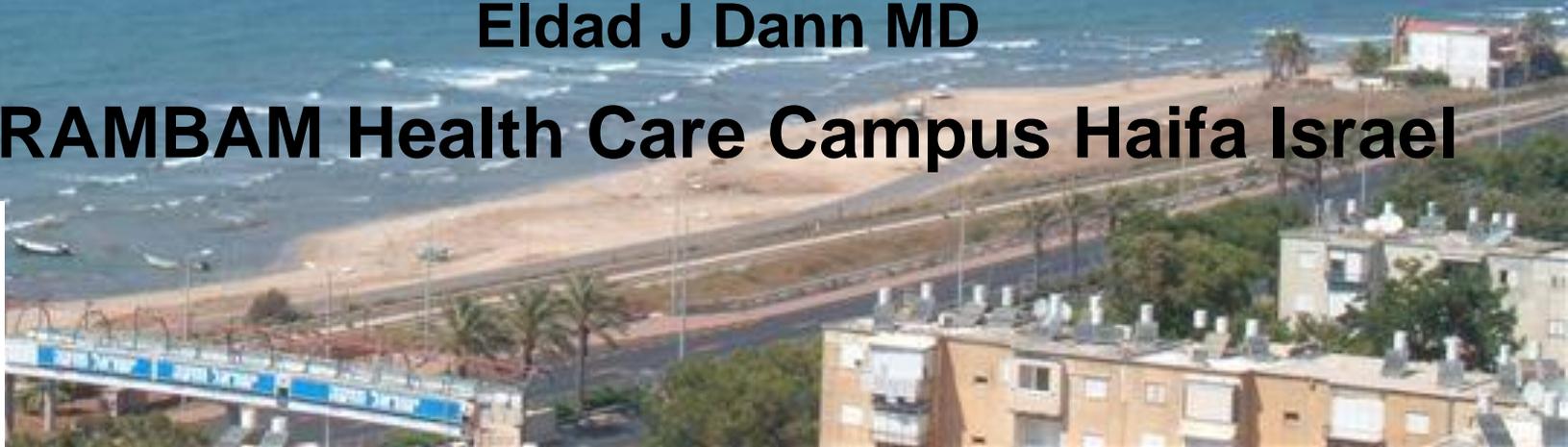


Blood Transfusion for war injuries: Experience from northern Israel, summer 2006

Eldad J Dann MD

RAMBAM Health Care Campus Haifa Israel



Rambam Campus (900 Beds tertiary medical center, level 1 trauma center for the north of Israel serving 1.3 million inhabitants)



**More than 45 rockets fell within 0.5 KM of Rambam medical center
Overall 93 rockets fell over the city 13 Death**



Lebanon War 2006 - First week

3970 Rockets fell within 33 days

901 rockets fell within urban areas



August 13, 2006



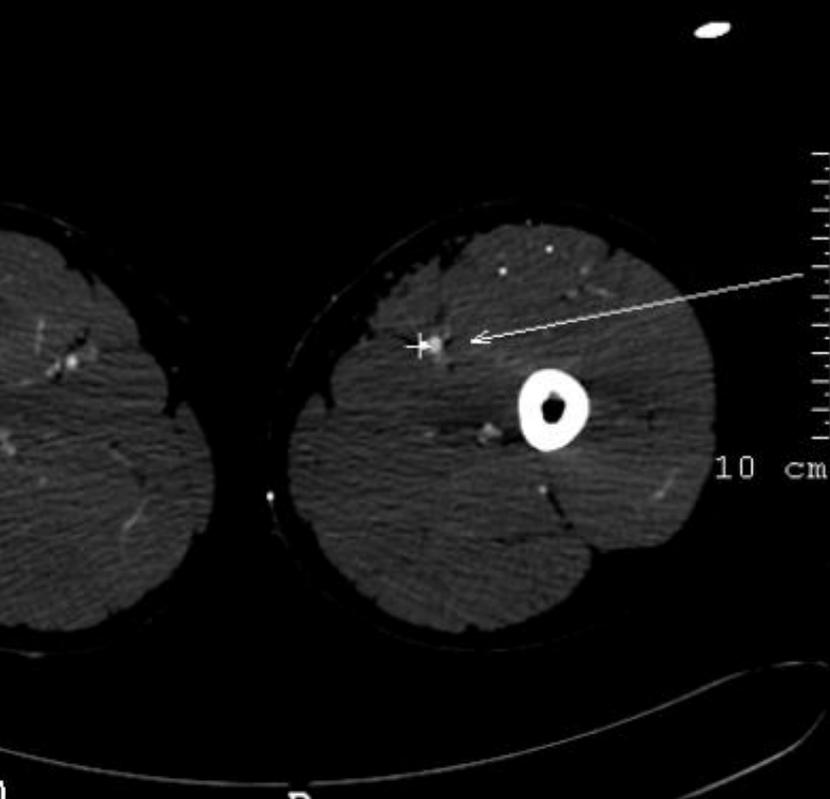
House Hit in Bat Galim- 9 injured

17.07.2006



Which shrapnel should be extracted ???

