Section II: Interventions at the disaster field

II.6: Fluids and urine volume monitoring early after extrication

TYPE OF FLUIDS in CRUSH-RELATED AKI

1. Volume resuscitation, 2. Alkalinization, 3. Other targets

	Solution (1000 ml)	Advantages	Drawbacks	Comments
Crystalloids	Isotonic saline	Effective Readily available	Hypervolemia, Hypertension	Preferred solution
	Isotonic saline + 5% Dextrose	Provides calories Attenuates hyperkalemia	Hard to find	Preferred, if available
	Hypotonic saline + HCO3	Improves acidosis Attenuates hyperkalemia	Complicated prep. Symp. alkalosis	Good for small scale disasters
	Mannitol-alkaline solution (Basal sol.: Hypotonic saline)	Plasma expander Diuresis, plugs, antioxid. Compartment syndrome	Hypervolemia, CHF Nephrotoxicity	Contraindicated in anuria
Colloids	Albumin Hydroxyethylstarch (HES)	Expansion of intravascular volume	Hard to find, side effects, expensive	Not preferred

The Journal of TRAUMA® Injury, Infection, and Critical Care

Preventing Renal Failure in Patients with Rhabdomyolysis: Do Bicarbonate and Mannitol Make a Difference?

Carlos V. R. Brown, MD, Peter Rhee, MD, MPH, Linda Chan, PhD, Kelly Evans, MS, Demetrios Demetriades, MD, PhD, and George C. Velmahos, MD, PhD

- Adult trauma ICU (1997– 2002)
- 1771 patients with abnormal CK
- Of the 382 pts with CK>5000 U/L
- 154 received, 228 did not receive MAN / BIC
- No difference in AKI, dialysis or mortality
- Tendency toward improved outcome if CK>30,000 U/L

No consensus among workgroup experts regarding mannitol administration !

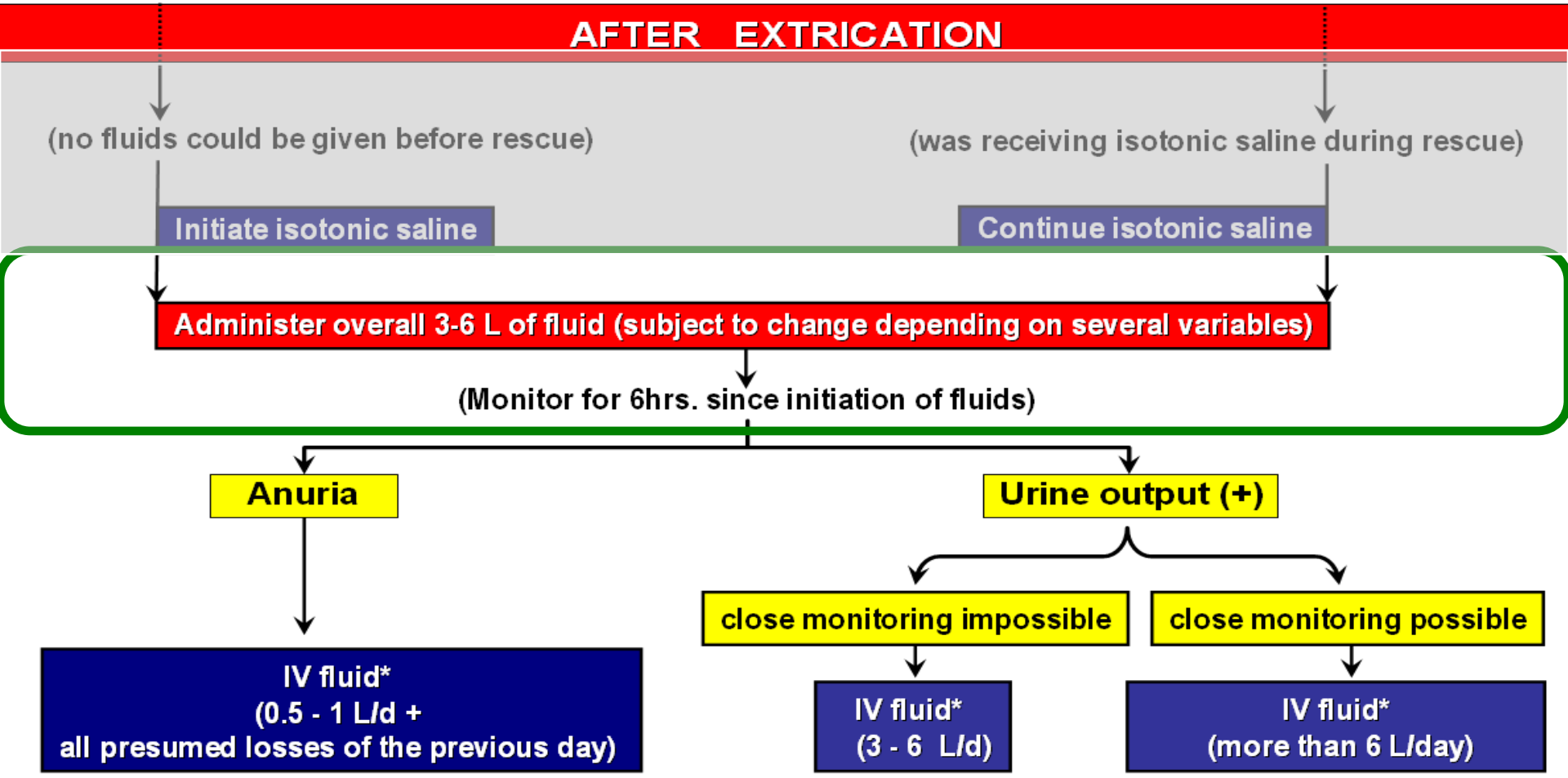
(Most suggest assesing response to a test dose)

