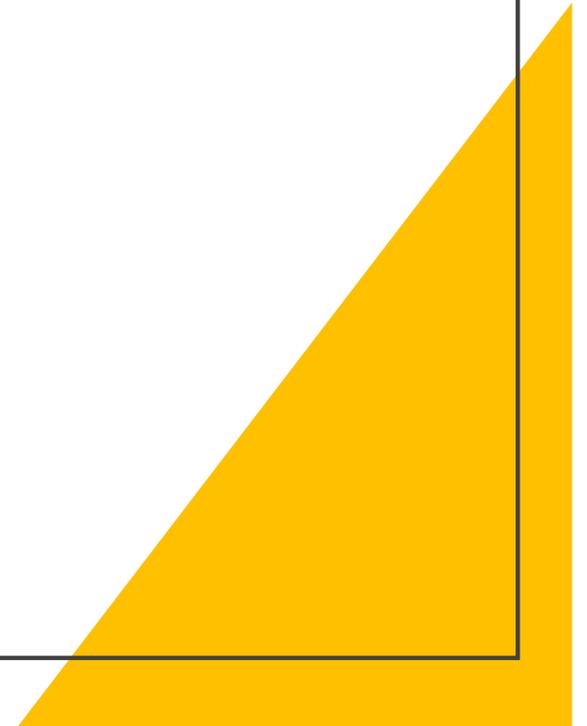


RePHILL

Pre-hospital blood in trauma



Advanced Trauma Life Support
for Doctors

ATLS[®]

STUDENT COURSE MANUAL
EIGHTH EDITION



American College of Surgeons Committee on Trauma

Traditional approach

- Immediate action if low BP
- 2 L of crystalloid stat (aiming 3:1 mL of blood loss)
- Then RBC if still shocked
- Colloids
- Then thinking moved to replacing what was lost

What is blood?

Packed Red blood cells

Without platelets, plasma, calcium

pH 6.79

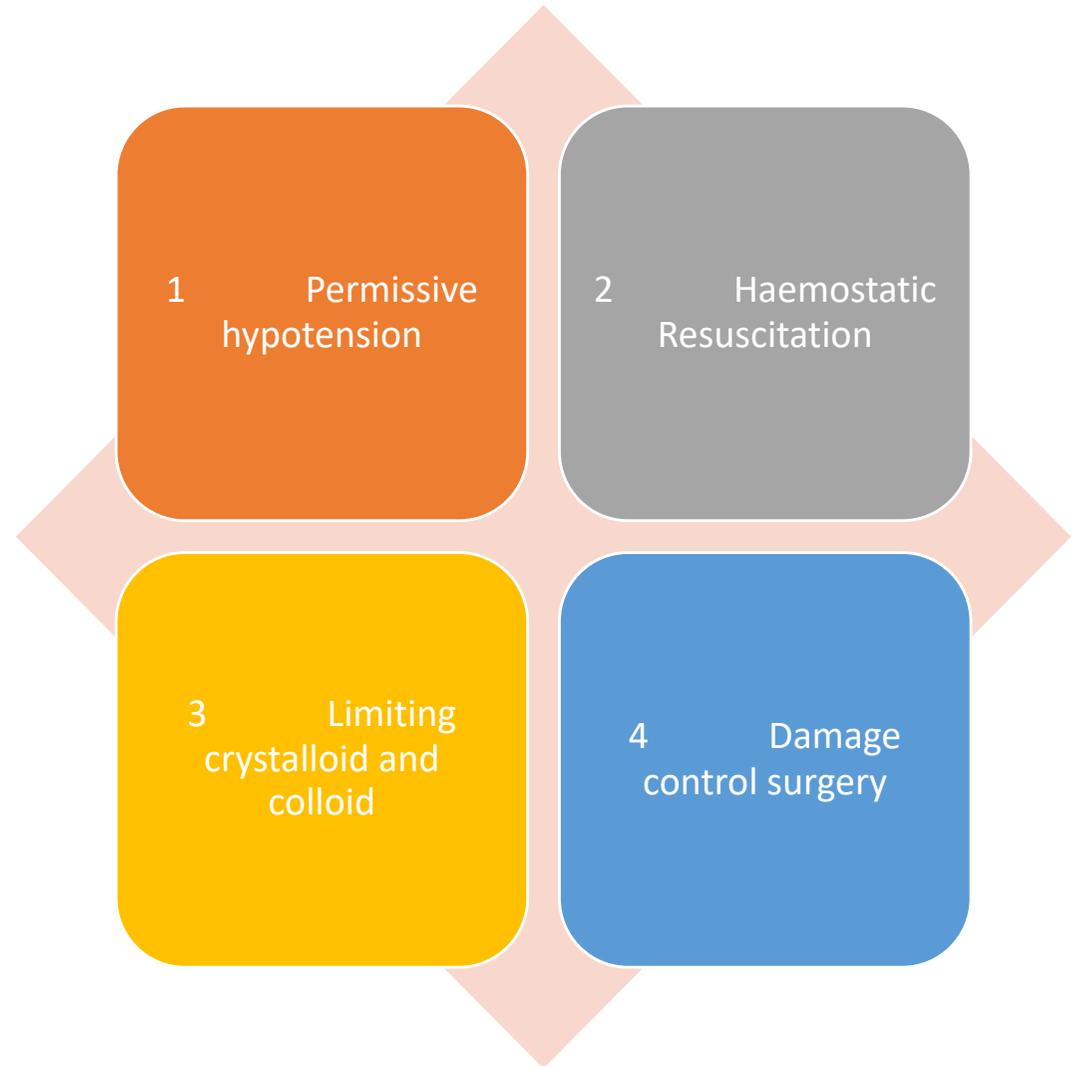
Older cells (6.7 days storage – EU, worse UK)

Damage Control Resuscitation (DCR)

↑ SBP fine once bleeding controlled (GDT approach)

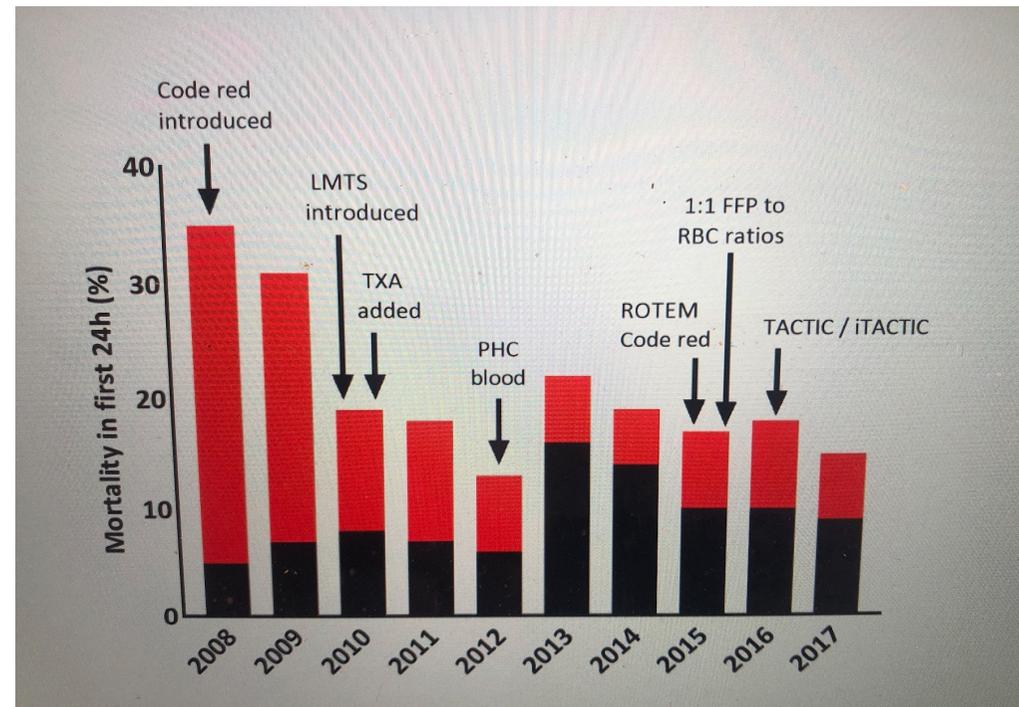
If bleeding, should think about Damage Control Resuscitation