m



R



20 cm

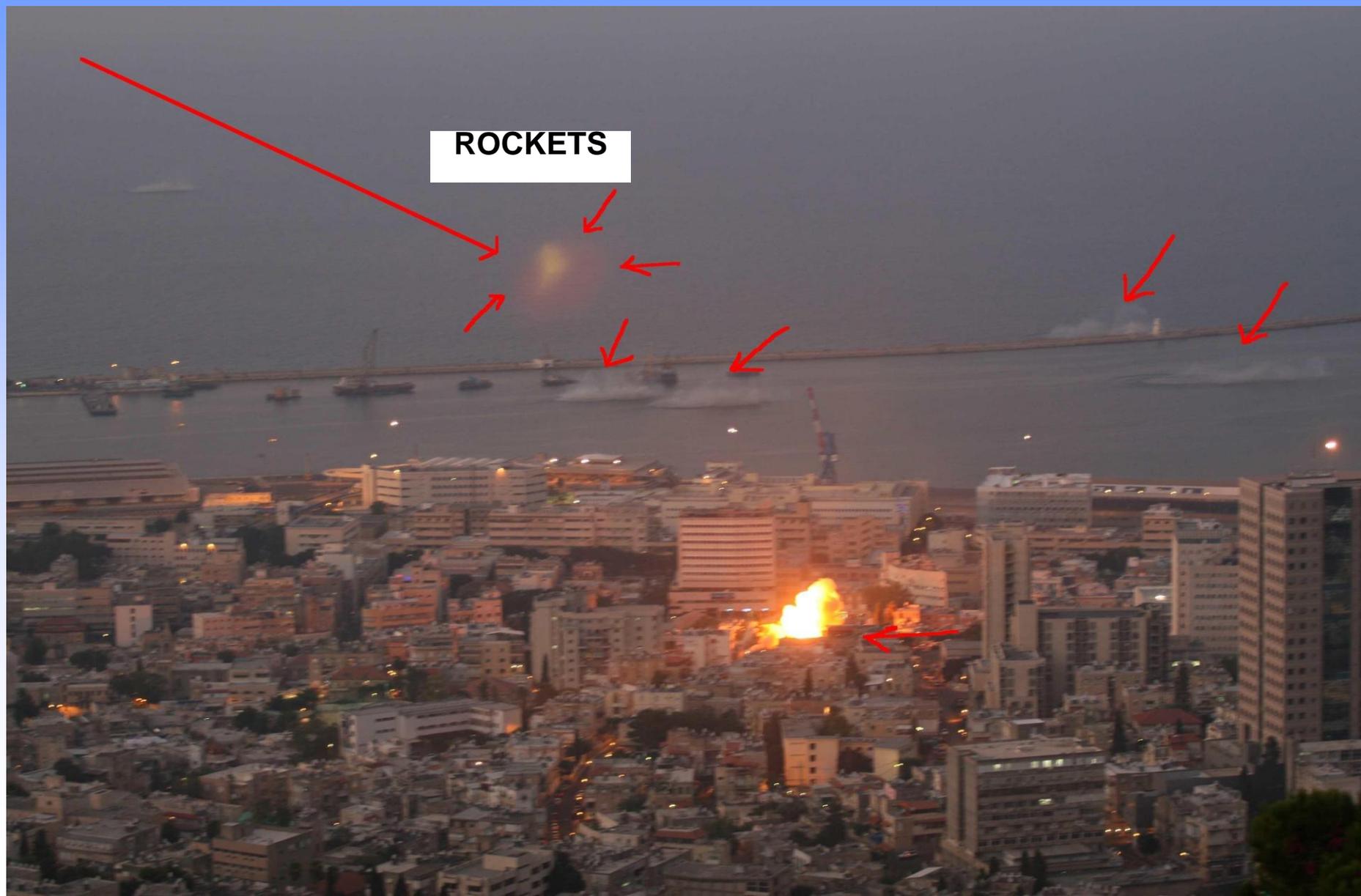


Lecture objectives

- Organization of emergency department for mass casualty even
- Transfusion medicine in mass casualty events
- Massive transfusion protocol.
- Pharmacologic treatment (anti fibrinolytic, activated factor VII)
- Fresh whole blood ?



Hospital Under Attack- Sunday, August 6th



Trauma Center- Evening Attack on Haifa Rambam- Sunday, August 6th



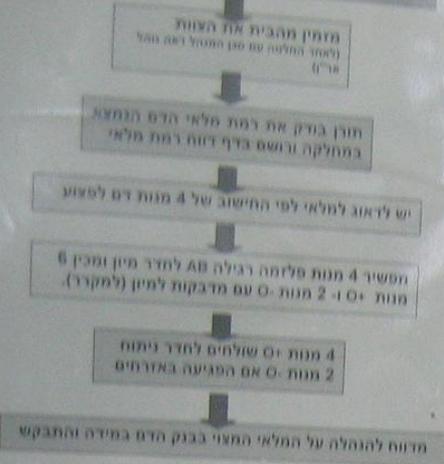
27/02/2007

בטחון

תורן בטחון - מירס 40-2525
 איתורית 44-465

שער ראשי - טל. 2747
 אינטרקום 5119

משרד - (עד השעה 13:00)
 טל. 2639



מספר טלפון בנק הדם - מגן דוד אדום ישרי בחיפה
 מספר טלפון מגן דוד אדום, חיפה
 מספר טלפון מדי"א, תל-אביב (מוקד) - משלוחים

8533576 / 855
 101 מ 851
 5300436

דעת קריאה בנק הדם:
 בזמן חרום עובדי בנק הדם באותו זמן יודיעו מיידית ל**לחברת המעבדה** (לינק) שחולטים
 על הימנע עזרה. אין לתקשר ישירות לראשי חוליות.

לינק: 45-2177 לחברת המעבדה

חוליה א'	חוליה ב'	חוליה ג'
מחיה טל. 85814, בית.	רווח טל. 85805, בית.	לוח 3 טל. 85807, בית.
קלית טל. 45-4902, בית.	גנייס טל. 85810, בית.	לינק טל. 85812, בית.
מחיה טל. 077-5254006, בית.	מחיה טל. 8520043, בית.	קנין טל. 85704, בית.
מחיה טל. 45-1210, 85822, בית.	לוח 6 טל. 85806, בית.	יוליה טל. 85424, בית.
מחיה טל. 8244278, בית.	מחיה טל. 8737599, בית.	מחיה טל. 8252348, בית.

מחיה טל. 077-5252032

מחיה טל. 85806, בית.

מחיה טל. 8244278, בית.

מחיה טל. 85806, בית.

מחיה טל. 8737599, בית.

מחיה טל. 8252348, בית.



Back up for communication system since cellular system will collapse during such incidence

Flow of duties for large scale casualties events

- BTS technician is informed on a large scale casualty event.