Brown et al. J Trauma 2004

Section II: Interventions at the disaster field

II.6: Fluids and urine volume monitoring early after extrication

OVERALL VOLUME and RATE of FLUIDS



BINGOL (TURKEY) EARTHQUAKE

- 16 victims; 12 male; mean age: 23 ± 13 yr.

Fluids and urinary output			
	Dialysis (-) (n:12)	Dialysis (+) (n:4)	p
Fluids (L/d.)	21.8±2.7	11±2.5	0.002
Ur. vol. (L/d.)	8.8±2.3	1.8±2.4	0.002

- **Mean time under the rubble: 10.3 ±7 (3 to 24) h.**
- **Duration between rescue and fluid resuscitation:**

→Nondialyzed: 3.7±3.3 h. vs dialyzed: 9.3±1.7 h. p<0.03

Gunal et al. JASN, 2004;15:1862-7

THERAPEUTIC INTERVENTIONS

MEDICAL

- Renal replacement therapy (dialysis)
- Blood and blood product transfusions
- Treatment of infections and other complications

SURGICAL

- Management of traumatic wounds, amputations
- Fasciotomy

DAILYSIS PRACTICE AFTER DISASTERS

Dialysis application is problematic !

	Number of clinics reported as Katrina-affected clinics	Number of clinics (%) reported closed for 10 days or longer within the Katrina-affected geographic area
Louisiana	55[a]	37 (67%)
Mississippi	30	7 (23%)
Alabama	9	1 (11%)
Total	94	45 (48%)

[a] Forty of these clinics were located in the New Orleans metropolitan area.

even

Dialysis supply is inadequate for chronic patients!

Kutner et al, KI, 76, 760-766, 2009

even

Dialysis supply is inadequate for chronic patients!

Kidney International, Vol. 62 (2002), pp. 2264–2271

5137 EXTRA dialysis sessions for crush cases

Renal replacement therapies in the aftermath of the catastrophic Marmara earthquake

MEHMET S. SEVER,[1] EKREM EREK,[2] RAYMOND VANHOLDER,[3] BIRSEN YURUGEN,[4]

There is a disparity between demand and supply

All modalities have:

- Logistic and medical advantages and drawbacks

Intermittent Hemodialysis

	Advantages	Drawbacks
Medical	- High clearance rate of low molecular weight solutes - Possibility to dialyze without anticoagulation	- Priming volume may induce hypotension - Risk of dialysis disequilibrium syndrome
Logistic	- Possibility to treat several pts. per day at the same position	- Need for experienced personnel and infrastructure

