
Walsh 2013	40	51	49	49	2.7%	0.79 [0.68 , 0.91]
Fan 2014	41	96	52	96	2.3%	0.79 [0.59 , 1.06]
Grover 2006	37	109	46	109	2.2%	0.80 [0.57 , 1.13]
Palmieri 2017	141	168	166	177	2.8%	0.89 [0.83 , 0.97]
Bush 1997	40	50	43	49	2.6%	0.91 [0.77 , 1.08]
Webert 2008 (1)	26	29	29	31	2.7%	0.96 [0.82 , 1.12]
Stanworth 2020	20	20	18	18	2.8%	1.00 [0.91 , 1.10]
DeZern 2016	59	59	30	30	2.8%	1.00 [0.95 , 1.05]
Total (95% CI)		**9997**		**10060**	**100.0%**	**0.59 [0.53 , 0.66]**
Total events:	4971		8203			

Heterogeneity: Tau² = 0.10; Chi² = 1104.24, df = 41 (P < 0.00001); I² = 96%

Test for overall effect: Z = 9.93 (P < 0.00001)

Test for subgroup differences: Not applicable

Risk Ratio M-H, Random, 95% CI

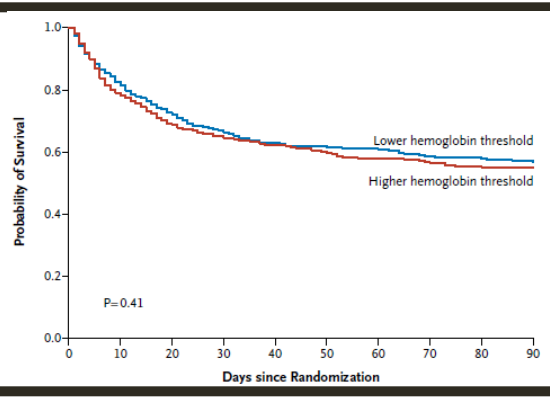
0.1 0.2 0.5 1 2 5 10

Favours restrictive Favours liberal

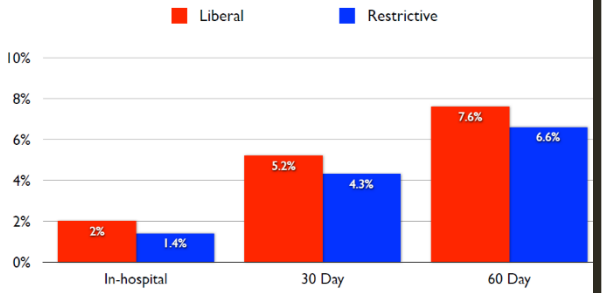
Carson JL, et al. Cochrane Database Syst Rev. 2021;12(12):CD002042.

KEY RBC TRIALS

TRISS
Holst
NEJM 2014
Septic Shock
n=998
70 vs 90 g/L
No subgroups



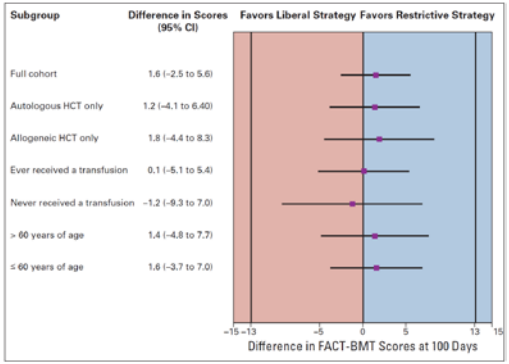
FOCUS
Carson
NEJM 2011
Fractured hips
Periop
n=2016
80 vs 100



TRICS III
Mazer
NEJM 2017
CVSx
n=5035
75 vs 95 g/L
No subgroups

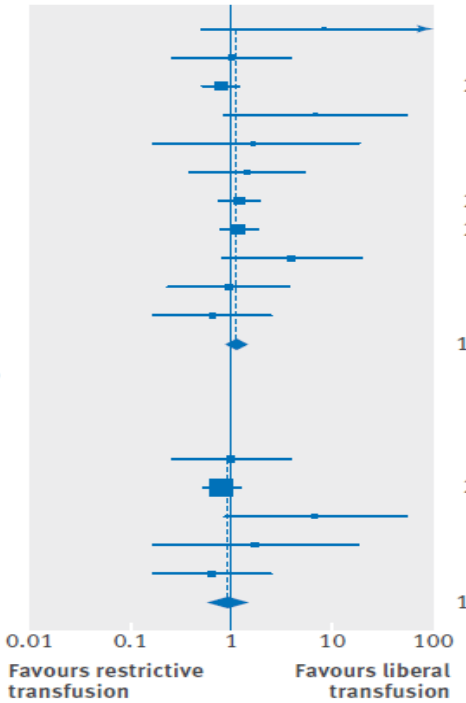
Composite: 0.90 (0.76-1.07)
Death: 0.85 (0.62-1.16)
Stroke: 0.92 (0.61-1.38)
MI: 1.00 (0.79-1.27)
Kidney Failure: 0.84 (0.60-1.19)