4 pillars of DCR



Previously

- Whole blood vs Packed Red Cells
- Plasma - FFP / freeze dried
- Pre-hospital delivery
- Military and civilian studies suggest early transfusion improves survival but trial evidence inconclusive



Pre-hospital blood?



UK's first air ambulance to carry BI

Continuing to be at the forefront of medical

Today, London's Air Ambulance, will make history as the first aircraft and cars.

Every day in London, victims of major trauma are attended by London's Air Ambulance. Many of these patients are the scene from blood loss and never make it to hospital.

Until today the highly trained medical teams have been unable to transfuse blood at the scene of the incident. Now it does not carry oxygen, it is not the ideal resuscitation fluid. Blood carries oxygen which is delivered to major organs. Transfusion may improve the patient's chance of survival.

Blood is a precious resource and must be stored at a specific temperature in special containers. The SCA Cool I Boxes*), which is also used by the British Military, was found to be the most suitable following extensive research the London.

London's Air Ambulance procedure one of the

Comment: The service strives to deliver serious bleed patients carrying blood.

"We are a honestly be

The Mayor around the



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²Department of Emergency Medicine, Royal Brisbane & Women's Hospital, Herston, Queensland, Australia
³Department of Emergency Medicine, Redcliffe Hospital, Redcliffe, Queensland, Australia
⁴Pathology Queensland Central Transfusion Laboratory, Royal Brisbane & Women's Hospital, Herston, Queensland, Australia

Correspondence to
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2012
 2012
 2012

ambulance company patients suffering from improve our service by

service can deliver. I

which have been adopted even more lives.'

The feasibility of civilian prehospital trauma teams carrying and administering packed red blood cells

Daniel Bodnar,^{1,2,3} Stephen Rashford,^{1,2} Sue Williams,⁴ Emma Enraght-Moony,¹ Lachlan Parker,¹ Benjamin Clarke^{1,2}

ABSTRACT

Objective To evaluate the feasibility, limitations and costs involved in providing prehospital trauma teams with packed red blood cells (pRBCs) for use in the prehospital setting.

Methods A retrospective cohort study, examining 18 months of historical data collated by the Queensland Ambulance Service Trauma Response Team (TRT) and the Pathology Queensland Central Transfusion Laboratory was undertaken.

Results Over an 18-month period (June 2012), of 500 pRBC units provided (26%) were administered to patients in the prehospital environment. Of the non-transfused units, 100 (20%) were returned to a hospital blood bank and reissued. No instances of equipment failure contributed to wastage of pRBCs. The cost of pRBCs for prehospital use was \$A55/unit transfused.

Conclusions It is feasible and practical for prehospital trauma teams with pRBCs in the field. Use of pRBCs in the prehospital setting is associated with similar rates of pRBC transfusion reported in emergency departments.

METHODS

Setting

The Queensland Ambulance Service (QAS) provides a 24/7, doctor-paramedic, road-based Trauma Response Team (TRT) to significant incidents in the Greater Brisbane area, servicing a population of approximately 2.4 million people. In the 2011 calendar year, there were 1584 activations of the TRT with 719 cases requiring active management by the TRT outside the current intensive care paramedic



1a- life box external



Internal

'Implementation without information'

RCTs published during study

PAMPER

- 30-day mortality was significantly lower in the plasma (FFP) group compared to control (23% vs 33.0%; difference -9.8%, $p=0.03$)
- NNT to prevent one death at 30 days=10

COMBAT

- no evidence of survival improvement

Post-hoc combined analysis of 626 participants in both studies suggest that prehospital plasma is associated with a survival benefit when transport times are longer than 20 min

Resuscitation with blood products in patients with trauma-related haemorrhagic shock receiving prehospital care (RePHILL): a multicentre, open-label, randomised, controlled, phase 3 trial



Nicholas Crombie, Heidi A Doughty, Jonathan R B Bishop, Amisha Desai, Emily F Dixon, James M Hancox, Mike J Herbert, Caroline Leech, Simon J Lewis, Mark R Nash, David N Naumann, Gemma Slinn, Hazel Smith, Iain M Smith, Rebekah K Wale, Alastair Wilson, Natalie Ives, Gavin D Perkins, on behalf of the RePHILL collaborative group*



Summary

Background Time to treatment matters in traumatic haemorrhage but the optimal prehospital use of blood in major trauma remains uncertain. We investigated whether use of packed red blood cells (PRBC) and lyophilised plasma (LyoPlas) was superior to use of 0·9% sodium chloride for improving tissue perfusion and reducing mortality in trauma-related haemorrhagic shock.

Methods Resuscitation with pre-hospital blood products (RePHILL) is a multicentre, allocation concealed, open-label, parallel group, randomised, controlled, phase 3 trial done in four civilian prehospital critical care services in the UK. Adults (age ≥ 16 years) with trauma-related haemorrhagic shock and hypotension (defined as systolic blood pressure < 90 mm Hg or absence of palpable radial pulse) were assessed for eligibility by prehospital critical care teams. Eligible participants were randomly assigned to receive either up to two units each of PRBC and LyoPlas or up to 1 L of 0·9% sodium chloride administered through the intravenous or intraosseous route. Sealed treatment packs which were identical in external appearance, containing PRBC–LyoPlas or 0·9% sodium chloride were prepared by blood banks and issued to participating sites according to a randomisation schedule prepared by the co-ordinating centre (1:1 ratio, stratified by site). The primary outcome was a composite of episode mortality or impaired lactate clearance, or both, measured in the intention-to-treat population. This study is completed and registered with ISRCTN.com, ISRCTN62326938.