Collins, Crit Care Clin,1991; Solez et al, KI, 1993; Vanholder et al, KI, 2000; Sever et al, KI, 2002

Slow Continuous Therapy

	Advantages	Drawbacks
Medical	- Better volume control - Gradual removal of solutes, ⊘ disequilibrium synd.	- Need for continuous anticoagulation - Low removal capacity for small solutes (i.e. K^+)
Logistic	- Can be established rapidly	- Ability to treat only one pt. per machine per day - Need for experienced personnel, electricity - Excessive amounts of substitution fluid

Collins, Crit Care Clin,1991; Solez et al, KI, 1993; Vanholder et al, KI, 2000; Sever et al, KI, 2002

Peritoneal Dialysis

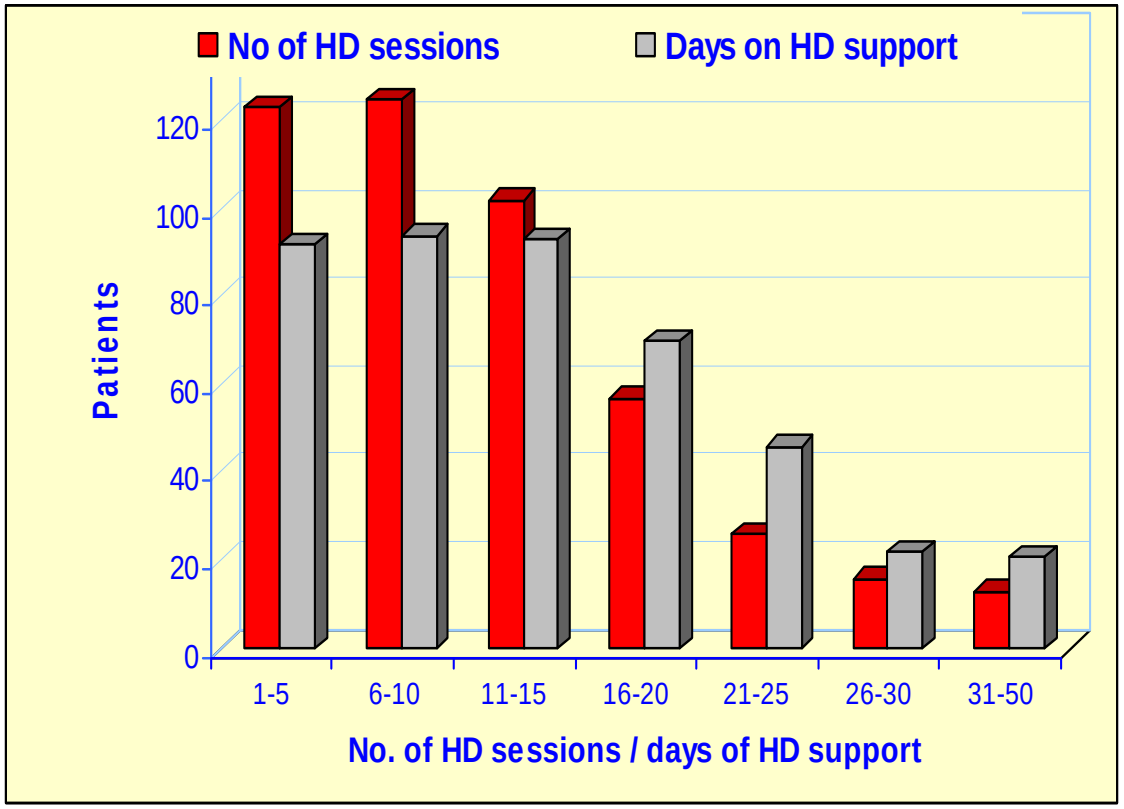
	Advantages	Drawbacks
Medical	- No need for vascular access, simpler technique - Less hemodynamic instability - Initiated rapidly, no risk of disequilibrium synd.	- Low clearance of small molecules (i.e. K^+) - Difficult to perform in patients with trauma and in some complications
Logistic	- No need for water and electricity	- Difficulty in maintaining sterile technique - Need for large quantities of dialysate

