Transfusion Strategies

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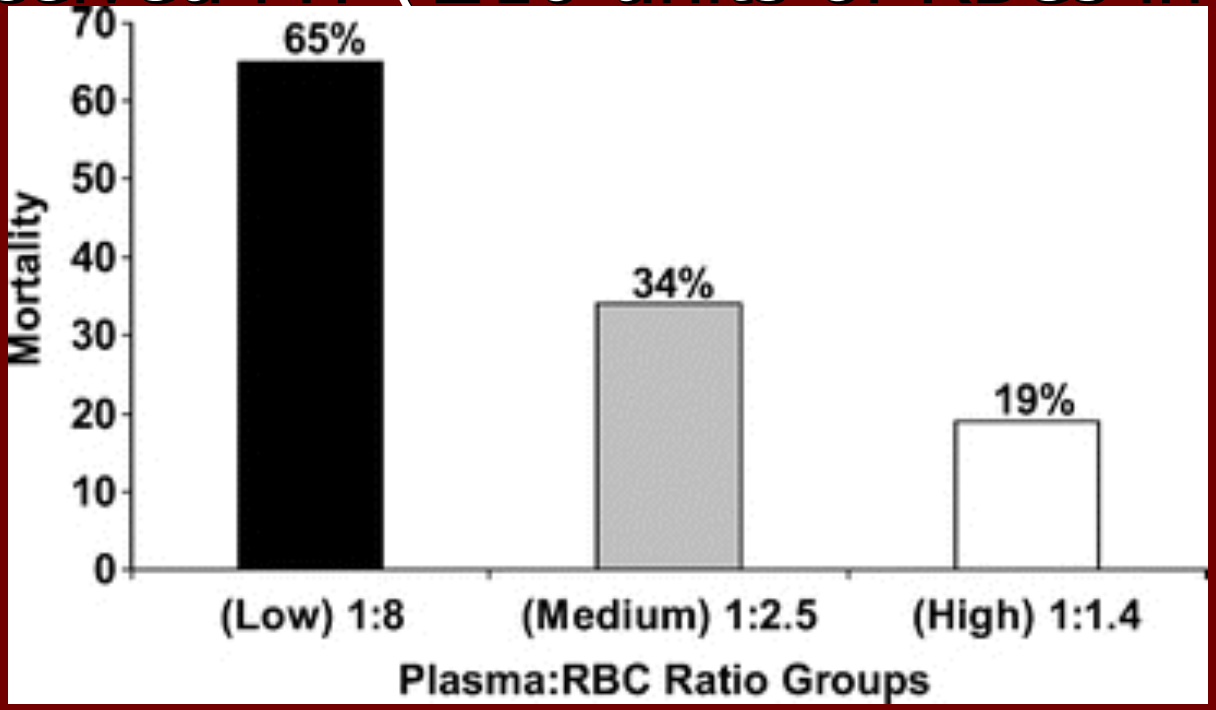
Blood to FFP ratio

- Old days (when I was a resident)
  - Gave 10 units of blood
  - Then you started thinking about other products
  - Most textbooks said platelets were the issue
  - Once you started FFP, it was 1 unit for every 4 units PRBC
- What changed??

The Ratio of Blood Products Transfused Affects Mortality in Patients Receiving MT at a Combat Support Hospital

- retrospective review of 246 pts
- received MT (≥10 units of RBCs in 24 hrs)



J Trauma 2007;63 pp 805-813

Why the difference?

- Military injuries are different now
  - Body armor
  - Extensive soft tissue damage mainly to extremities
  - Blast component to the injury
- Is this experience applicable to the civilian trauma patient???