TRIST
Tay
JCO 2020
Hematology
n=300
70 vs 90



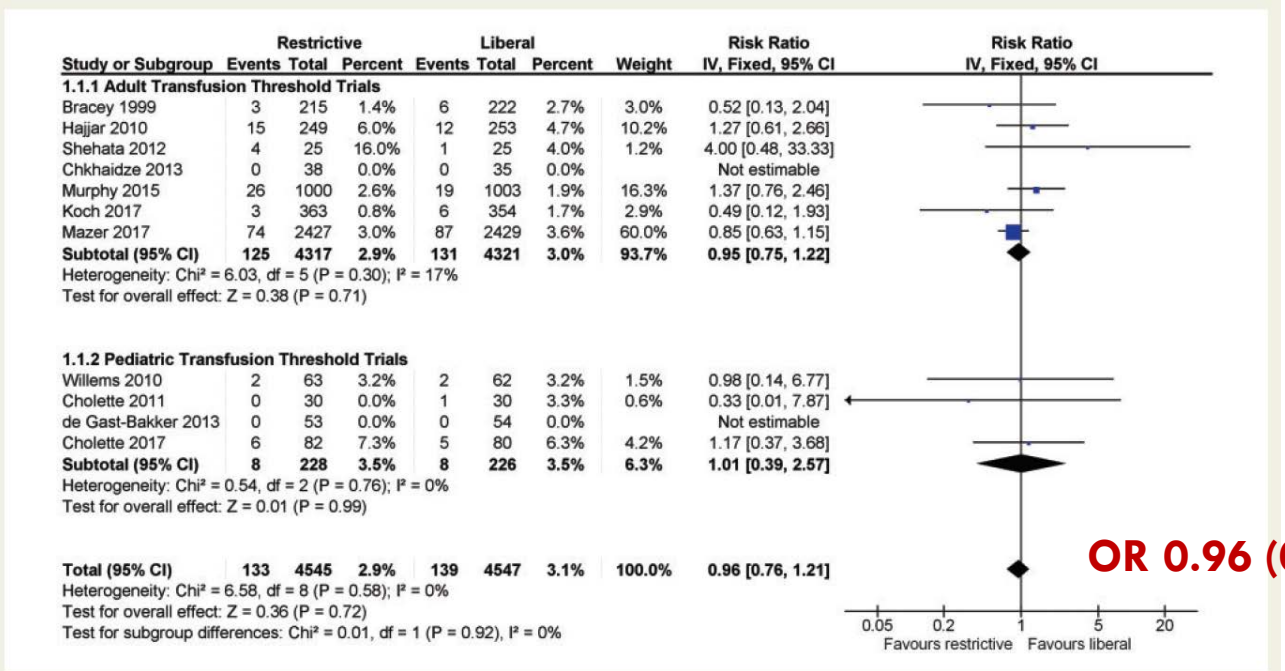
NO BENEFIT IN CVD PATIENTS

Study	No of events/ total No of patients: Restrictive transfusion	Liberal transfusion	Risk ratio MH random effect (95% CI)	Weight (%)	Risk ratio MH random effect (95% CI)
All studies					
Almeida 2015	7/22	0/12		0.9	8.48 (0.53 to 136.76)
Bush 1997	4/49	4/50		3.8	1.02 (0.27 to 3.85)
Carson 2011	43/1008	52/995		27.7	0.82 (0.55 to 1.21)
Carson 2013	7/55	1/55		1.6	7.00 (0.89 to 55.01)
Cooper 2011	2/24	1/21		1.3	1.75 (0.17 to 17.95)
Gregersen 2015	6/34	3/25		4.0	1.47 (0.41 to 5.32)
Hebert 1999	29/111	31/146		23.9	1.23 (0.79 to 1.91)
Holst 2014	33/75	24/66		26.5	1.21 (0.80 to 1.82)
Jairath 2015*	6/49	2/67		2.8	4.10 (0.86 to 19.47)
Parker 2013	4/70	4/67		3.7	0.96 (0.25 to 3.67)
Walsh 2013	3/17	4/15		3.8	0.66 (0.18 to 1.50)
Total	144/1514	126/1519		100.0	1.15 (0.88 to 1.50)
Test for heterogeneity: τ^2=0.03, χ^2=11.58, df=10, P=0.31, I^2=14%					
Test for overall effect: z=1.04, P=0.30					
Studies randomised by CVD					
Bush 1997	4/49	4/50		3.8	1.02 (0.27 to 3.85)
Carson 2011	43/1008	52/995		27.7	0.82 (0.55 to 1.21)
Carson 2013	7/55	1/55		1.6	7.00 (0.89 to 55.01)
Cooper 2011	2/24	1/21		1.3	1.75 (0.17 to 17.95)
Walsh 2013	3/17	4/15		3.8	0.66 (0.18 to 1.50)
Total	59/1153	62/1136		100.0	0.96 (0.58 to 1.59)
Test for heterogeneity: τ^2=0.06, χ^2=4.67, df=4, P=0.32, I^2=14%					
Test for overall effect: z=0.17, P=0.87					