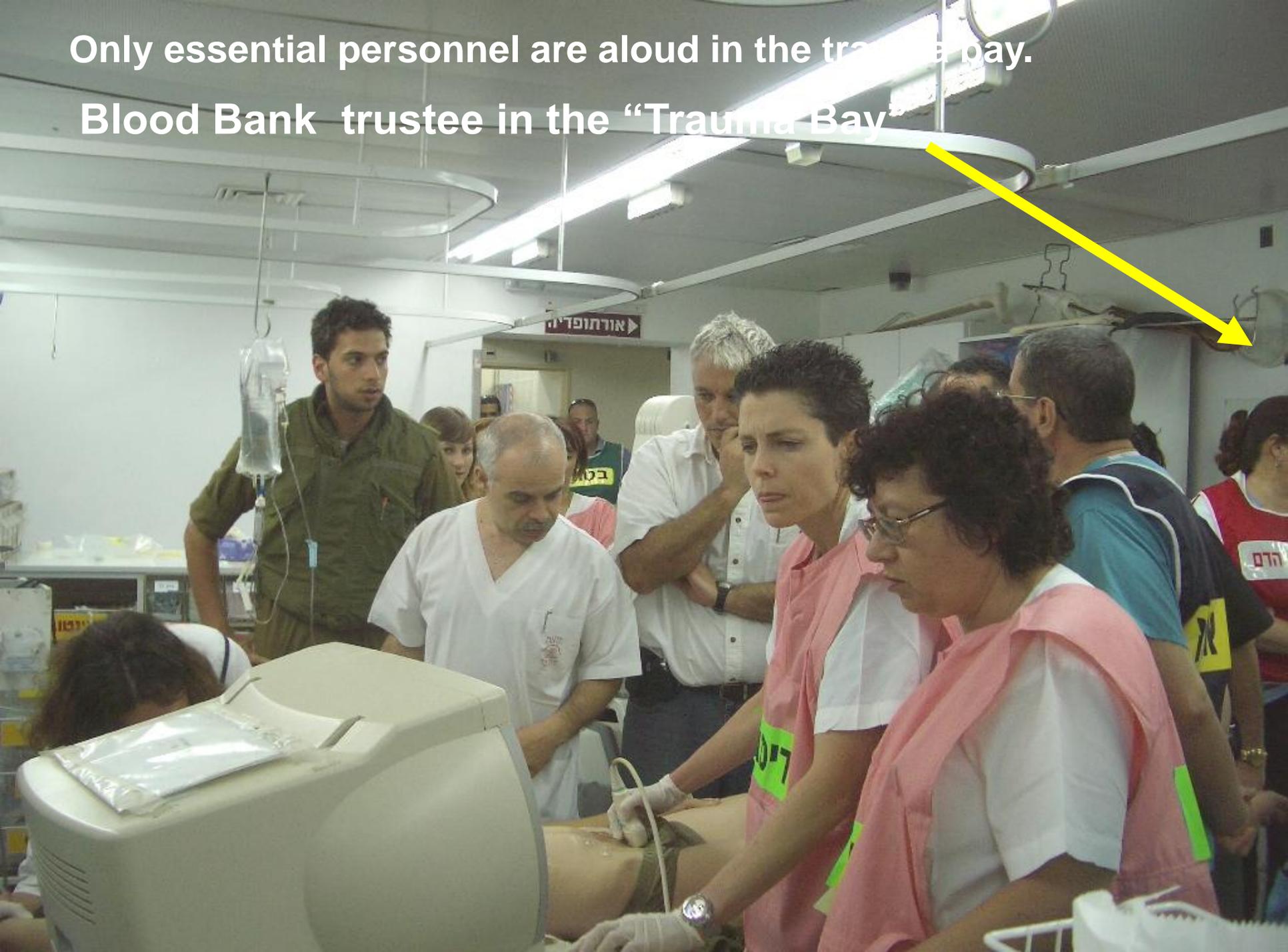
Notify Blood Bank Director.

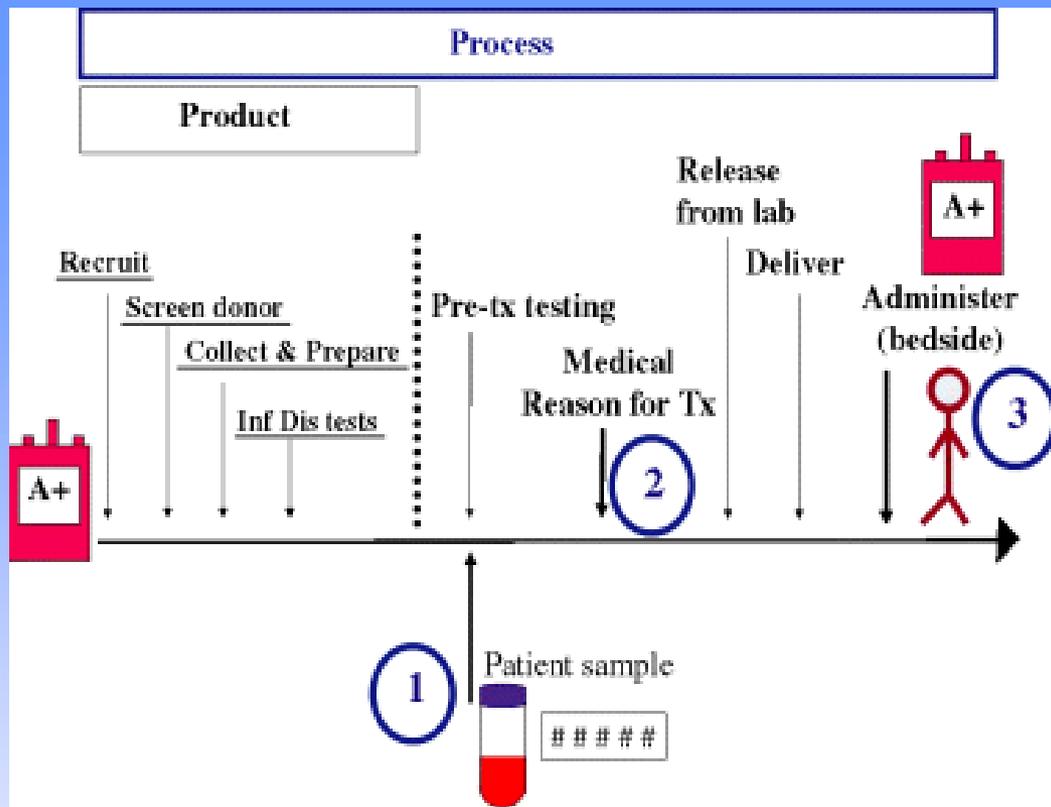
- If unavailable, notify Deputy Director Summon the BTS technician on call to hospital and if needed, summon other BTS members.
- Thaw 4 units of FFP AB, label and prepare 6 O^{pos} PRBC and 2 O^{neg} PRBC to be sent to the ER (will be kept in the refrigerator until demanded)
- Check the blood product stock. Make sure that the stock is full. If more than 50 casualties are expected, order RBC 1,3 x Nu of patients (A x 0.4, O x 0.4, B x 0.2)
- Report to hospital administration if additional blood products are required.



