

Innovations in Trauma Care



Louise E Niggemeyer RN, MEd
Trauma Program Manager
Department of Trauma Surgery
The Alfred

Circa 1930



Circa 2003





Overview

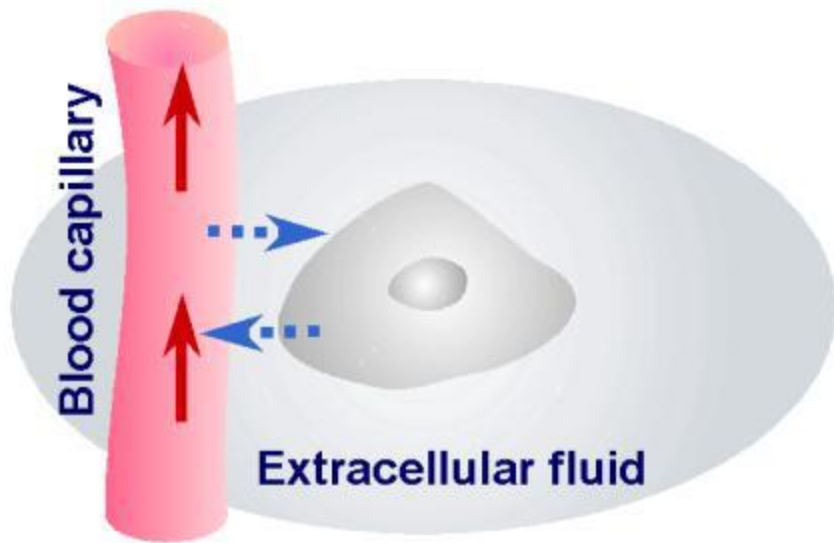
- Technology
- Nursing
- Trauma System

Technology....



And you thought your job sucked

Clinical Microdialysis





Clinical Microdialysis

- First described in 1974
- The 1987 Rx Parkinson's



What is microdialysis?

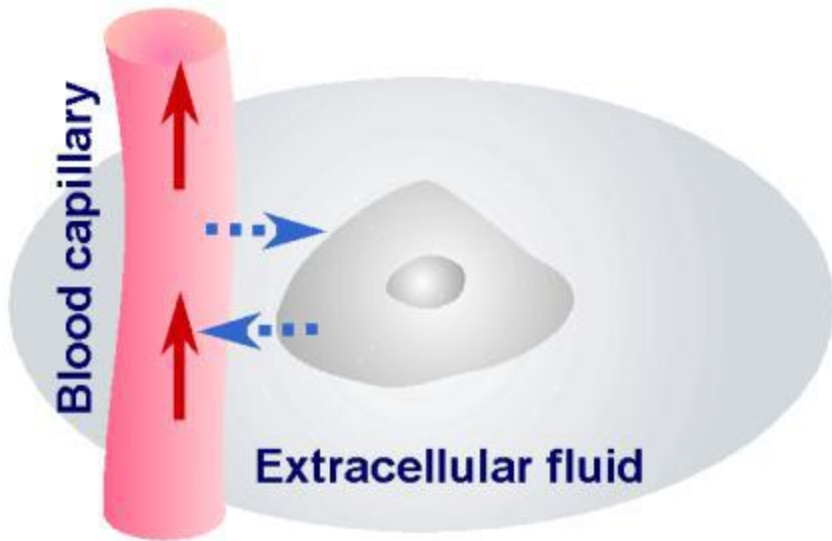
- Continuous tissue chemistry monitoring
- Alerts tissue chemistry changes before clinical changes become evident
- Titrate interventions
 - don't have to wait for lab results



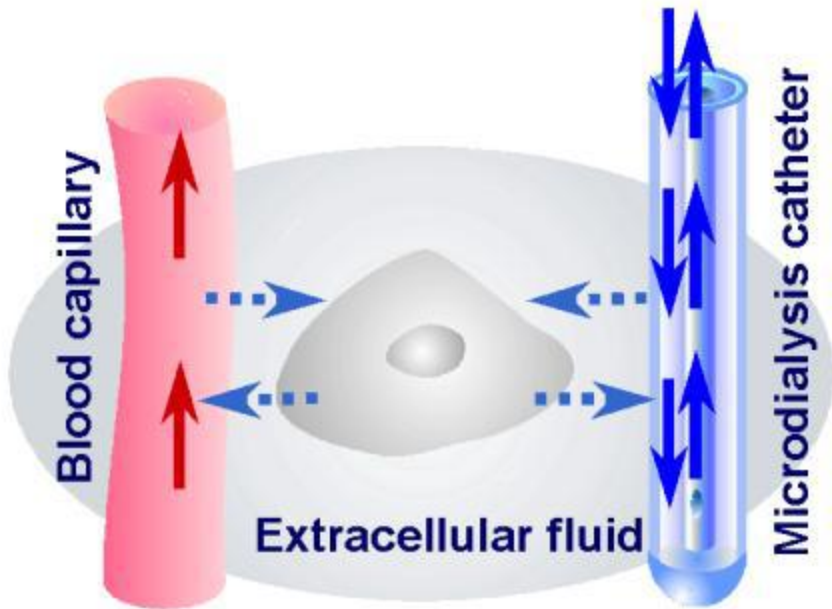
Clinical Applications

- Where continuous monitoring is required
 - neurotrauma
 - shock
 - sepsis
 - invasive monitoring
 - Operative procedures
- Early chemical markers of ischemia can be detected by using microdialysis
 - monitoring of myocutaneous grafts