BMJ 2016;352:i1351

NO BENEFIT FOR CARDIAC SURGERY PATIENTS



Study or Subgroup	Restrictive Events	Total	Percent	Liberal Events	Total	Percent	Weight	Risk Ratio IV, Fixed, 95% CI
1.1.1 Adult Transfusion Threshold Trials								
Bracey 1999	3	215	1.4%	6	222	2.7%	3.0%	0.52 [0.13, 2.04]
Hajjar 2010	15	249	6.0%	12	253	4.7%	10.2%	1.27 [0.61, 2.66]
Shehata 2012	4	25	16.0%	1	25	4.0%	1.2%	4.00 [0.48, 33.33]
Chkhaidze 2013	0	38	0.0%	0	35	0.0%		Not estimable
Murphy 2015	26	1000	2.6%	19	1003	1.9%	16.3%	1.37 [0.76, 2.46]
Koch 2017	3	363	0.8%	6	354	1.7%	2.9%	0.49 [0.12, 1.93]
Mazer 2017	74	2427	3.0%	87	2429	3.6%	60.0%	0.85 [0.63, 1.15]
Subtotal (95% CI)	**125**	**4317**	**2.9%**	**131**	**4321**	**3.0%**	**93.7%**	**0.95 [0.75, 1.22]**
Heterogeneity: Chi² = 6.03, df = 5 (P = 0.30); I² = 17%								
Test for overall effect: Z = 0.38 (P = 0.71)								
1.1.2 Pediatric Transfusion Threshold Trials								
Willems 2010	2	63	3.2%	2	62	3.2%	1.5%	0.98 [0.14, 6.77]
Cholette 2011	0	30	0.0%	1	30	3.3%	0.6%	0.33 [0.01, 7.87]
de Gast-Bakker 2013	0	53	0.0%	0	54	0.0%		Not estimable
Cholette 2017	6	82	7.3%	5	80	6.3%	4.2%	1.17 [0.37, 3.68]
Subtotal (95% CI)	**8**	**228**	**3.5%**	**8**	**226**	**3.5%**	**6.3%**	**1.01 [0.39, 2.57]**
Heterogeneity: Chi² = 0.54, df = 2 (P = 0.76); I² = 0%								
Test for overall effect: Z = 0.01 (P = 0.99)								
Total (95% CI)	**133**	**4545**	**2.9%**	**139**	**4547**	**3.1%**	**100.0%**	**0.96 [0.76, 1.21]**
Heterogeneity: Chi² = 6.58, df = 8 (P = 0.58); I² = 0%								
Test for overall effect: Z = 0.36 (P = 0.72)								
Test for subgroup differences: Chi² = 0.01, df = 1 (P = 0.92), I² = 0%								

Figure 4 Mortality within 30 days of surgery in randomized controlled trials of adult and paediatric cardiac surgery patients. Fixed-effects meta-analysis.

OR 0.96 (0.76-1.21)

Shehata et al. Eur Heart J 2019; 1: 1081-1088

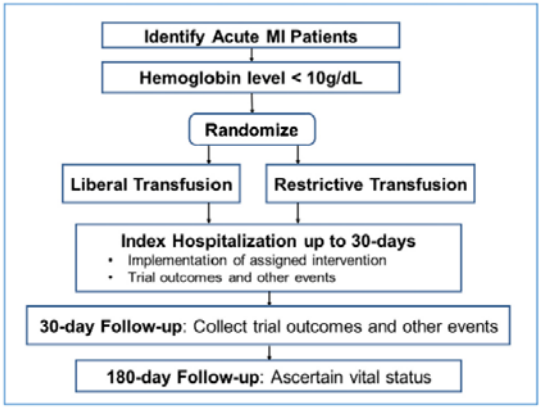
REALITY TRIAL – RCT 80 VS. 100 G/L IN PATIENTS WITH ACUTE MYOCARDIAL INFARCTION

Table 3. Primary and Secondary Outcomes at 30 Days Among the As-Randomized Population in a Study of the Effect of a Restrictive vs Liberal Blood Transfusion Strategy on Patients With Acute Myocardial Infarction and Anemia