Collins, Crit Care Clin,1991; Solez et al, KI, 1993; Vanholder et al, KI, 2000; Sever et al, KI, 2002

RENAL REPLACEMENT THERAPY
(The Marmara Earthquake experience)

Dialysis support in 477 (74.6%) patients

IHD: 462, SCT: 34, PD: 8



HD sessions: 11.1±8.0
Days on HD: 13.4 ±9.0

5137 sessions of IHD

Sever et al. Kidney Int 2002

BLOOD and BLOOD PRODUCT TRANSFUSIONS

(The Marmara earthquake experience)

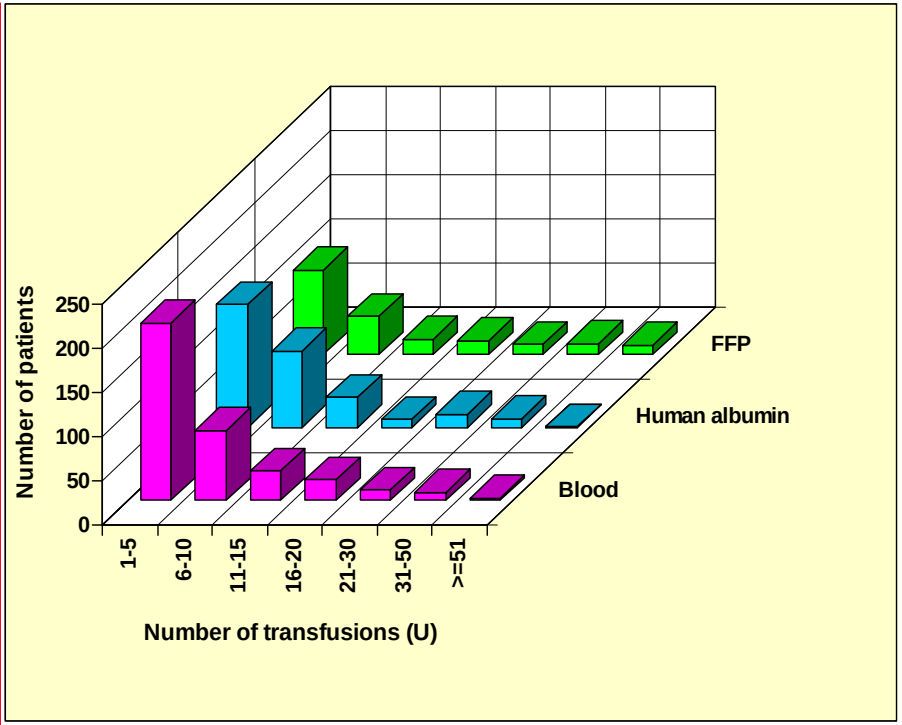
Blood: 2981 u.

FFP: 2837 u.

H. alb.: 2594 u.

4u.