Lancet Haematol 2022

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See Online/Comment
[https://doi.org/10.1016/S2352-3026\(22\)00074-6](https://doi.org/10.1016/S2352-3026(22)00074-6)

*Members are listed in the appendix (p 113)

NIHR Surgical Reconstruction and Microbiology Research Centre, Queen Elizabeth Hospital, University Hospitals Birmingham NHS Foundation Trust, Birmingham, UK (N Crombie FCRA, H Smith MSc, I M Smith FRCS); NHS Blood and Transplant, Birmingham, UK

Protocol

Design: Multicentre, allocation concealed, open-label, parallel group, randomised, controlled, phase 3 trial

Setting: 4 UK civilian prehospital critical care services

Adults (≥ 16) with trauma-related haemorrhagic shock and hypotension (SBP < 90 mm Hg or absent radial pulse)

Eligible participants were randomly assigned to receive either:

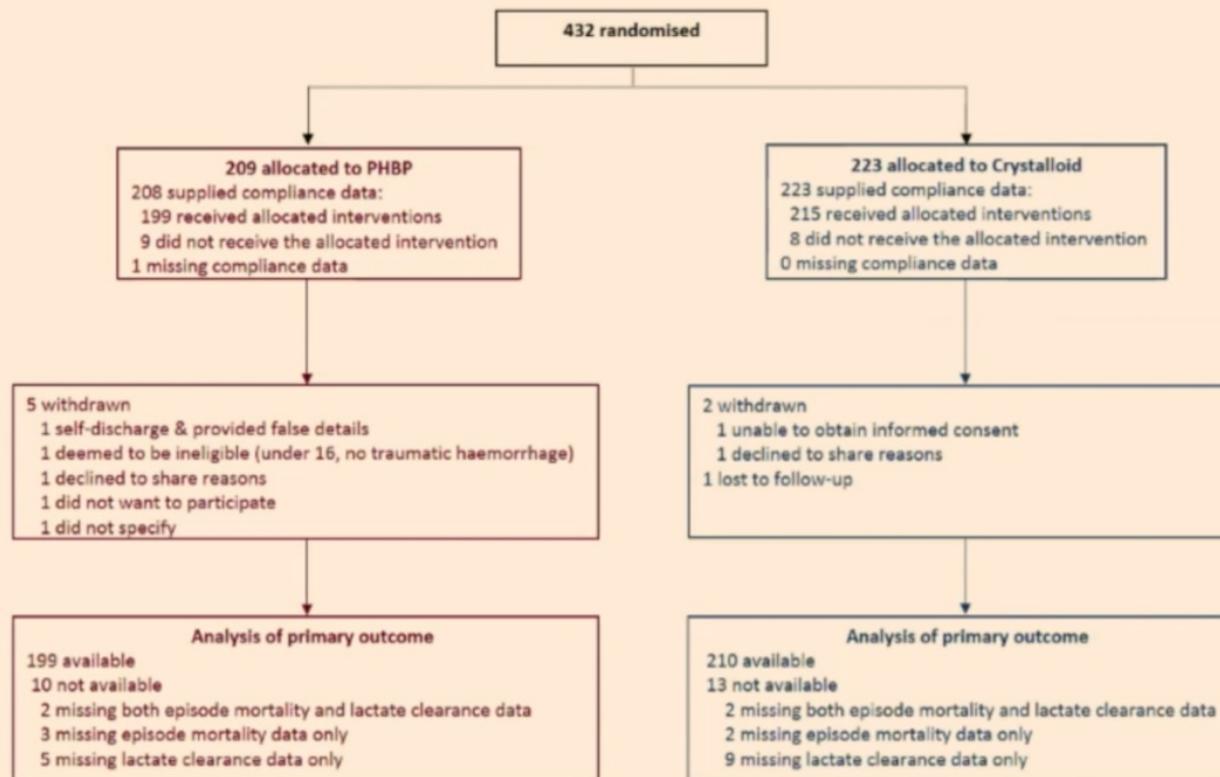
- up to 2 units each of PRBC and LyoPlas or
- up to 1 L of 0.9% sodium chloride
- administered through the intravenous or intraosseous route via sealed treatment packs

Endpoint

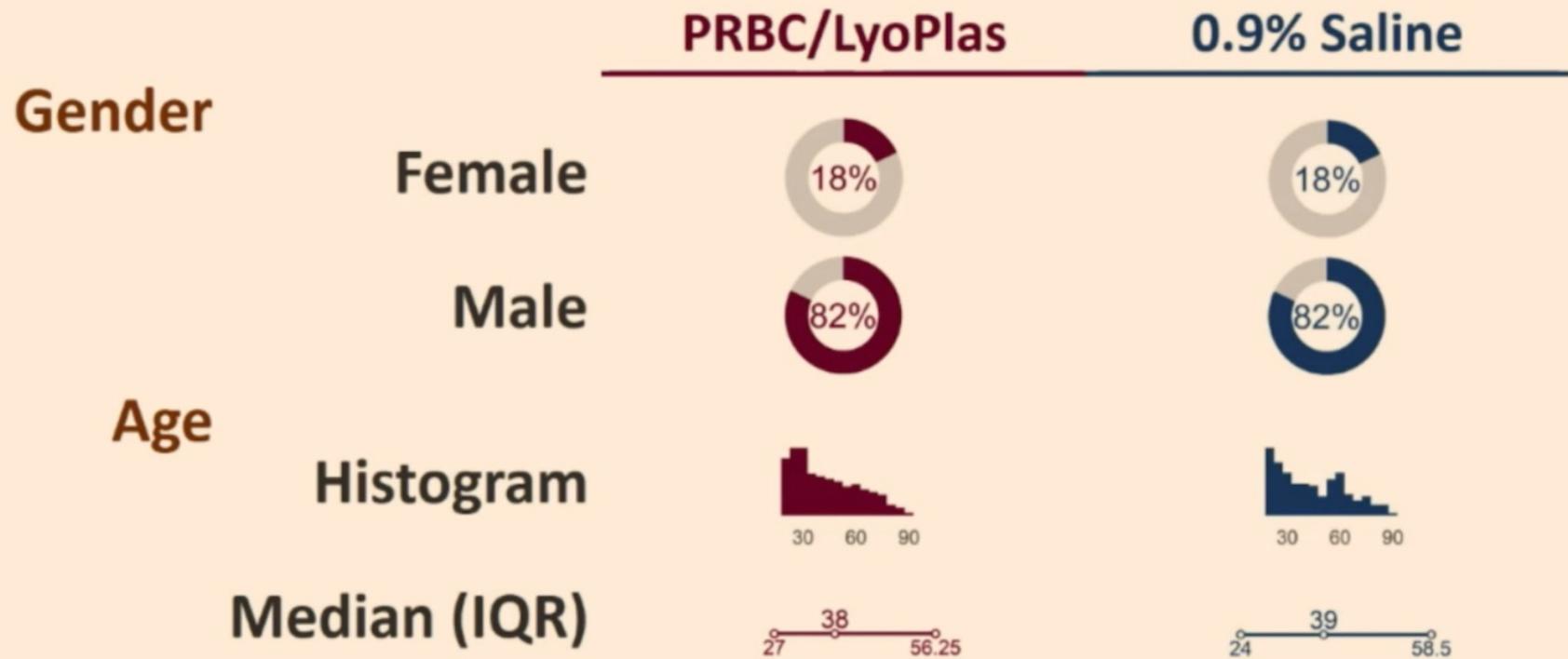
- Composite
 - Episode mortality
 - Failure to clear lactate (<20% per hour in first 2 hours)
 - Or both
 - Patient POOs, Laboratory LOOs, Monitor MOOs
-
- Numbers
 - Power: Absolute difference 20% to 10%
 - Changed when actually 65%