Outcome	No. (%)		Difference (95% CI), %	Relative risk (1-sided 97.5% CI)
	Restrictive	Liberal		
Primary (major adverse cardiovascular events), No./total No. (%) [95% CI][a]				
As-treated population	36/327 (11.0) [7.5 to 14.6]	45/322 (14.0) [10.0 to 17.9]	−3.0 (−8.4 to 2.4)	0.79 (0.00 to 1.19)
As-randomized population	38/342 (11.1) [7.6 to 14.6]	46/324 (14.2) [10.2 to 18.2]	−3.1 (−8.4 to 2.3)	0.78 (0.00 to 1.17)

JAMA. 2021;325(6):552-560. doi:10.1001/jama.2021.0135

MINT TRIAL – COMPLETION SPRING 2024



70-80 vs 100 g/L

Primary end point: Composite of all-cause mortality and recurrent MI through 30 d.

Secondary end points:

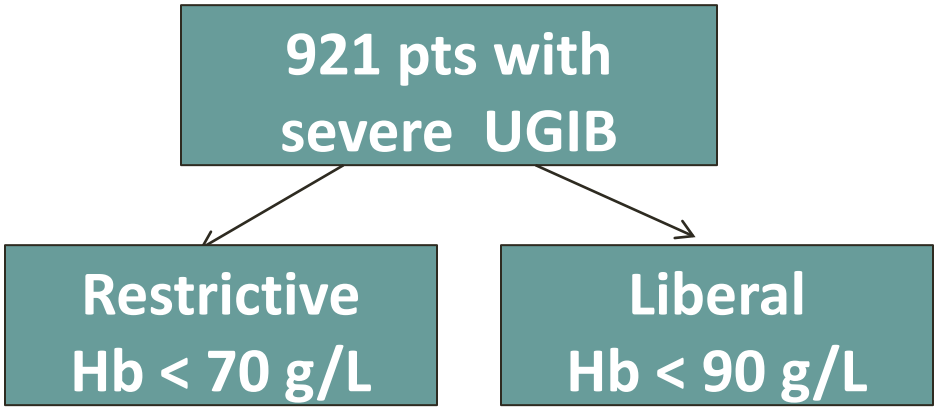
1) all-cause mortality through 30 d,
2) recurrent MI through 30 d,
3) the composite outcome of all-cause mortality, nonfatal recurrent MI, ischemia driven unscheduled coronary revascularization (percutaneous coronary intervention or coronary artery bypass grafting), or readmission to the hospital for ischemic cardiac diagnosis within 30 d.

Tertiary end points:

1) all-cause mortality, nonfatal recurrent MI, or unstable angina (ie, acute coronary syndrome) within 30 d;
2) ischemia driven unscheduled coronary revascularization within 30 d;
3) unscheduled readmission to hospital for ischemic cardiac diagnosis within 30 d;
4) congestive heart failure within 30 d;
5) unscheduled readmission to hospital for any reason within 30 d;
6) individual thrombotic/hemorrhagic outcomes of stroke, pulmonary embolism or deep venous thrombosis, and bleeding within 30 d;
7) individual infectious outcomes of pneumonia, and blood stream infection within 30 d;
8) individual in-hospital outcomes of length of hospital stay following randomization and number of days in intensive care unit;
9) patient reported quality of life using the EuroQol questionnaire (EQ-5D) at 30 d;
10) all-cause mortality at 6-months following randomization.

Carson JL, et al; MINT Investigators. Rationale and design for the myocardial ischemia and transfusion (MINT) randomized clinical trial. Am Heart J. 2023 Mar;257:120-129

GI BLEEDING



6 week survival	95%	91%	P=0.02
Further bleeding	10%	16%	P=0.05
Adverse events	40%	48%	P=0.02
RBC transfusion	1.5 units	3.7 units	P<0.001
No RBC transfusion	51%	15%	P<0.001

Villanueva et al. NEJM Jan 2013;368:11-21

PPH – WOMB TRIAL

37 Dutch hospitals, 521 women randomized

PPH with >1000 ml, Hb drop of 19+ points, and hemoglobin between 48-79 g/L, no severe symptoms of anemia (dyspnea, syncope, HR>100)