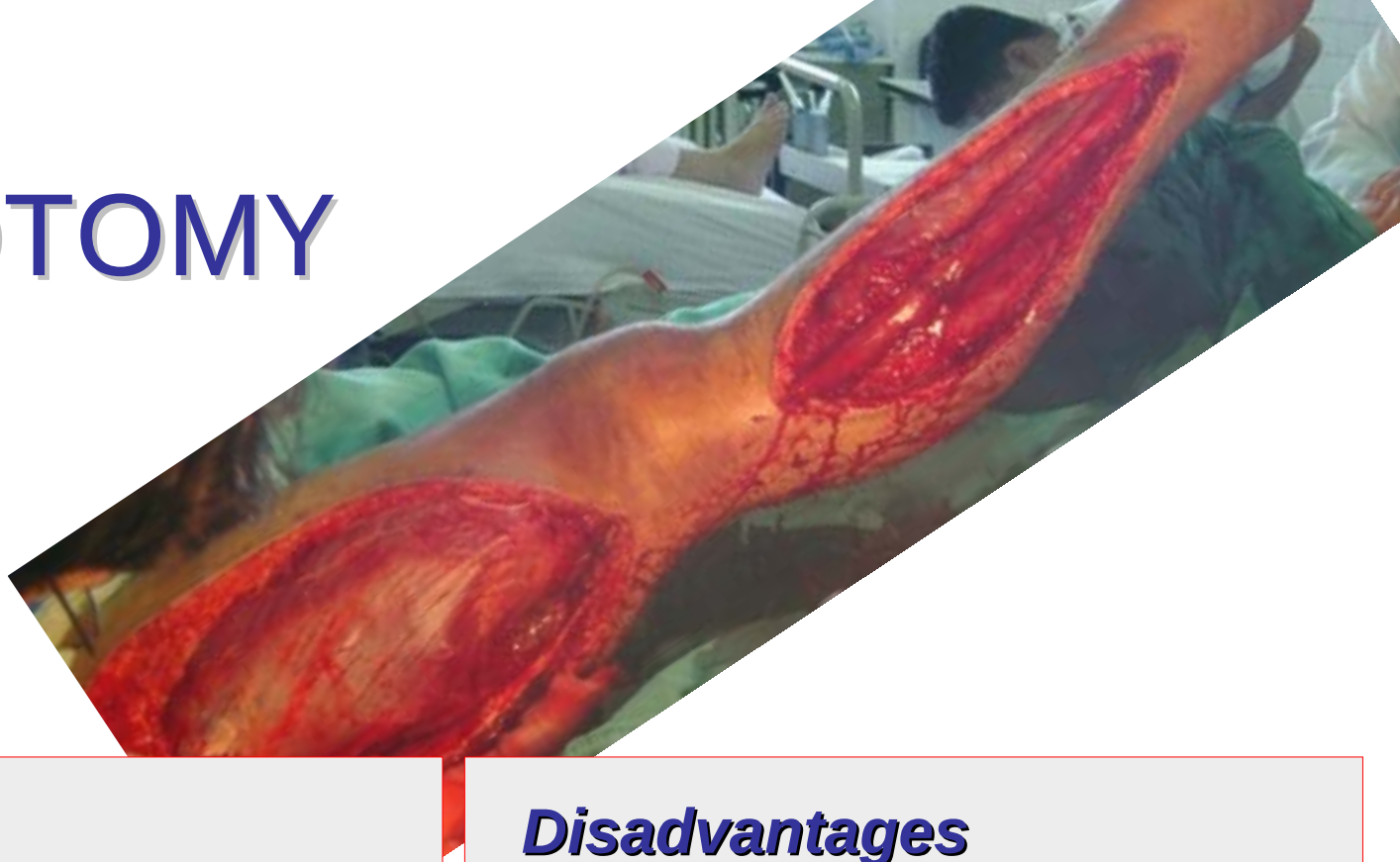
8500 units



- **Medical concerns**
- **Logistic concerns**

Sever et al. Nephron 2002

FASCIOTOMY



Advantages

- Decompression ⇒↘ necrotic muscle mass
- Distal ischemia / necrosis can be prevented
- Irreversible neurologic damage prevented

Disadvantages

- A closed wound ⇒open wound⇒infection
- Higher risk of amputation (infection)
- Long term sensory / motor losses

Sheridan and Matsen. J Bone Joint Surg Am 1976
Szewczyk. J Trauma 1998

Better et al. Kidney Int 2003
Michaelson. World J Surg 1992
Matsuoka et al. J Trauma 2002

FASCIOTOMIES in the Marmara E.

397 fasciotomies in 323 patients

Sepsis: Fasc. (+): 25%
Fasc. (-): 13%

Mortality: Sepsis (+): 27%
Sepsis (-): 12%

Sever et al. NDT 2002

Fasciotomies ⇒ objective criteria

Better et al. KI 2003;63:1155-1157

RENAL DISASTER / CRUSH SYNDROME

- Introduction
- Etiology / pathogenesis
- Clinical / lab. findings
- Prophylactic / therapeutic interventions

LOGISTIC ISSUES

- Severity assesment
- Providing health care
- Medical support
- Other logistic issues