Great achievement

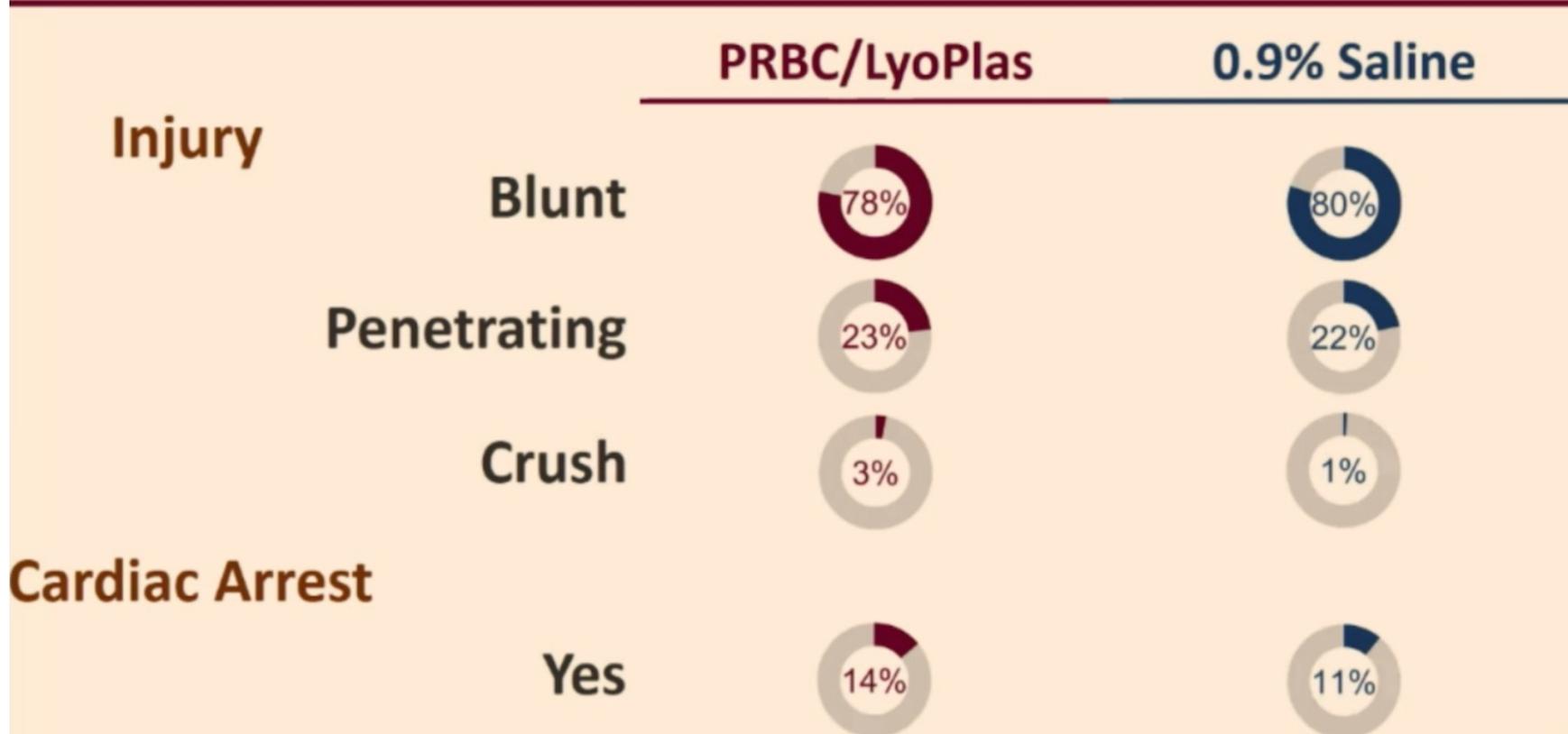
CONSORT Participant Flow Diagram



Patient Characteristics



Patient Characteristics



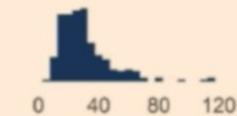
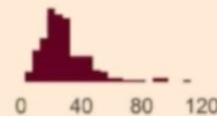
Patient Characteristics

PRBC/LyoPlas

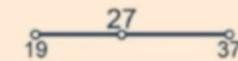
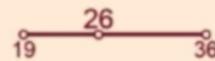
0.9% Saline

Time to On Scene (mins)

Histogram

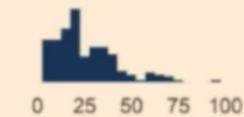
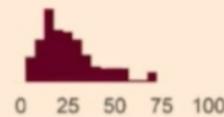


Median (IQR)

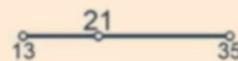
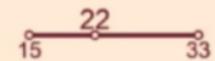


Time to Intervention (mins)

Histogram



Median (IQR)



Patient Characteristics

PRBC/LyoPlas

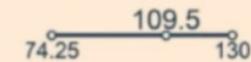
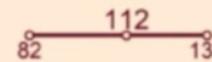
0.9% Saline

Heart Rate (bpm)

Histogram

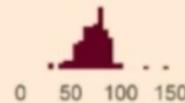


Median (IQR)

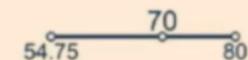
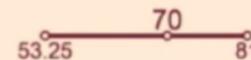


Systolic Blood Pressure (mmHg)