Randomized to transfusion or no transfusion

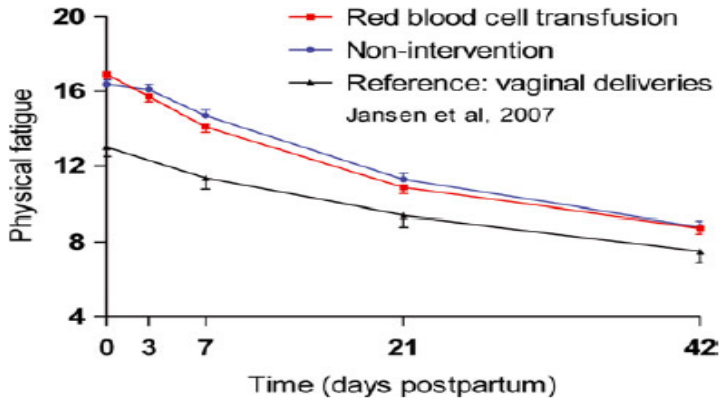


Table 2. Blood loss, haemoglobin concentration, and RBC transfusion

Variable	Transfusion (*n* = 258)	Non-intervention (*n* = 261)	*P*
RBC transfusion			
Units per woman	2 (2–2)	0 (0–0)	<0.001
Total units*	517	88	<0.001
Hb concentration after transfusion, g/dl)**	9.0 (8.5–9.6)	8.9 (8.2–9.7)	0.56
Hb concentration at discharge (g/dl)***	9.0 (8.5–9.5)	7.4 (6.8–7.7)	<0.001
Hb concentration at 6 weeks (g/dl)****	12.1 (11.3–12.6)	11.9 (10.9–12.6)	0.18

BJOG 2014;121:1005–1014.

AABB RBC GUIDELINE 2016

Transfusion is not indicated until the hemoglobin is 70 g/L for hospitalized, hemodynamically stable patients (including ICU patients) – strong recommendation, moderate quality evidence

For orthopedic and cardiac surgery and those with pre-existing cardiovascular disease, the AABB recommends 80 g/L (strong recommendation, moderate quality evidence)

- 80 g/L likely comparable to 70 g/L but RCT evidence not available for all groups

Acute coronary syndrome – no recommendation

JAMA. 2016;316(19):2025-2035. doi:10.1001/jama.2016.9185
Published online October 12, 2016.