CONCLUSIONS

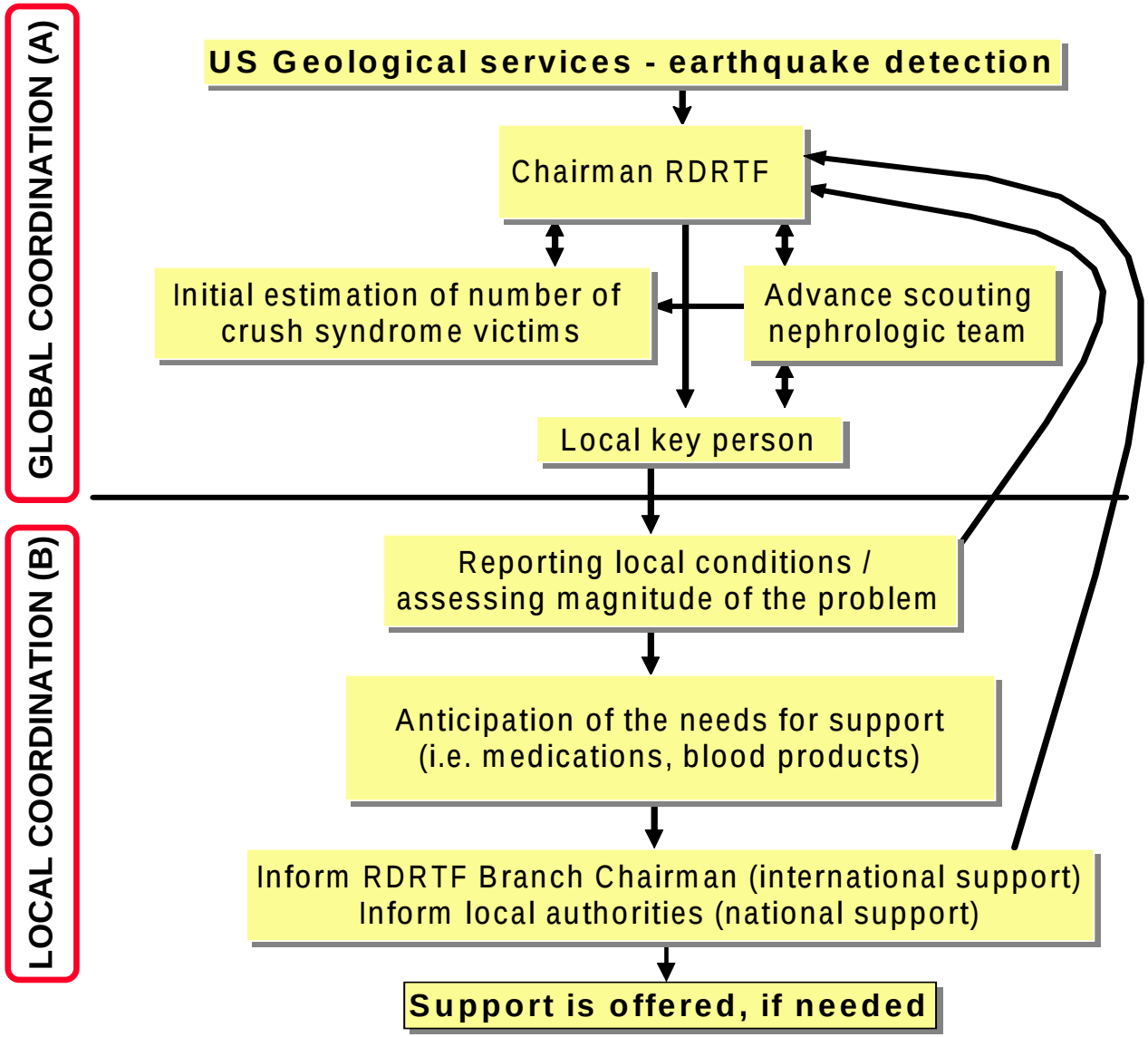
LOGISTICS

- **Procurement**
- **Maintenance**
- **Distribution**
- **Replacement**

} **Personnel / material**

Vital in disasters due to chaotic conditions

LOGISTIC PLANNING



Sever, Vanholder, Lameire. NEJM 2006

LOCAL LOGISTIC INTERVENTIONS

I. Severity assesment

II. Providing health care

- **Rescue activities**
- **Evacuation of the victims**
- **Logistic planning in hospitals**

III. Medical support

IV. Other logistic issues

- **Global logistic needs**
- **Managing chr. patients**
- **Medical records**

THE INCIDENCE

Many factors effective!