The Principle of Microdialysis



The Principle of Microdialysis





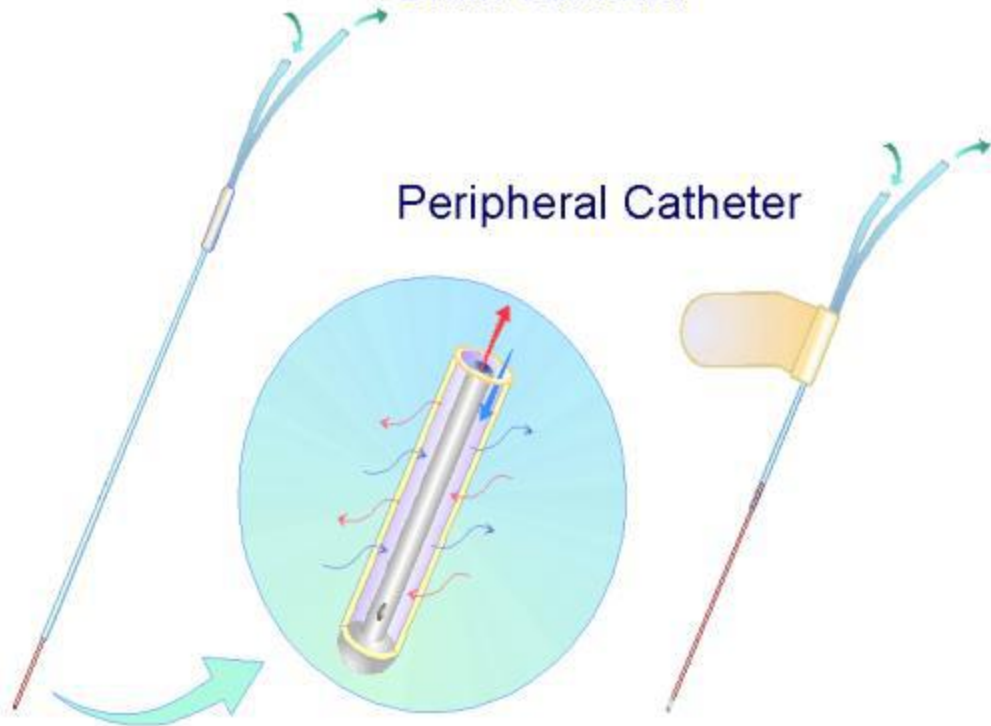
Types

■ Brain

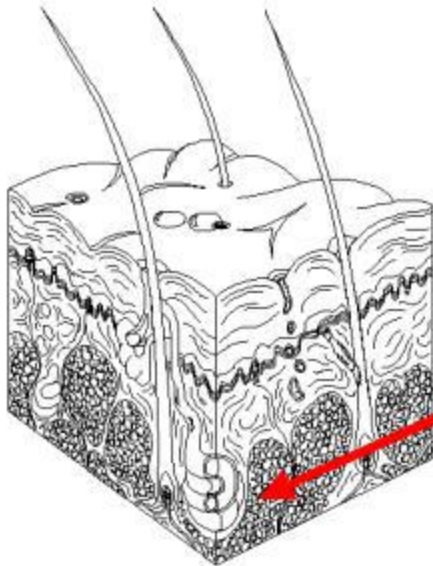
■ Adipose tissue

Brain catheter

Peripheral Catheter



Subcutaneous microdialysis



Position of the catheter
in the adipose tissue

Analytes:

Glucose

Lactate

Pyruvate

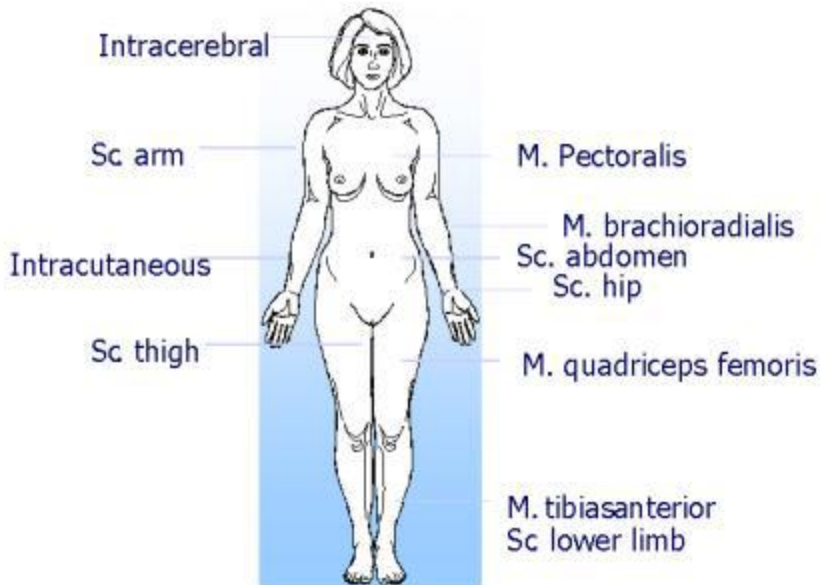
Glycerol

Glutamate

Urea



Catheter locations



Lou Lou rating

- Ease of insertion
 - OK
- Intellectual work
 - High
- Number crunching quotient
 - High