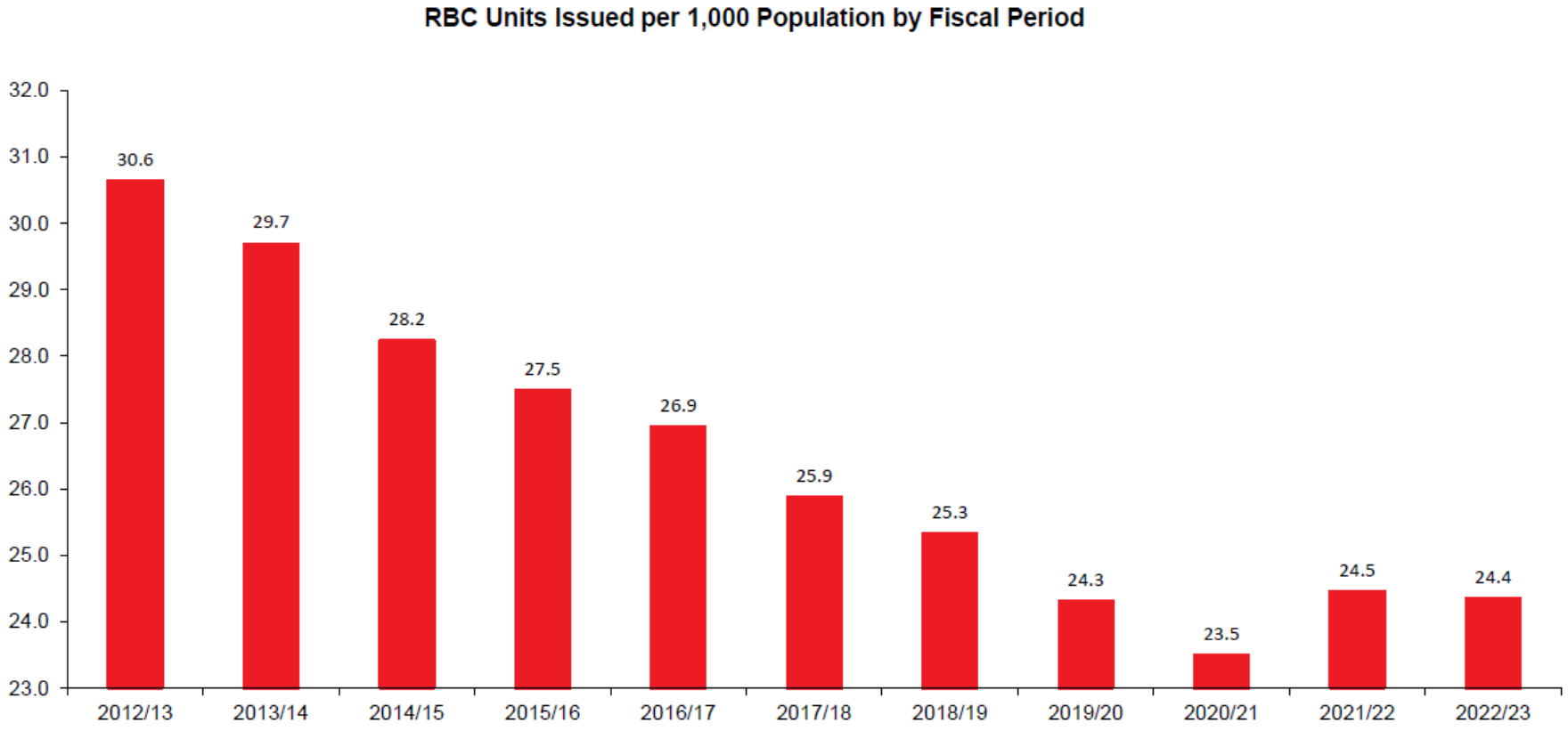
2018 FRANKFURT GUIDELINES

Newer but same as AABB plus:

- The panel recommended a restrictive RBC transfusion threshold (hemoglobin concentration <75 g/L) in patients undergoing cardiovascular surgery
- The panel recommended a restrictive transfusion threshold (hemoglobin concentration 70-80 g/dL) in hemodynamically stable patients with acute gastrointestinal bleeding