Only essential personnel are aloud in the trauma bay.

Blood Bank trustee in the "Trauma Bay"





Transfusion Safety: process and product. Safe transfusion depends upon a series of linked processes and includes more than just blood safety. Numbers 1–3 refer to the three zones of error in the process of transfusion. See text for details

1. Presence of a blood bank representative, e.g., BTS deputy director or another “blood bank trustee” in the ER with the aim to monitor the samples for type and screen and thus **reduce hazardous miscollection or mislabeling**

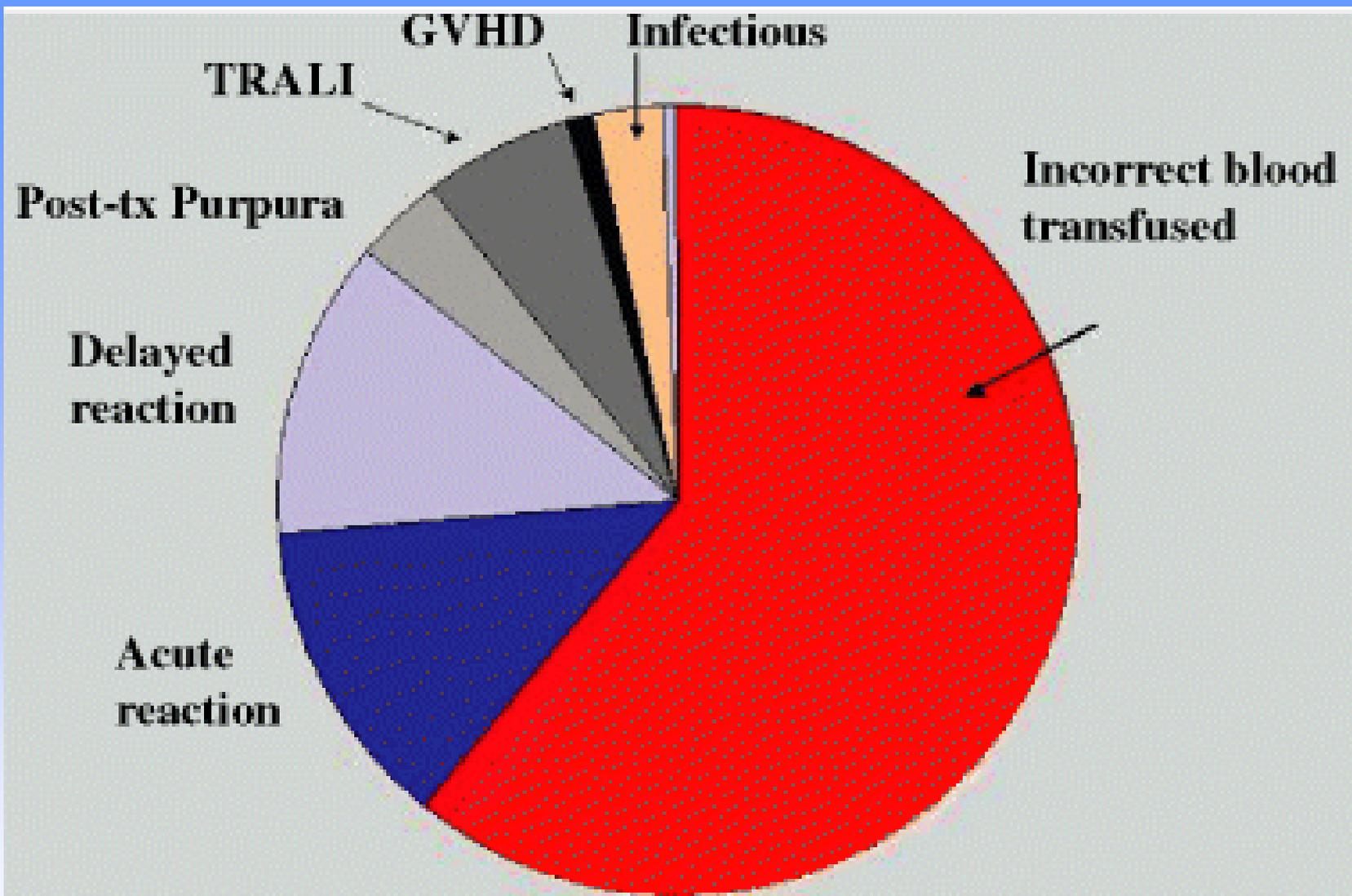


Fig 3 Serious hazards of transfusion (1996–2001). The relative frequency of different transfusion risk is shown. Data available from <http://www.shotuk.org/index.htm> TRALI, transfusion-related lung Injury; GVHD, graft-versus-host disease

3. Since the use of a running temporary 8-digit ID number for unidentified patients is prone to human errors under the stress of a large scale casualty event, an addition of a second, **4-digit number printed in bold and large size font** proves to be beneficial.

Case 1020

Izraeli Adam

Age24

ID 5547552-1

IIIIIIIIIIIIIIIIIIII

Case 1021

Unknown

Age

ID 7012345-6*

IIIIIIIIIIII

1. Presence of a blood bank representative, e.g., BTS deputy director or another “blood bank trustee” in the ER with the aim to monitor the samples for type and screen and thus **reduce hazardous miscollection or mislabeling.**
2. Presence of one more “blood bank trustee”, i.e., either a transfusion medicine physician or an expert in coagulation and disorders in the OR. This person, preferably the **BTS Director, provides real time consultation in issues related to transfusion medicine, acts as a liaison between the OR and the blood bank** and also monitors blood products requests and available products on the anesthesiology cart trying to reduce mistransfusion.