Damage Control Hematology: The Impact of a Trauma Exsanguination Protocol on Survival and Blood Product Utilization

- Immediate and continued release of blood products in predefined ratio of 10 uPRBC to 4 uFFP and 2 uPLT
- preTEP and post-TEP comparison
  - Immediate surgery by trauma team and
  - Received > 10 uPRBC in first 24 hrs
- Multivariable analysis was performed to compare mortality and overall blood product consumption between groups

J Trauma. 2008;64:1177–1183

Table 1 Baseline Characteristics and Descriptive Data of the Study Groups

Characteristic	Pre-TEP (n = 117)	TEP (n = 94)	*p*
Age, yr (±SD)	39.3 ± 17.7	35.5 ± 15.3	*0.176*
Male (%)	76	73	*0.657*
w-RTS (±SD)	4.45 ± 2.6	3.74 ± 2.8	*0.037**
ISS (±SD)	29.8 ± 16.2	32 ± 16.8	*0.217*
TRISS (±SD)	0.53 ± 0.38	0.40 ± 0.39	*0.029*
Penetrating mechanism (%)	30	56	0.012*

* Statistically significant at $p < 0.05$.

TEP, trauma exsanguination protocol; w-RTS, weighted Revised Trauma Score; ISS, Injury Severity Score; TRISS, trauma-related Injury Severity Score.

Table 2 Univariate Analyses of Primary and Secondary Outcome Measures

Variable	Pre-TEP (n = 117)	TEP (n = 94)	*p*
30-d mortality (%)	65.8	51.1	0.030*
24-h blood product use (units)	39 ± 28	31.8 ± 19	0.017*
24-h RBC use (units)	19.8 ± 12.8	18.8 ± 11.2	0.695
24-h FFP use (units)	12.4 ± 12.5	9.9 ± 7	0.595
24-h PLT use (units)	6.8 ± 7.2	3.1 ± 3.7	<0.001*
Intraoperative RBC use (units)	11.1 ± 8.5	16 ± 11.4	0.001*
Intraoperative FFP use (units)	4.3 ± 4	8.2 ± 6.8	<0.001*
Intraoperative PLT use (units)	1.1 ± 2.6	2.2 ± 2.3	<0.001*
Intraoperative crystalloid (L)	6.7 ± 4.2	4.9 ± 3.0	0.002*
Unexpected survivors (%)	5.1	22.3	<0.001*
Unexpected deaths (%)	22.2	8.5	0.007*

* Statistically significant at $p < 0.05$.

TEP, trauma exsanguination protocol; RBC, red blood cell; FFP, fresh frozen plasma; PLT, platelets.

Predefined MTP are Associated With a Reduction in Organ Failure and Postinjury Complications

- TEP - immediate delivery of products in 3:2 ratio of RBC:FFP and 5:1 for RBC:plt
- Inclusion criteria same as last paper

Table 1 Demographic and Injury Score Differences Between Groups

	Pre-TEP (n = 141)	TEP (n = 125)	*p*
Age, yr (±SD)	38.5 (±17.8)	35.6 (±15.5)	0.101
Male (%)	86	94	0.367
Penetrating mechanism (%)	40	51	0.034
ISS (±SD)	28.0 (±15.5)	33.3 (±15.9)	0.006
w-RTS (±SD)	4.29 (±2.5)	3.48 (±2.6)	0.010
Predicted survival by TRISS, % (±SD)	52	35	<0.001

ISS, Injury severity score; w-RTS, weighted revised trauma score; TRISS, Trauma related Injury Severity Score.