Mueller et al. JAMA. 2019;321(10):983-997

CANADA



45.5 to 31 per 1000 between 1999 and 2015; UK NICE Guideline

COMPARISON TO THE REST OF THE WORLD

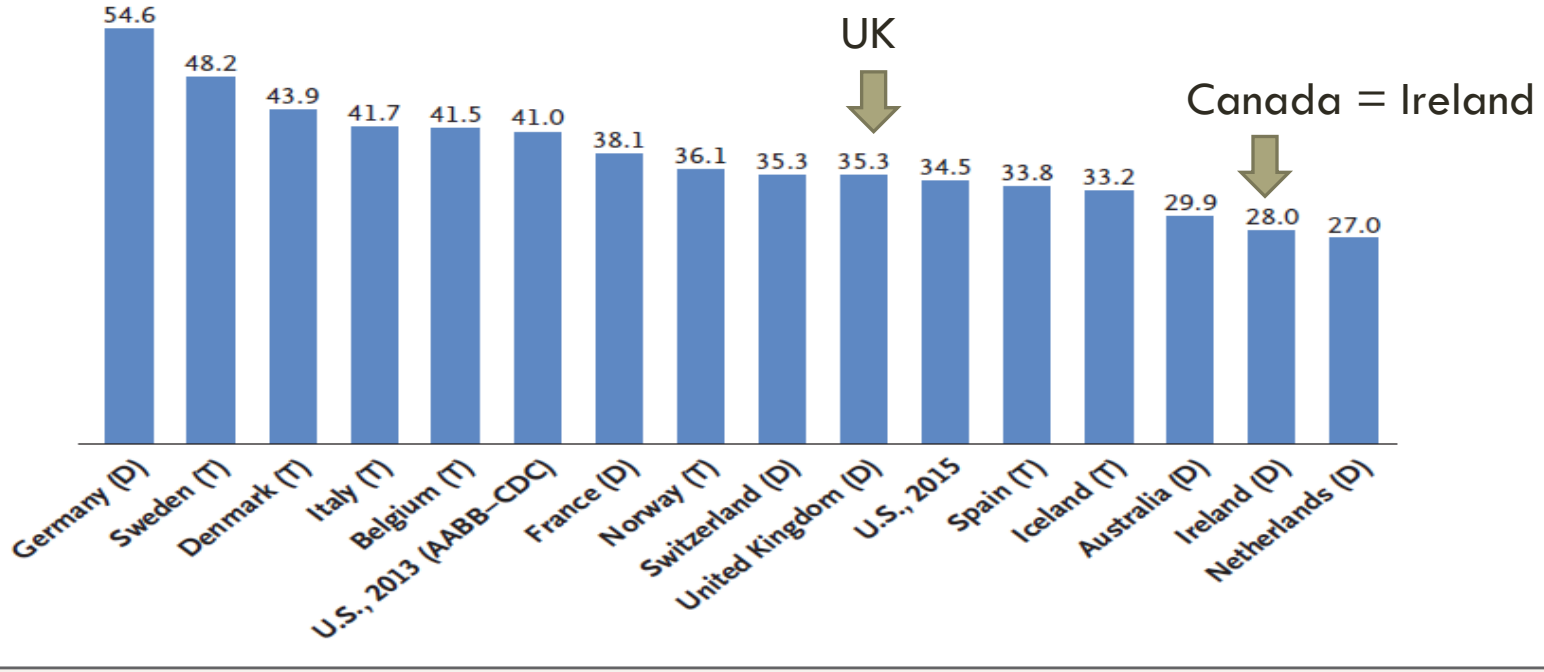
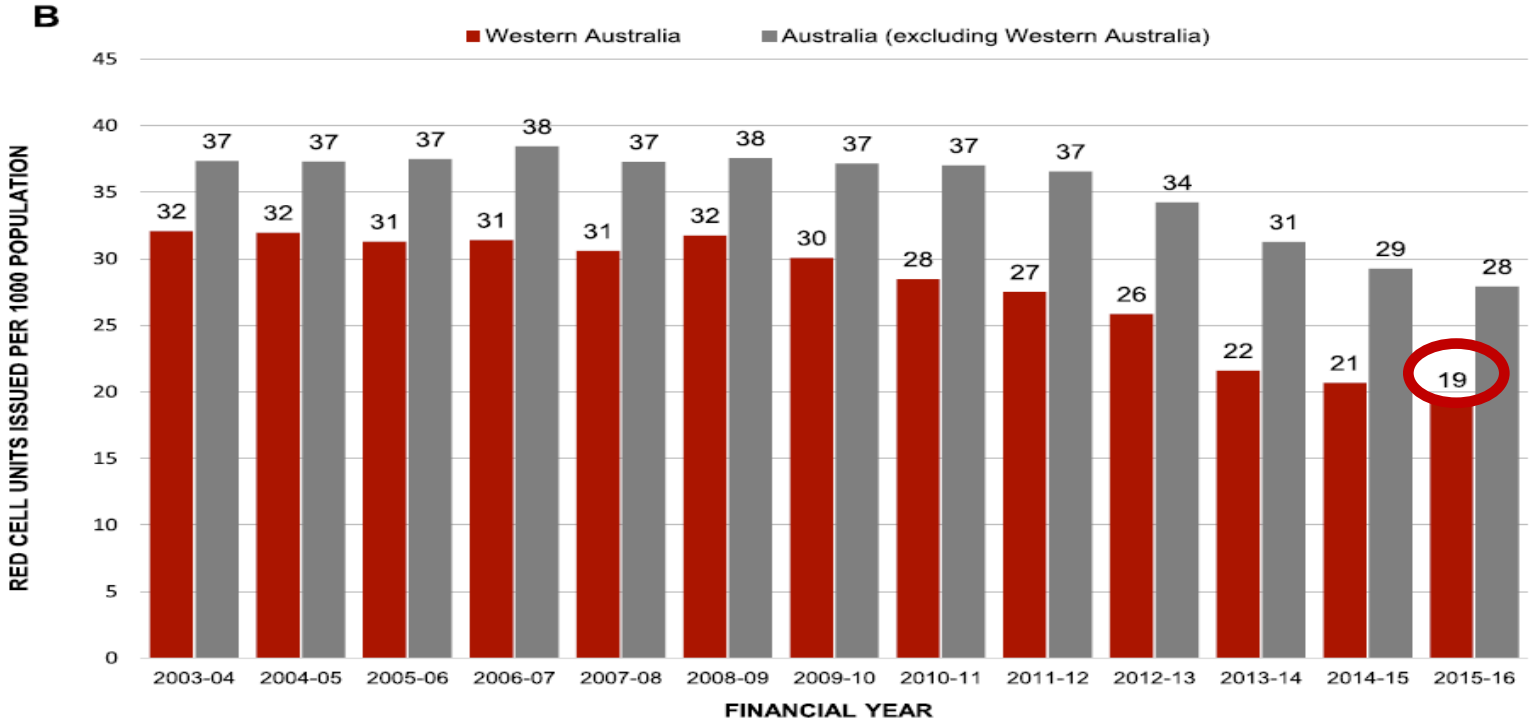


Figure 3. Transfusion Rates in the United States in 2013 and 2015, as Compared with Rates in Other Developed Countries.

N Engl J Med 2017;377:1261-72.

WHAT PATIENT BLOOD MANAGEMENT ADDS TO RESTRICTIVE TRANSFUSION THRESHOLDS



Leahy et al . Transfusion 2017 Jun;57(6):1347-1358.

REASONABLE APPROACH FOR INPATIENTS

Patient scenario	Hemoglobin	Transfusion approach
Young patient with severe iron or B12 deficiency anemia with only fatigue and pallor	Any	Iv iron (or B12 im/po)
Young patient with reversible asymptomatic anemia (eg. Postpartum, recovering young trauma)	<50 g/L	1 unit
Average patient without symptoms or cardiac history (eg. ICU, CVICU, hem-onc)	<70 g/L	1 unit
Cardiac history without symptoms	<70-80 g/L	1 unit
Hemodynamic symptoms (tachycardia, pre-syncope, etc)	<90 g/L	1 unit
Myocardial infarction with only fatigue and pallor	<80 g/L	1 unit GO SLOW
Slow bleeding and asymptomatic anemia	<70 g/L	1-2 units
Rapid hemorrhage (eg. Stabbing, gunshot, varices)	Keep 60-110 g/L	As many as you need! Order uncrossmatched!