Blood Bank trustee in ER



Packed Red Blood Cells requested and transfused in 3 medical centers following suicide bombing events

Date	No. of patients admitted to the ER	No. of patients for whom blood was ordered	PRBCs matched (first 2 h)	PRBCs released (first 2 h)	PRBCs transfused (first 2 h + unmatched)	C/T ratio (first 2 h)	% PRBCs transfused
2 December 2001	19	9	32	48	22 + 16	1.45	79
31 March 2002	30	5	41	47	22 + 5	1.86	57
7 May 2002	10	6	10	29	5 + 11	2	55
22 May 2002	44	8	22	38	4 + 10	5.5	37
4 August 2002	11	7	14	16	9	1.55	56
9 September 2003	36	11	12	93	8 + 56	1.5	69
4 October 2003	31	15	46	34	11 + 4	4.18	44
26 October 2005	33	6	31	28	11 + 4	2.81	53
5 December 2005	21	3	9	7	5 + 1	1.8	86
Total	235	70	217	340	204		
Mean ± SD	26 ± 11	7.78 ± 3.56	24 ± 14	38 ± 25	22.6	2.52 ± 1.42	60 ± 16
Median	30	7	22	34		1.86	56

An excessive demand is common that may lead to temporary impression of Blood products shortage

What quantity of blood products do we order from the blood bank depot?

Blood requirements us. Wounding Agents Vietnam

	Gunshot	Artillery (Mortar/Rockets)	Mines and Booby trapst
Casualties*	4565	6631	1854
Percent requiring blood	23.7%	14%	37.0%
Mean blood requirements (all casualties)	1.6 units	1.0 units	1.9units
Mean blood requirements (casualties requiring) blood	7.2 units	6.3 units	8.9 units

*Does not include burns ,multiple agents, and unknown categories were excluded

Booby traps include grenades, which are otherwise omitted

Mendelson JA The use of whole blood and blood volume expanders in US military medical facilities in Vietnam The J of TRAUMA 15;1:1-13 1975

Was patient given blood products on his way to hospital?



**Over 40 Helicopters Landed at Rambam
Median evacuation time of 3 hours versus 1H and 10
min reported by the German trauma registry**



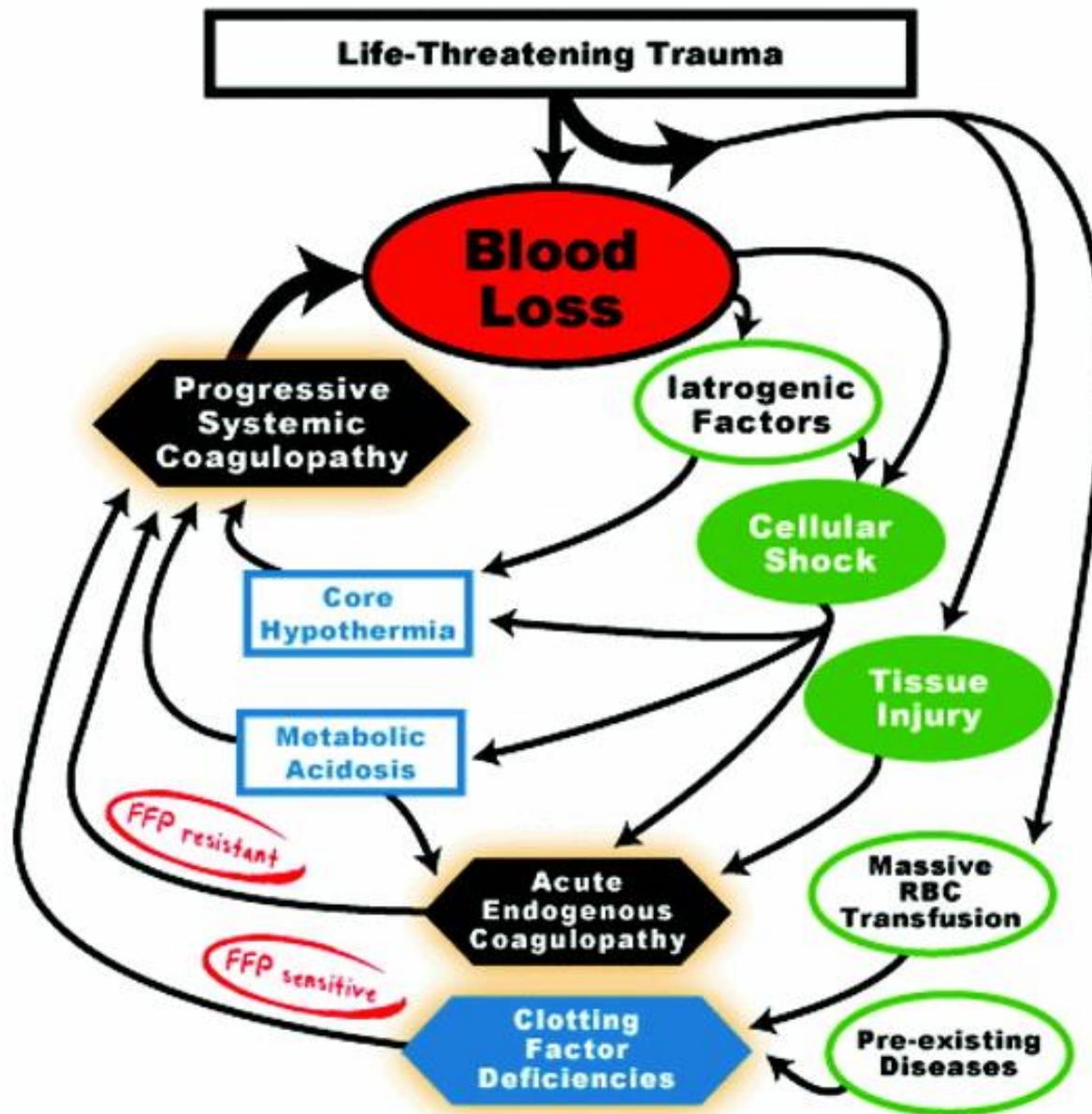
Management of massive blood loss: a template guideline

Therapeutic goals:

- **Maintenance of tissue perfusion and oxygenation by restoration of blood volume and restoration of blood volume and haemoglobin. Treating any surgical source of bleeding;**
- **Correcting coagulopathy by the judicious use of blood component therapy.**

"Early consultation with surgical, anaesthetic and haematology colleagues is advisable and the importance of good communication and cooperation in this situation cannot be overemphasized."