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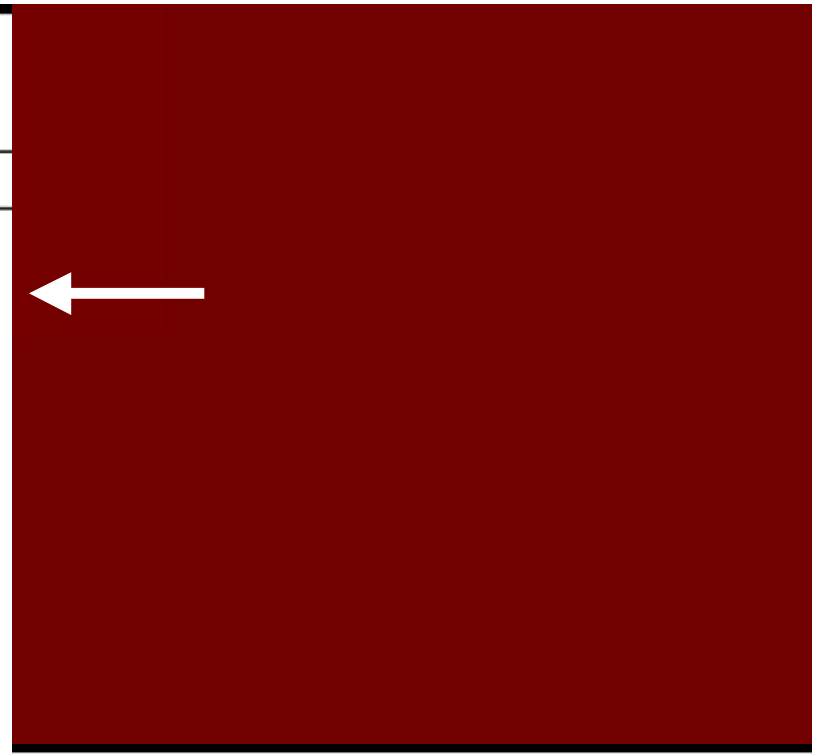
Table 2 Outcome and Resuscitation Comparison Between Groups

	Pre-TEP (n = 141)	TEP (n = 125)	*p*
24-h survival (%)	61	69	0.185
30-d survival (%)	37.6	56.8	0.001
Hospital length of stay, d (±SD)	16.4 (±20.1)	12.0 (±12.1)	0.049
ICU length of stay, d (±SD)	6.6 (±9.4)	5.0 (±8.3)	0.239
Ventilator days, d (±SD)	8.2 (±9.7)	5.7 (±7.2)	0.017
IO blood products, units (±SD)	11.0 U (±SD)	14.7 U (±SD)	0.001
IO crystalloid, L (±SD)	7.0 L (±SD)	4.8 L (±SD)	<0.001
24-h blood products (±SD)	38.7 U (±SD)	31.2 U (±SD)	0.050