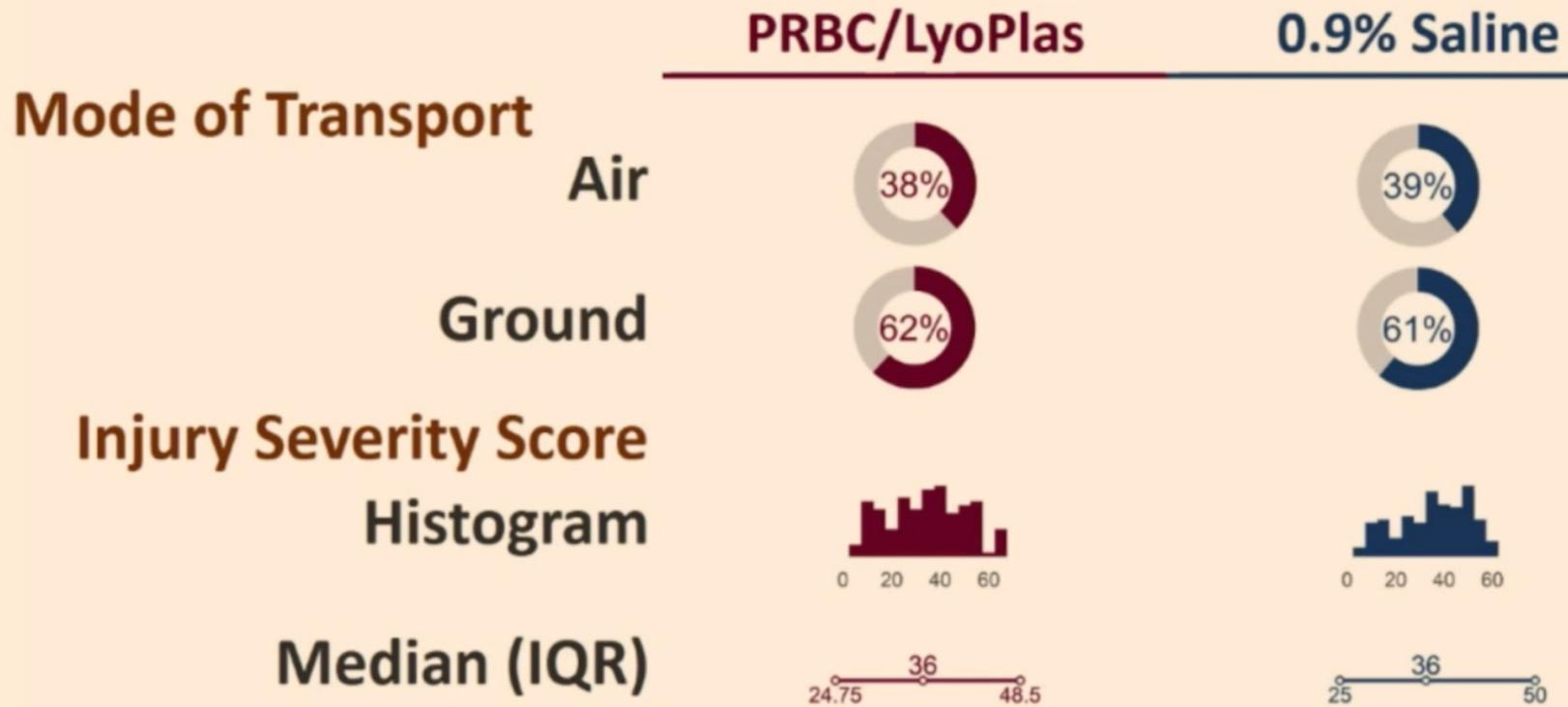
Histogram



Median (IQR)

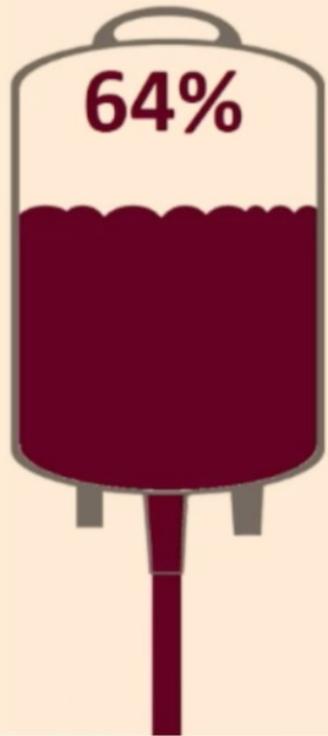


Patient Characteristics



PRIMARY OUTCOME

PRBC/LyoPlas



Adjusted Risk Ratio

1.01 (0.88 to 1.17); p=0.86

Adjusted Risk Difference

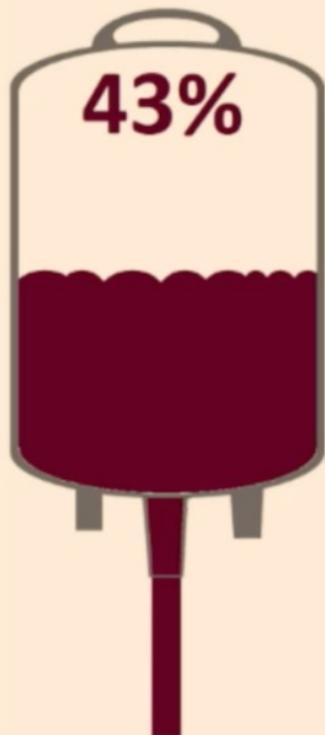
-0.25% (-9% to 9%); p=0.996

0.9% Saline



PRIMARY OUTCOME: Episode Mortality

PRBC/LyoPlas



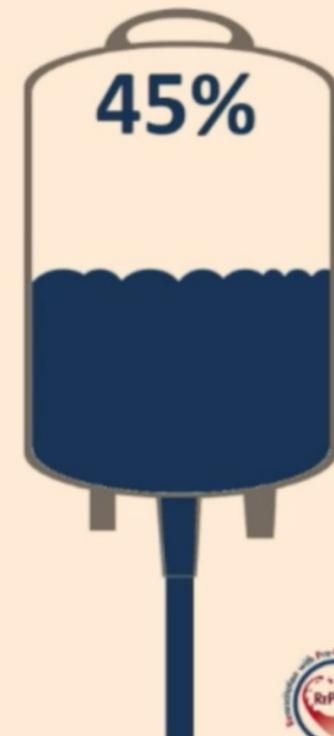
Adjusted Risk Ratio

0.97 (0.78 to 1.20); $p=0.75$

Adjusted Risk Difference

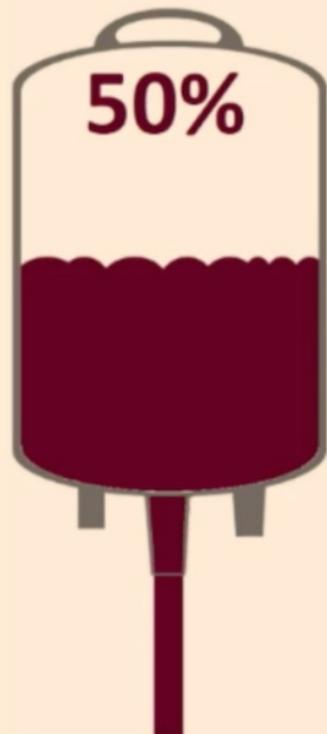
-3% (-12% to 7%); $p=0.57$

0.9% Saline



PRIMARY OUTCOME: Failure to Clear Lactate

PRBC/LyoPlas



Adjusted Risk Ratio

0.94 (0.78 to 1.13); $p=0.52$

Adjusted Risk Difference

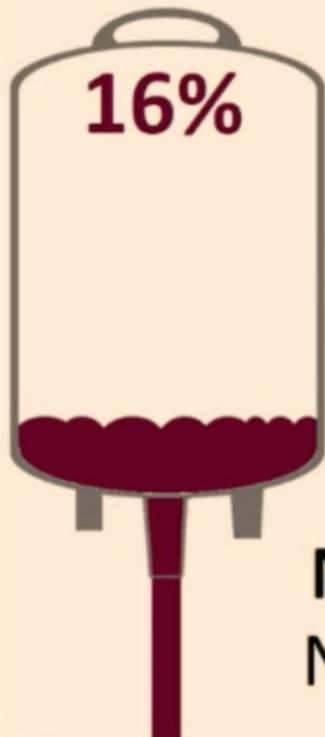
-5% (-14% to 5%); $p=0.35$

0.9% Saline



Mortality within 3 hours of injury

PRBC/LyoPlas



Adjusted Risk Ratio

0.75 (0.50 to 1.13); p=0.17

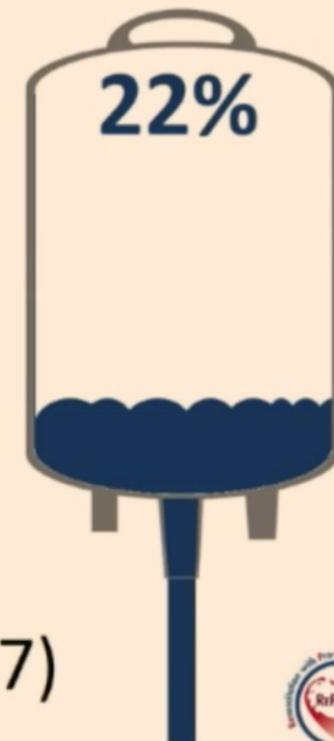
Adjusted Risk Difference

-7% (-15% to 1%); p=0.08

NNT (NNTB and NNTH):