Stainby D Br J Anaesth 2000; 85:487, Br J Haem 2006 135



Massive transfusion

Defined as transfusion of 10 or more PRBC within 24 hours

Transfusion of ≥ 5 units of PC within 4 hours

Coagulopathy is common and once present is difficult to correct

Early treatment with plasma and platelets are associated with improved outcome.

Goals: plasma coag factors $>40\%$ **INR** <1.5

Platelets counts **50 – 100** $\times 10^9/L$

Temperature $>34^{\circ}C$

improve tissue oxygenation to reduce acidosis

TRANSFUSION- ISS MEDIAN 17 (6-75) MASSIVE

PT'S who had MASSIVE TRANSFUSIONS 7-8/2006

N=21	HB	PLT X10 ³ /u l	B.E.	PH	H ₂ CO ₃ ⁻	INR	PTT	FIBRINOGEN
Emergency room (RANGE)	10.6 (7.3-13.7)	262 84-464	-5.8 -22-0.4	7.318 6.92-7.5	20 7.4-25	1.26 1.12-2.2	33" 24-57	N.D
1H-2H	-	-	-3 -15 - -2	7.01-7.34 N=3	22 13 -24	1.55 1.24-2.31	44" 23-89	119 62-183
H4-H8	9.9 6.6-15.1	120 84-173	-1.6 -7.8 - +10	7.355 7.2-7.4	22.6 18 - 35	1.35 1.03-2.33	41" 30 - 53	181 102 - 245
24H	10.52 7.9-14.4	98 40-213	0.7 -2.2-+6.4	7.42 7.29-7.49	25.4 20.3-31.2	1.27 1.01-1.47	38.9 30.7-43.9	272 49-358

Casualties admitted to 3 hospitals during July 12th to August 15th 2006

Medical Center	Total number of patients	Pt's with anxiety	Wounded Pt's (hospitalized)	Pt's transfused	Pt's receiving massive transfusion
Rambam	842	338 (10)	504 (289)	60(7%)	21(35%)
Ziv	1558	420	1138 (415)	32(2%)	4(12.5%)
Western Galilee	1805	937	868 (195)	15(1%)	1(6%)

Blood product transfused to casualties from July 12th to August 15 2006 during PFG II v PFG 1982

Medical Center	Patients (n)	Packed Cells PRBC	Fresh frozen Plasma FFP	Cryo – precipitate	platelets
Rambam	64	463	413	266	258
Ziv	32	134	34	50	30
Western Galilee	15	71	68	51	10
RAMBAM 1982 6/6-15/9/82	223	1830	754	44	15

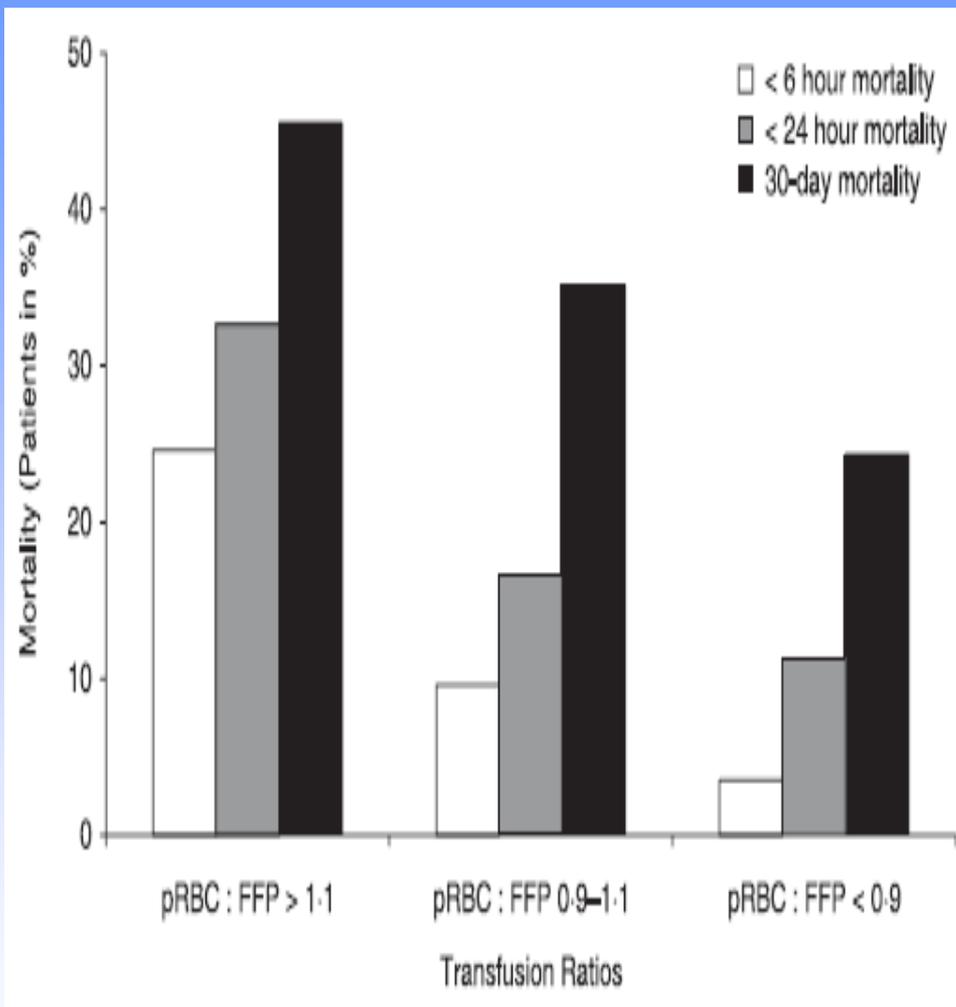
Median products received according to injury severity score. (MEAN)