Complications Rates Between Groups

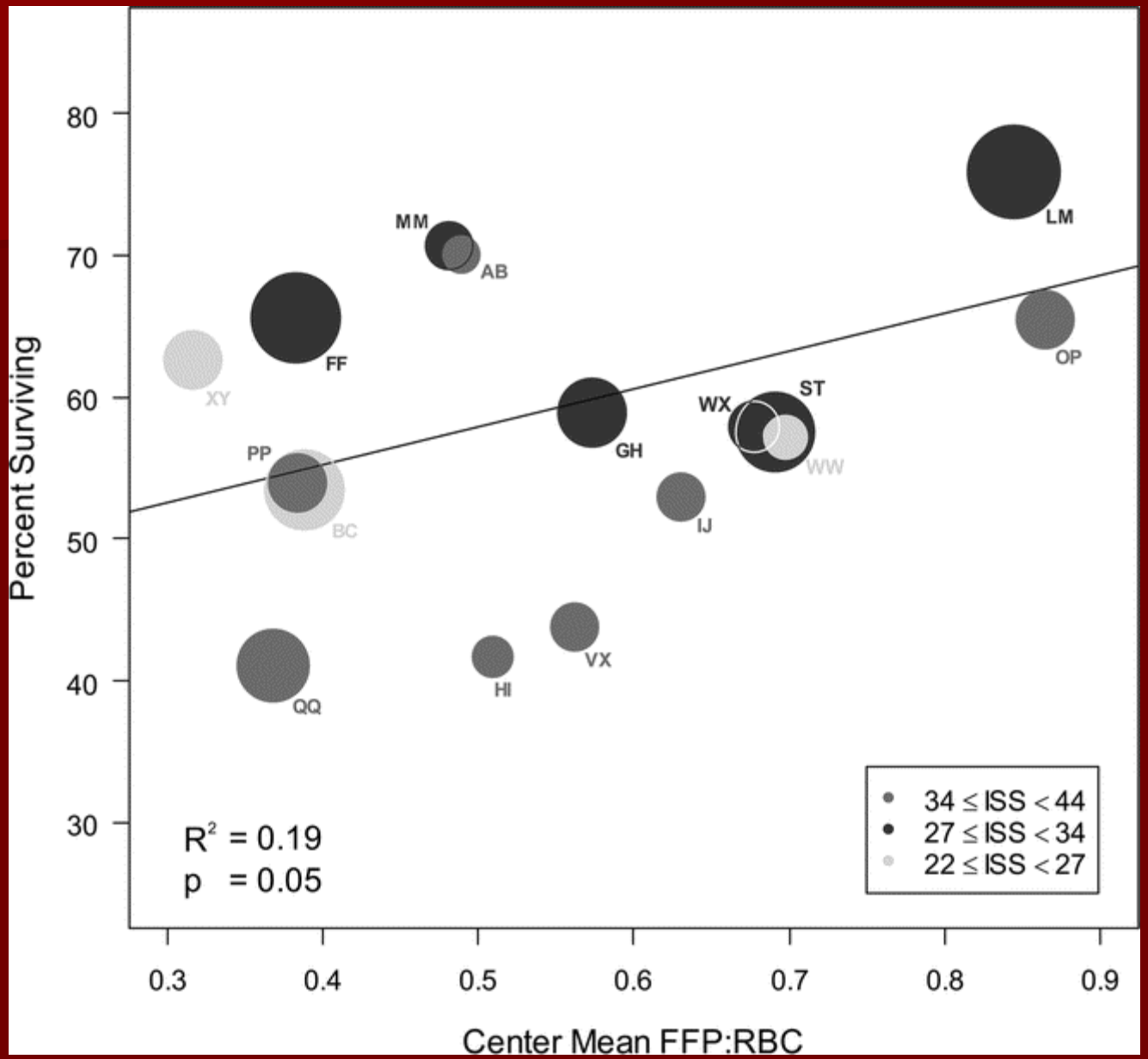
	Pre-TEP (n = 141)	TEP (n = 125)	*p*
SIRS (%)	55.3	52.8	0.682
Severe sepsis/septic shock (%)	19.8	10.0	0.019
Ventilator-dependent respiratory failure (%)	62.4	60.8	0.787
Ventilator associated pneumonia (%)	39.0	27.2	0.041
Abdominal compartment syndrome (%)	9.9	0.0	<0.001
Open abdomen (%)	30.5	6.4	<0.001
Need for renal replacement therapy (%)	2.8	3.2	0.826