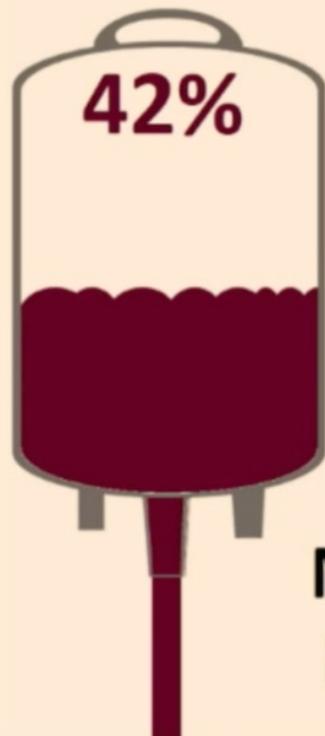
NNTB 15 (NNTH 112 to ∞ to NNTB 7)

0.9% Saline



All-cause Mortality within 30 days of injury

PRBC/LyoPlas



Adjusted Risk Ratio

0.94 (0.76 to 1.17); p=0.59

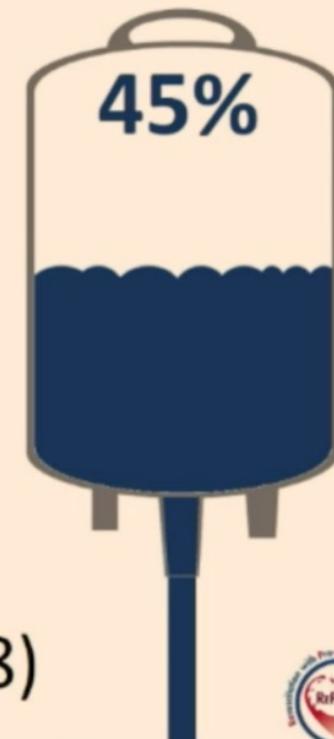
Adjusted Risk Difference

-4% (-13% to 6%); p=0.44

NNT (NNTB and NNTH):

NNTB 27 (NNTH 17 to ∞ to NNTB 8)

0.9% Saline



Bayesian analysis

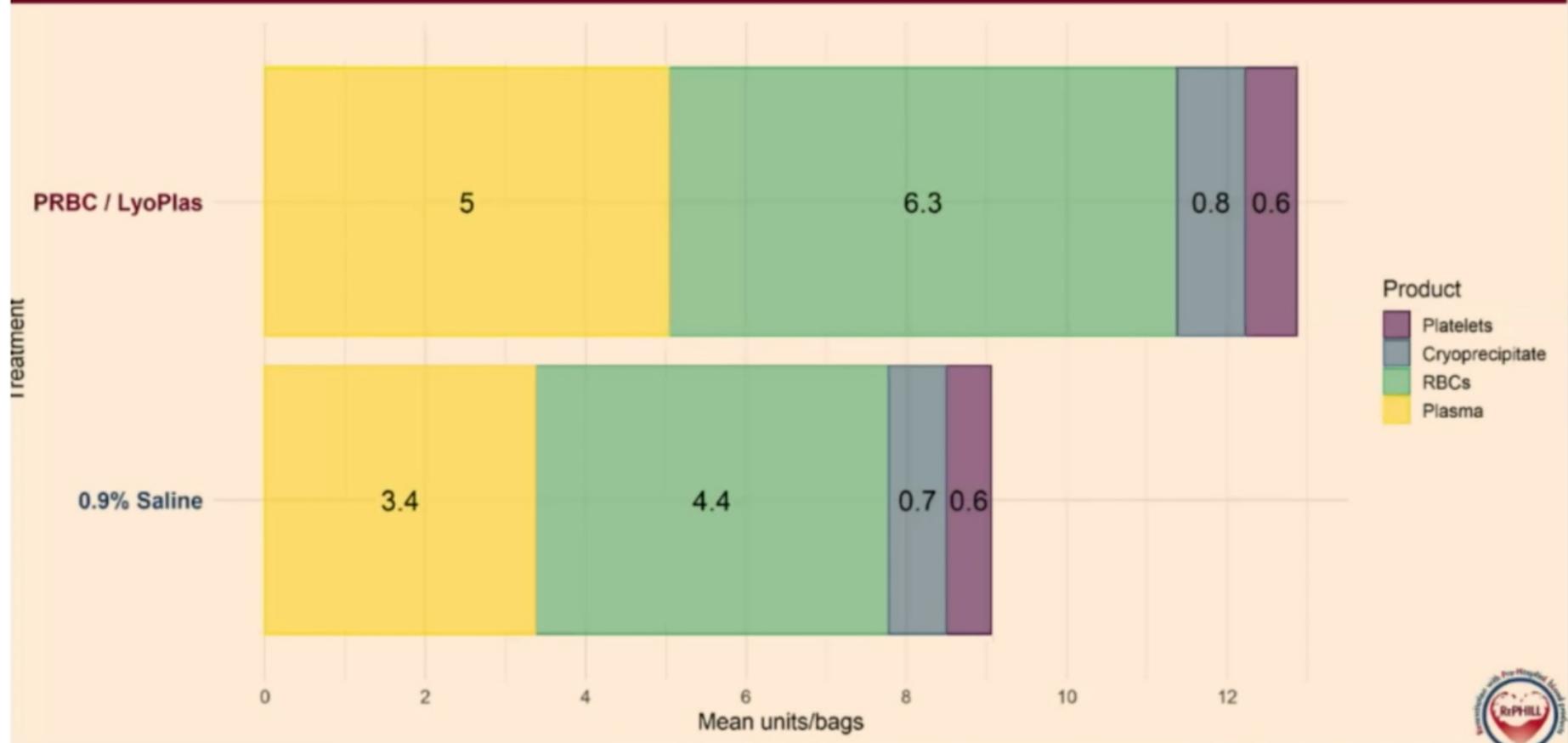
Probability blood better (ARR<0):