	PULSE	CRYSTALLOIDS mll	PC	FFP	PLAT	CRYO
ISS< (N=34)	91 (163)	1000(1770) (n=97soldiers)	4 0-17	1.5 0-18	0 0-12 M(1.9)	- M()
ISS≥16 (N=26)	110.29 (22)	3000(3140) (n=21soldiers)	7 (0-45)	13 (0-54)	0 0-48 M(7.4)	- M()
			P=0.026	P=0.002		

34 PATIENTS WITH ISS HAD BLOOD

26 PATIENTS WITH ISS> 16 HAD BLOOD

Results are presented as median and range



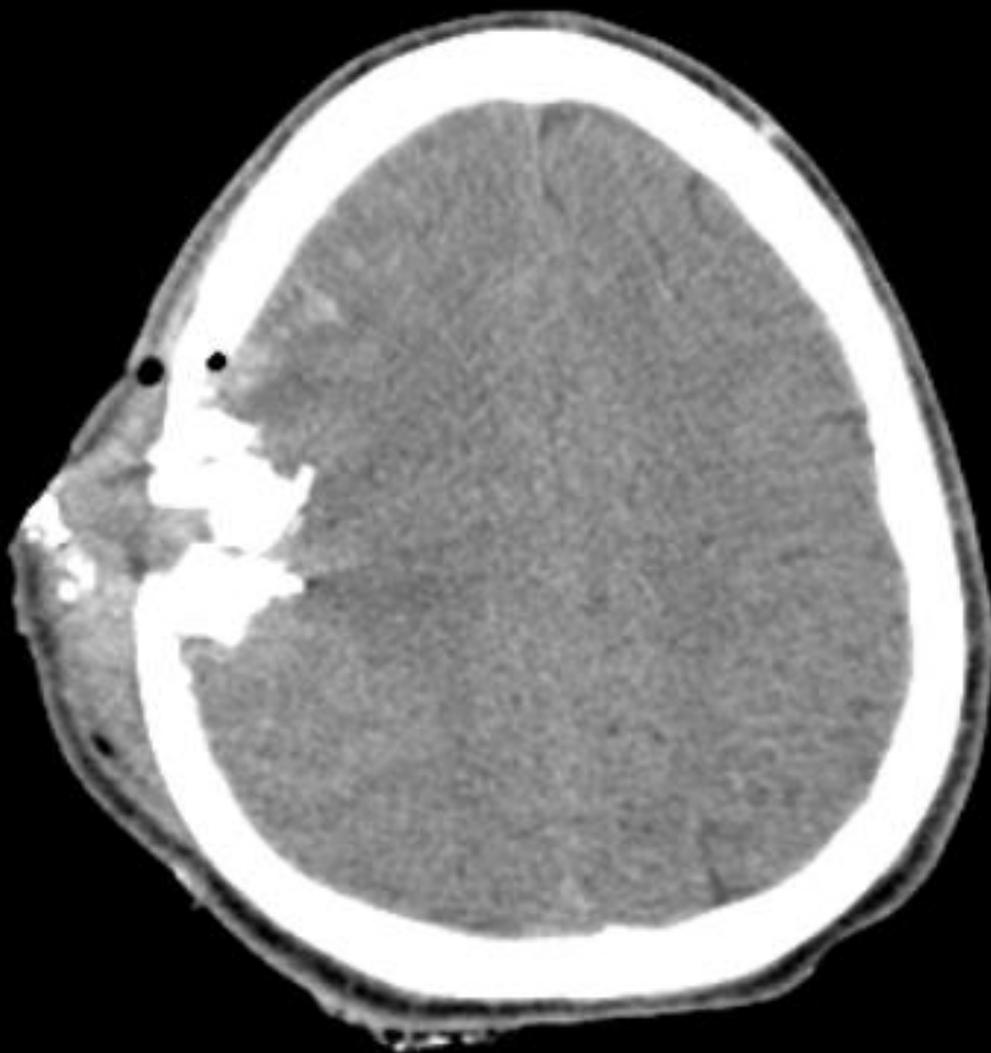
30 day mortality rates were 45.5, 35.1 and 24% for rbc/FFP >1.1 ,0.9-1.1, <0.9 (p<0.001)

Ventilator days and length of stay for intensive care unit and overall in hospital were highest in the <0.9 ratio p<0.0005