CASE 1: STABLE PATIENT ON THE MEDICINE WARD

78 year old man admitted with an exacerbation of heart failure and right leg cellulitis.

During admission the patient has been stabilized with adjustment of cardiac medications, diuretics, and antibiotics and is now day 10 post admission.

The hemoglobin has dropped from 122 g/L on admission to 78 g/L today.

The plan is for discharge home with home care in the next 2-3 days. He has no chest pain and his heart failure is stabilized.

What could be causing his slow drop in hemoglobin?

When would you think of a blood transfusion?

How many units would you transfuse?

How slow?

Does a blood transfusion improve heart failure or post-discharge outcomes?

CASE 2: PATIENT WITH ISCHEMIC HEART DISEASE GOING TO THE OR

86 year old single woman without children with spontaneous hip fracture admitted through the ED.

Past history of ischemic heart disease with CABG 4 years ago.

Increasing difficulties with ADLs but living independently in an apartment.

3 months before admission hemoglobin 113 g/L, MCV 81, ferritin 18.

On list for OR tonight.

CBC shows hemoglobin 89 g/L, MCV 76.

Anemia is asymptomatic.

What is the cause of the anemia?

What is the first-line treatment of this type of anemia?

What is role of transfusion for this patient?

How many units would you transfuse at a time?

How slow?

What blood bank testing should be done pre-OR?

CASE 3: PATIENT WITH A GI HEMORRHAGE IN THE ED

62 year old man with a suspected upper GI bleed presents to the ED by ambulance with melena, dizziness, and pre-syncope

Past history of hypertension on two agents, including a B-blocker

On a DOAC for atrial fibrillation with last dose 6 hours before admission

HR 89, BP 86/42, in afib

Alert and oriented

2 Liters of crystalloid administered

Hemoglobin 95 g/L (6 months ago hemoglobin was 164 g/L at his routine check up)

HR 81, BP 91/45

What is the role of red cell transfusion in GI bleeds?

How many units would you transfuse at a time?

Should you activate the massive hemorrhage protocol?

What is the consequence of liberal transfusion strategy in GI bleeding?

SUMMARY

RBCs are expensive and associated with adverse events

Adhere to a restrictive transfusion strategy – 70 g/L and 1 unit at a time = default strategy unless brisk hemorrhage

The largest risk is TACO – be thoughtful with onboarding

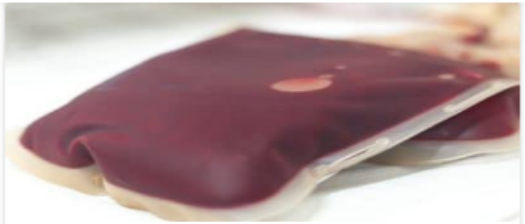
We have an extensive literature base to support a restrictive transfusion strategy

Guidelines support a restrictive approach

5 THINGS I HOPE YOU WILL DO IN 2023-2024

1. Give iron deficient patients iron instead of blood unless clear hemodynamic instability
2. Make extra efforts for young patients of childbearing potential and/or need for solid organ transplant to prevent transfusion and alloimmunization risk
3. Adopt a restrictive transfusion approach for most patients
4. ***Transfuse one at a time*** (even in the operating room) unless brisk bleeding – check hemoglobin after every unit
5. Thoughtfully onboard red cells in patients at higher risk of TACO

BloodBankGuy



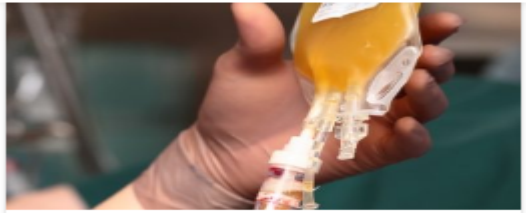
023: RBC Transfusion Guidelines with Jeff Carson

Whither RBCs? There's no one better than lead author Dr. Jeff Carson to discuss the 2016 AABB RBC transfusion threshold recommendations!

035: Why Give Platelets? with Rick Kaufman

Platelets are tiny, but they can be a big issue! Dr. Rick Kaufman magnifies what the evidence shows about platelet transfusion.

Listen to This Episode!



016: Plasma Transfusion with Jeannie Callum

As many as 50% of plasma transfusions are unnecessary or inappropriate! You need to know why, and Dr. Jeannie Callum explains it SO well!

THANK YOU FOR YOUR ATTENTION
HAPPY TO TAKE QUESTIONS