Primary outcome 44-53%

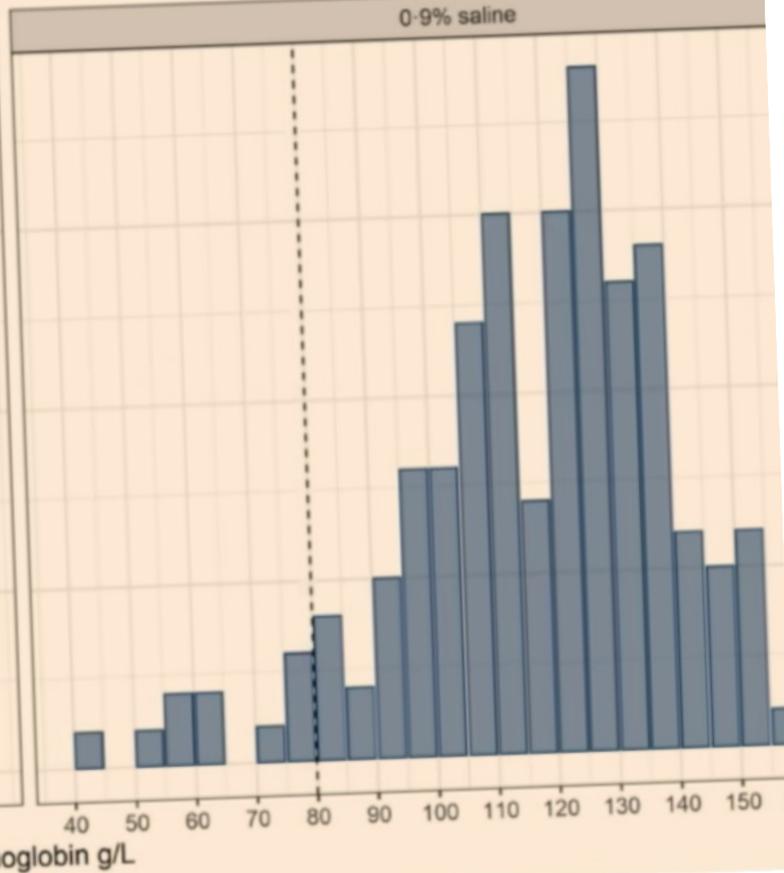
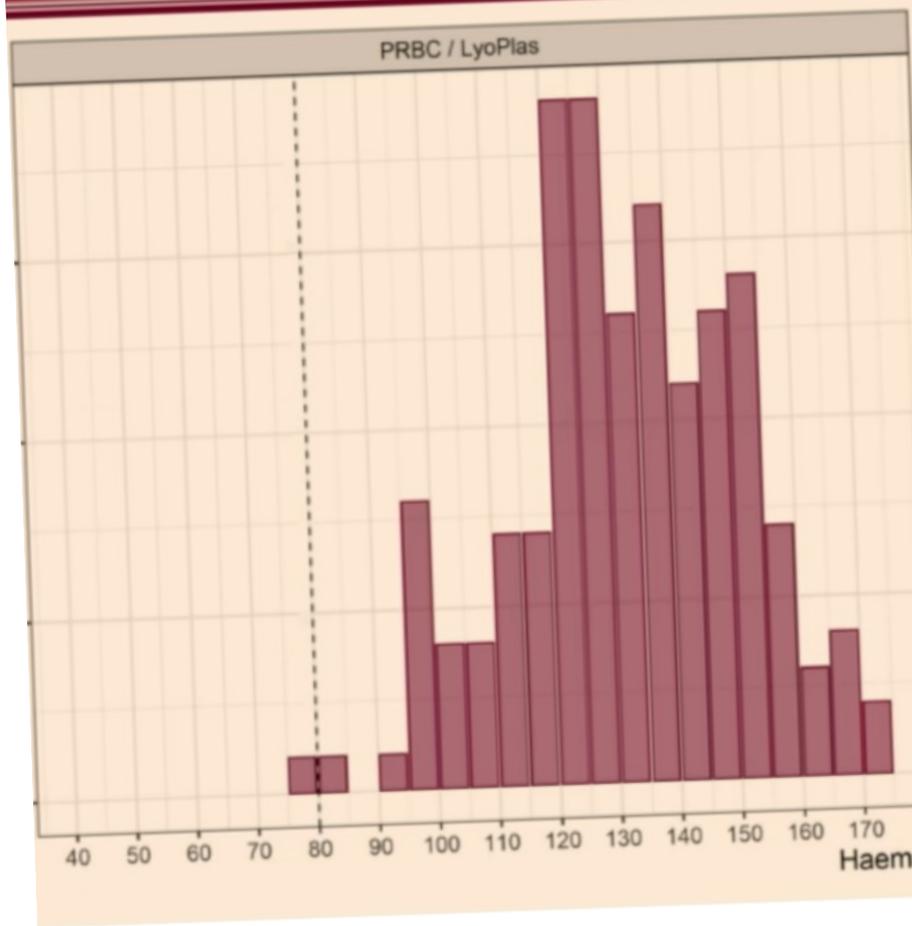
Mortality 71-88%

Lactate clearance 81-87%

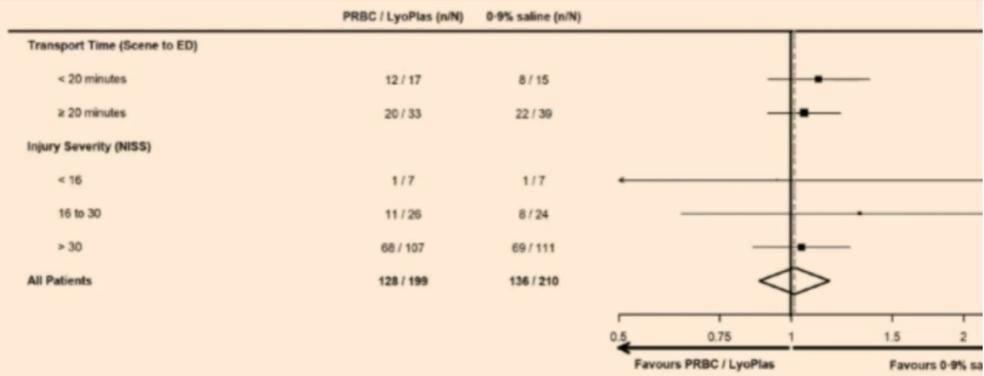
Total 24 hour blood products



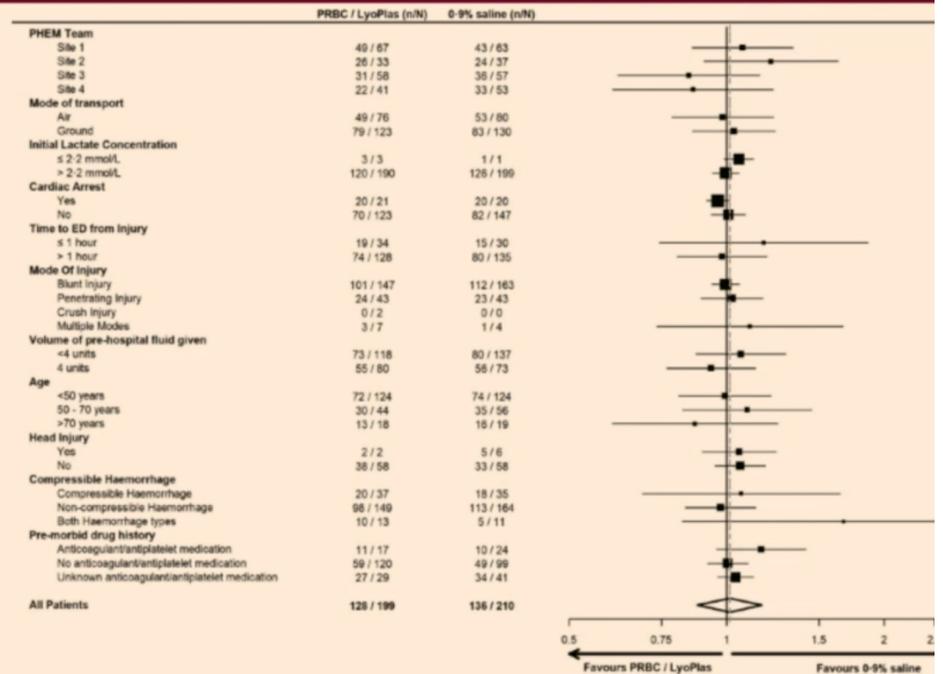
Haemoglobin on ED arrival



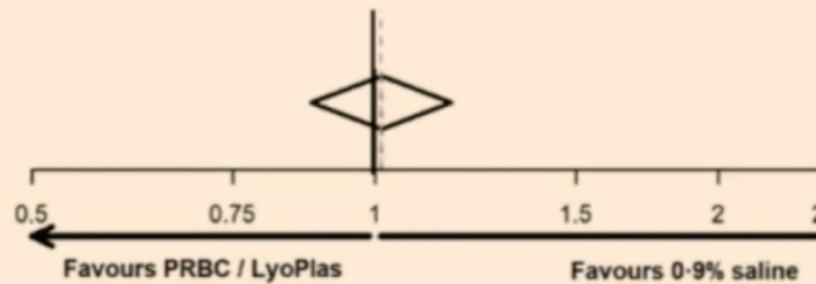
Post-hoc Subgroup Analyses



Subgroup Analyses



Conclusion



Reflections and what now?