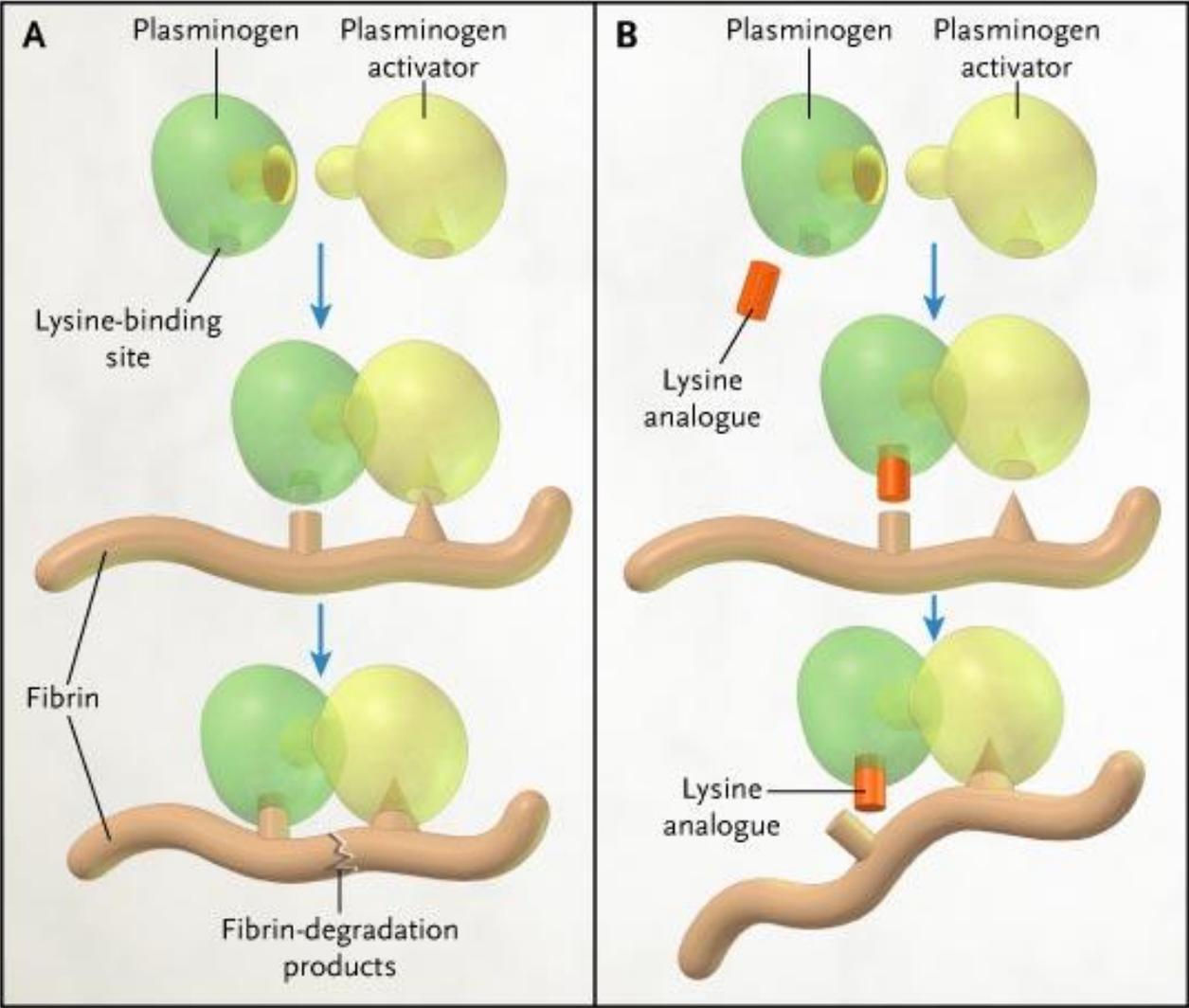
Fig. 2 Early (< 6-h and < 24-h) and 30-day mortality rates in percent (%) for patients transfused with pRBC : FFP > 1 : 1, pRBC : FFP 0.9-1.1 (1 : 1), and pRBC:FFP < 0.9 ratios during immediate care (P < 0.0001 for < 6-h and 24-h mortality; P < 0.001 for 30-day mortality).

Pack number	Massive transfusion protocol Blood products released
Pack n° 1	3 PC+3 FFP
Pack n° 2	3 PC+ 3 FFP
Pack n° 3	3 PC + 2 FFP+ 10 units cryo precipitate 6 units platelets
Pack n° 4	4 PC + 4 FFP
Pack n° 5	4 PC +4 FFP 6 units platelets cryo According to platelets count

Penetrating Head Injury treated with surgery and Factor VIIa



Mode of Action of Lysine Analogues (Aminocaproic Acid and Tranexamic Acid)





白求恩同志



HENRY NORMAN BETHUNE
1890-1939

Born in Gravenhurst, Bethune studied medicine in Toronto. He made significant contributions to thoracic surgery in Montréal hospitals, and became a strong advocate of socialized medicine. In 1936-37, during the Spanish Civil War, he led a Canadian medical team which, while serving with the Republican forces, pioneered the use of mobile blood transfusion services. He subsequently worked as a battlefield surgeon and medical adviser with the forces of Mao Tse-tung. After his death at the war front, on November 12, 1939, he became a national hero in China.

**Yanan 1938 marching
blood bank- the issue of
fresh whole blood**

Modern War Surgery: operations in an evacuation hospital during the October 1973 Arab Israeli War

Pfeefferman R, Rozin RR, Durst AL, Marin G

51 severely wounded soldiers, operated upon for abdominal, thoracic, vascular, and brain injury.

39/51 severely hypotensive on arrival to the hospital

Average blood used 15 units of whole blood per patient 7-(1-5)units, 21-(6-15)U 11-(16-25)U 4-(26-40)U, 3-(41-60)U

Mortality; at evacuation hospital 4(8%)

at central hospital 8(16%)

“The first 8-10 units of blood given to each casualty were from the stored blood bank supply which was less than 24 h old

Whenever more blood needed **it was drawn from donors and immediately transmitted.”**

J of trauma vol 16: 694-703 1976

Fresh whole Blood: A Controversial Military Practice-Iraq

During 10 month of (OIF) 3/03 to 12/03

2349 units of blood products were transfused to 281 Pts.

FWB was used during shortage of blood products.

Mainly in forward surgical team (FST) were 20 u of PRBC available and in combat support hospital when no platelets were available or when blood supply was short.

In 2004 87patients received 545 units.

2222 donor samples tested from 5/03 to 8/05

3 HCV serology+ ,1 HTLV1 + 1 unconfirmed HIV

Conclusions

- **Patients with high Injury Severity Score($ISS \geq$)are expected to require a higher quantity of blood components.**
- **Coagulopathy is a major concern during first hours of therapy. Preemptive therapy is recommended. (at least a 1:1 ratio of packed cells to FFP for massively bleeding patient).**
- **Blood Bank should have a flow chart of duties for mass casualty events.**
- **A massive transfusion protocol should be recommended. A rapid pack release system should be considered to facilitate blood products administration.**
- **Transfusion medicine physician should be involved early in the treatment of complicated patients providing a real-time consultation.**



Thanks to Blood Bank technicians who work in harmony and are devoted for sake of saving human lives.

Trauma Resuscitation Unit RAMBAM 2006



3

Thanks to Lilach Bonstein, Gila Hymms, Mirit Barzilay and Dr Moshe Michaelson - Emergency Department
Prof Brenner Dr Hofman hemostasis unit RAMBAM
Health Care Campus