- Intensity of the disaster
- Population density of the region
- Structural characteristics of buildings
- Timing (moment) of disaster
- Efficacy of rescue activities

Noji et al., 1990; Nadjafi et al., 1997

Gujarat Earthquake:
Death: 19,727; Cr.:35

Viroja et al, WCN Abstracts, 2001

Bam Earthquake:
Death: 25,000; Cr.: 160 (Dx+)

Hatamizadeh et al.
AJKD 2006; 3:428-38

September 11 terrorism
Death: >3,000; Cr.: 1

Goldfarb and Chung, Am J Med, 2002

RENAL DISASTER / CRUSH SYNDROME

- Introduction
- Etiology / pathogenesis
- Clinical / lab. findings
- Prophylactic / therapeutic interventions

LOGISTIC ISSUES

- Severity assesment
- **Providing health care**
  - Rescue Activities
  - Evacuation of the victims
  - Logistic planning in hospitals
- Medical support
- Other logistic issues

CONCLUSIONS

RESCUE ACTIVITIES

(The Armenian Earthquake Experience)

RESCUER	*n*	%
Ordinary people (untrained)	125	55.1
Self	21	9.3
Military member	13	5.7
Experienced Soviet rescue teams	6	2.6
Experienced foreign rescue teams	2	0.9
Unidentified	136	60
Total	227	100

SOUTHERN ITALIAN EARTHQUAKE

-Only 18% of the uninjured people took part in the rescue activities

People living in disaster prone regions should consider that they **are** needed as **"rescuers"** in the case of a disaster.

Noji et al. 1993

De Bruycker et al., 1985

RESCUE ACTIVITIES (Time Period Under the Rubble-I)

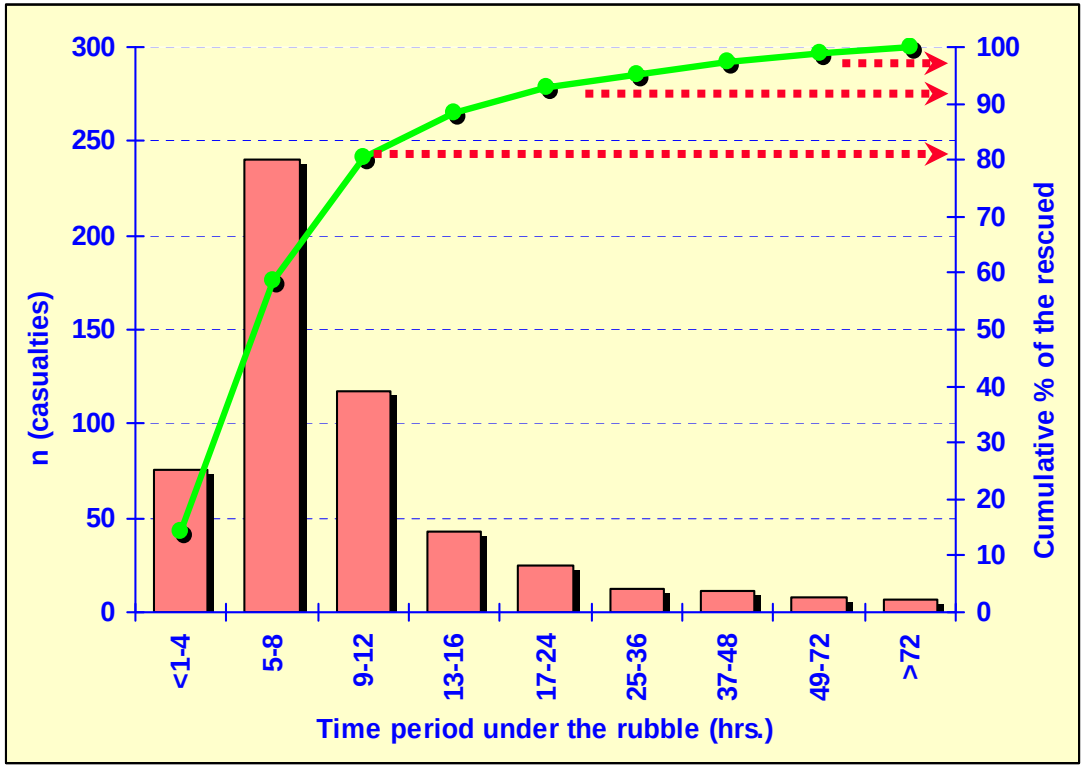
The Marmara Earthquake Experience

Kobe earthquake: 9 hrs.