Primary outcome choice

Proportion with transport
time
<20 min

Population older, more
severely injured, high
proportion of blunt
traumatic injuries than in
observational military
studies

Reflections and what now?

PRBCs vs Whole blood

↑ K/H+

low Ca/DPG

Lyophilised plasma
(vs FFP)

Role of coagulation
factors, platelets,
whole blood?

PRBC didn't really
raise Hb, required or
plasma first?

Reflections and what now?

'The implication is that the logistical and financial costs of bringing blood product resuscitation forward from hospital to the prehospital domain might not be routinely justified within the context of a modern major trauma network.'

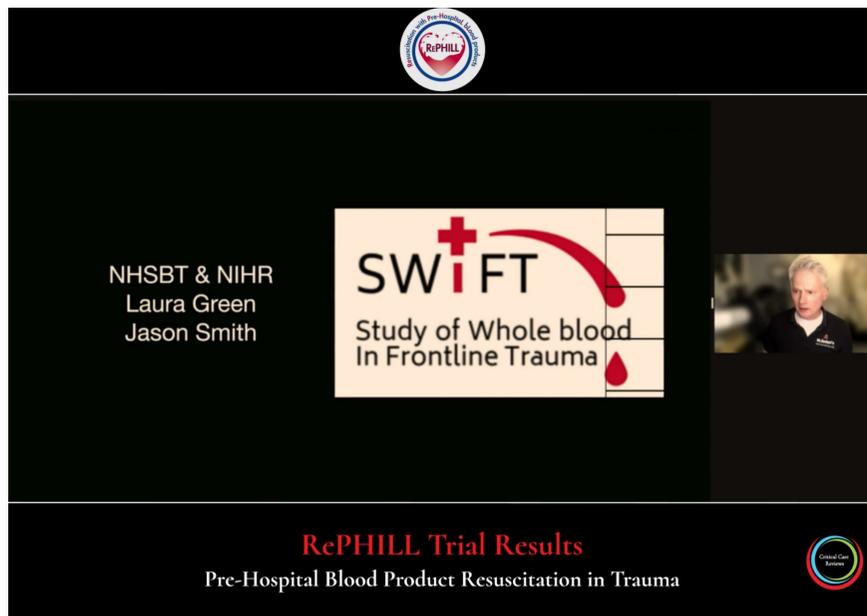


Who might benefit - Goldilocks patients
Not if too sick
Small transfer time – over transfusion (reach Hb)?



Centres without blood vs those already using it

What now?

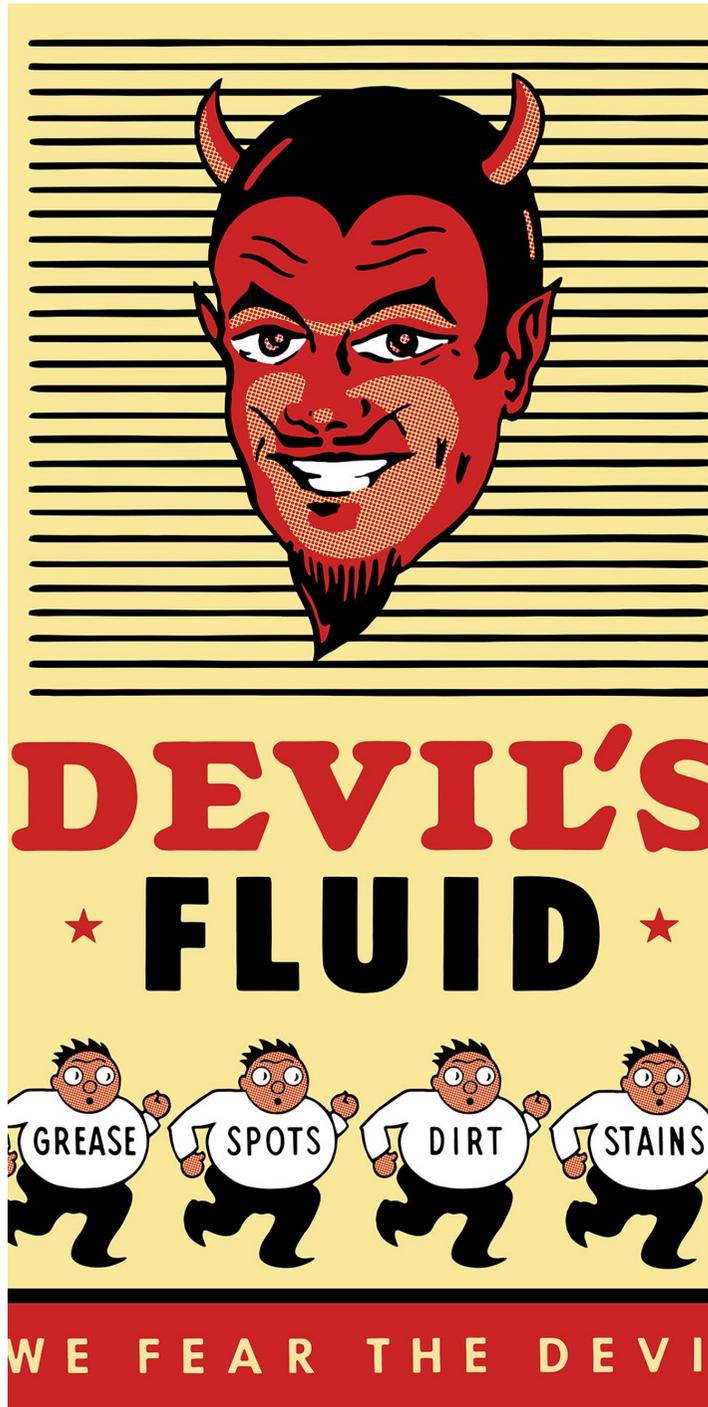


The image is a screenshot of a presentation slide. At the top center is the RePHILL logo, which is a circular emblem with a red cross and the text 'RePHILL' and 'Pre-Hospital Blood Product Resuscitation in Trauma'. Below this, on the left, is the text 'NHSBT & NIHR' followed by 'Laura Green' and 'Jason Smith'. In the center is a large logo for 'SWIFT Study of Whole blood In Frontline Trauma', featuring a red cross and a red swoosh. To the right of the SWIFT logo is a small inset video frame showing a man with short blonde hair. At the bottom of the slide, the text 'RePHILL Trial Results' is written in red, with 'Pre-Hospital Blood Product Resuscitation in Trauma' below it. In the bottom right corner, there is a small circular logo for 'Clinical Commissioning'.

- PREHO-PLYO

- PRIEST

(both plasma trials)



Questions?