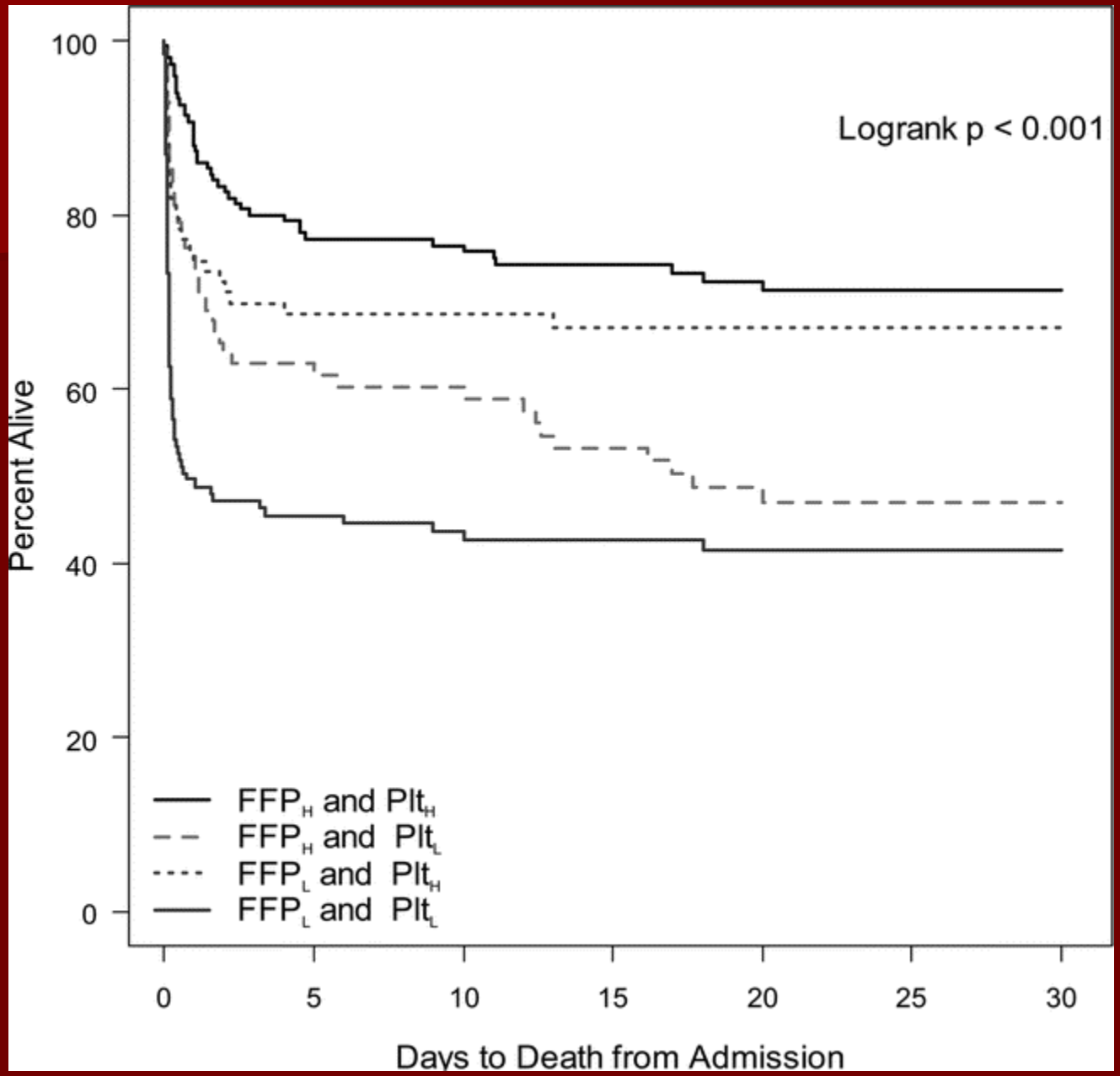
SIRS, systemic inflammatory response syndrome; open abdomen, failure to achieve primary fascial closure by hospital day 7.

Increased FFP and PLT to RBC Ratios Improves Outcome in 466 Massively Transfused Civilian Trauma Patients

- Retrospective review of MT trauma pts transported from the scene to 16 level 1 trauma centers between 5/05 and 6/06
- Based on high and low plasma and platelet to RBC ratios, 4 groups were analyzed

Ann Surg. 2008;248:447-58


Percent Surviving
80
70
60
50
40
30
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Center Mean FFP:RBC
MM
AB
LM
FF
XY
OP
WX
ST
GH
WW
PP
BC
IJ
VX
HI
QQ
R^2 = 0.19
p = 0.05
34 ≤ ISS < 44
27 ≤ ISS < 34
22 ≤ ISS < 27