Oda et al, 1997

11.7±14.3 (0.5-135) hrs.

Sever et al. KI 2001



Rescue activities within the first 2 days are of vital importance

Sever et al, Crit Care Med 2002

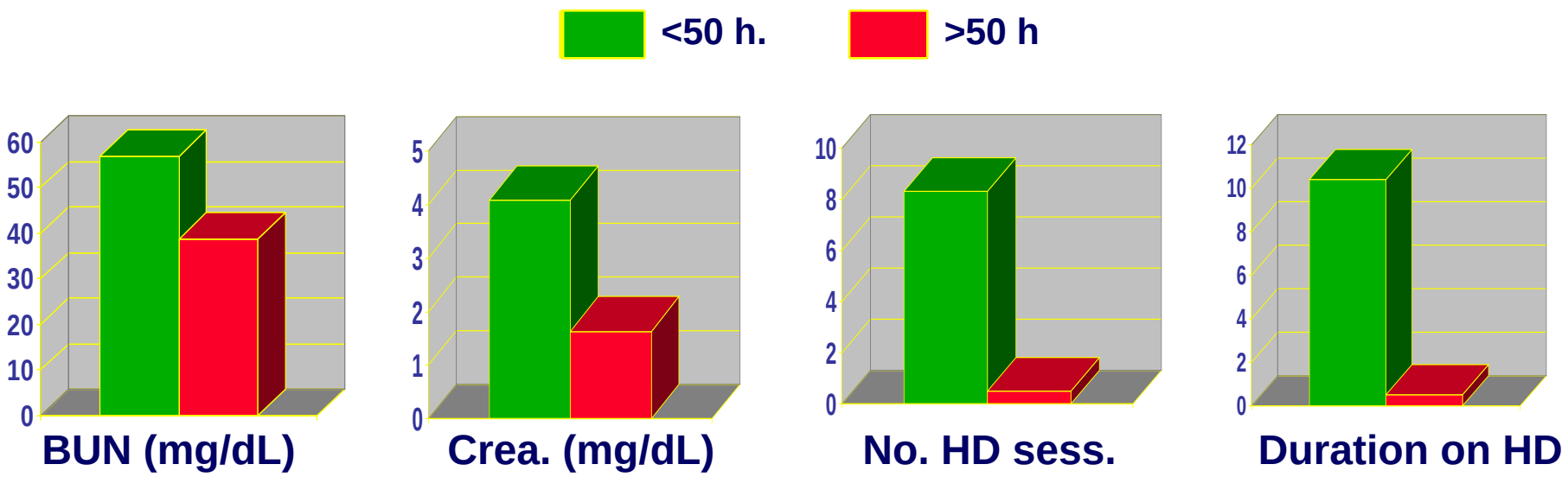
RESCUE ACTIVITIES (Time Period Under the Rubble-II)

The Marmara Earthquake Experience

Non-survivors vs. survivors: (p=0.26)

Dialyzed: 10±10 hrs.
Not dialyzed: 16±23 hrs.

p<0.001



Only the victims with mild trauma can survive under the rubble for longer periods

Sever et al. Crit Care Med 2002;30:2443-9

CONCLUSIONS

- **Disasters and subsequent "renal disasters" will continue to be major causes of death in the future.**

- **Number of deaths due to crush s.** (renal disaster victims) **can be decreased by appopriate management.**

- **Medical practice during disasters differ considerably as compared to routine medical applications.**

- **National / international disaster preparedness and logistic planning can be helpful to decrease post-disaster chaos and provide effective health care.**