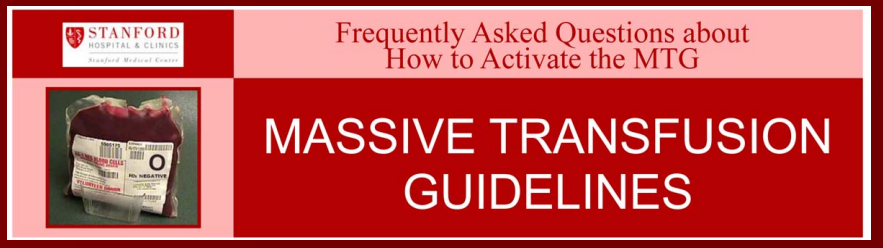

Logrank p < 0.001
Percent Alive
100
80
60
40
20
0
0
5
10
15
20
25
30
Days to Death from Admission
FFP$_H$ and Plt$_H$
FFP$_H$ and Plt$_L$
FFP$_L$ and Plt$_H$
FFP$_L$ and Plt$_L$

Outcome in 466 Massively Transfused Civilian Trauma Patients

- Survival in civilian MT patients is associated with increased plasma and platelet ratios
- Massive transfusion practice guidelines should aim for a 1:1:1 ratio of plasma:platelets:RBCs

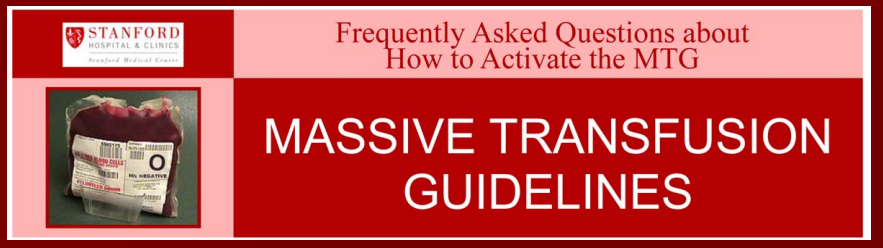
Ann Surg 2008;248:447-58

Methods



- Design
  - Retrospective cohort
- Setting
  - ACS Verified Level 1 Trauma Center
- Cohorts
  - 2 years pre and post MTP implementation
  - July 2003 - June 2005 (pre-MTP)
  - July 2005 - June 2007 (post-MTP)

Protocol



- MTP guidelines
  - Surgeon activated
  - Facilitated product release
  - MTG pack - 6 units PRBC, 4 units FFP, 6 pack platelets (1 unit)
- Time to transfusion
  - Defined as time to patient specific product
  - Does not include initial uncrossed trauma cooler

Demographics

	Pre-MTP	Post-MTP	
	n=40	n=37	*p-Value*
Average Age	42	45	0.94
Male	29 (73%)	25 (62%)	0.77
Blunt trauma	35/40 (88%)	28/37 (76%)	0.18
ISS	32	28	0.27

The cohorts were statistically similar

Product Utilization

	Pre-MTP Mean (95% CI)	Post-MTP Mean (95% CI)	*p-Value*
PRBC	23.9 (18.7 - 29.1)	20.5 (15.5 - 25.5)	0.34
FFP	12.3 (9.6 - 15.0)	10.7 (7.8 - 13.6)	0.42
Plt	2.3 (1.7 - 2.9)	2.8 (1.8 - 3.7)	0.41
FFP:PRBC	1:1.8 (1:1.5 - 1:2.2)	1:1.8 (1:1.5 - 1:2.1)	0.97
Plt:PRBC	1:1.7 (1:1.4 - 1:2.1)	1:1.3 (1:1.1 - 1:1.5)	0.05*

Product use was statistically similar except for increased Plt:PRBC ratio

Stanford MTG

- Time to products (pRBC, FFP, platelets) were all significantly better – but *all* too slow

	Pre-MTP	Post-MTP	*p-Value*
Mortality	45%	19%	0.02*

Time to product

	Pre-MTP Mean (95% CI)	Post-MTP Mean (95% CI)	p-Value
PRBC	115 (85 - 146)	71 (49 - 93)	0.02*
FFP	254 (185 - 323)	169 (130 - 209)	0.04*
Platelets	418 (316 - 519)	241 (169 - 311)	0.01*

*p < 0.05

Time in minutes

Mortality

	Pre-MTP	Post-MTP	*p-Value*
Patients	40	37	
Mortality	45%	19%	0.02*

*p < 0.05