Brain Tissue Oxygen - LICOX



Traumatic Brain Injury



See

**To optimize cerebral blood flow,
that is in & out of the head:**

Prevent Hypotension

Prevent Hypoxia

Prevent Hypoventilation

e

An iceberg floating in the ocean. The tip of the iceberg is above the water line, and the much larger base is submerged. The text 'ICP/CPP' is written on the tip, and 'pbtO₂' is written on the submerged base. A vertical bar with horizontal stripes of various shades of blue, black, and yellow is on the left side of the image.

ICP/CPP

pbtO₂



LICOX

Tells you how the
injured cells are
travelling

Balance between O_2 supply (O_2 content &
CBF) & demand (cerebral metabolism)

Catheter

- Pre-calibrated, stable
- Single, double, or triple lumen bolt
- Tunneled





Values

The 30 - 20 - 15 - 10 - 5 Rule

- Normal > 30 mmHg (25 - 50 mmHg)
- Ischemia reported at ranges of less than 8 - 12 mmHg (10)
- Critical PbtO₂ = **5** - 8 mmHg



Influences on Oxygen

- Systemic factors of major influence on pbtO₂
 - ABP, ICP, paO₂, paCO₂, pH, temperature
 - Blood Hgb content, viscosity and Hct
 - Medications



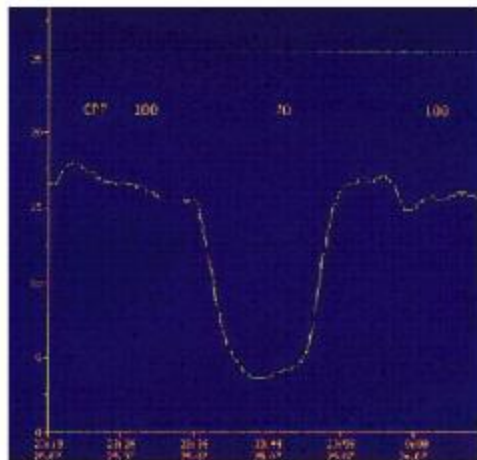
ICP / CPP management

- ICP may be normal but $\text{pbtO}_2 \downarrow$
- CPP may be at OK but $\text{pbtO}_2 \downarrow$

ICP / CPP management

CPP at times will need to be much higher than imagined

pbtO₂



Time



Hyperventilation management

- \downarrow PaCO₂ lowers ICP but also \downarrow pbtO₂
- PaCO₂ results in vasoconstriction & \downarrow CBF therefore \downarrow O₂



Hyperoxia

- Normal tissue – $\uparrow \text{FiO}_2$ has little effect on P_{btO_2}
- Injured brain - $\uparrow \text{FiO}_2$ results in an $\uparrow \text{P}_{\text{btO}_2}$ (if blood flow present)

C. Robertson et al., 1999

Lou Lou rating

- Ease of insertion
 - same as ICP
- Intellectual work
 - high
- Number crunching quotient
 - high
- Benefit
 - HIGH



Nursing driven intervention



Best Practice Grant for TBI

- Decompressive Craniectomy
- Intensive Neuromonitoring
 - Latrobe University nursing research

Retrievable IVC Filters





Trauma - high-risk

■ Virchow's triad

- hypercoagulability
- endothelial damage
- venous stasis

■ Contraindications to prophylaxis

- TBI
- haemorrhage



Premorbid Risk...

- Age

- 40-60 years relative risk x 2
- 61-75y x 3
- >75y x 4

- Obesity x 2

- malignancy x 3

- abnormal coagulation x 2

- history of thrombosis /
thromboembolism x 3



Iatrogenic Risk...

- femoral vein lines x 2
- transfusion > 4units x 2
- operation > 2hrs x 2
- major venous repair x 3

Injury-related risk

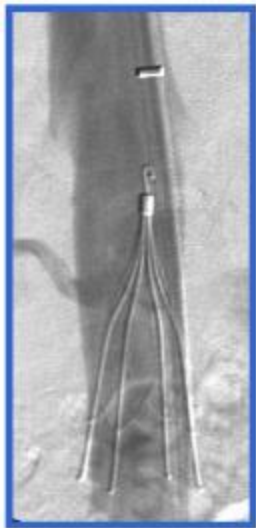
- Twice the risk
 - severe chest injury AIS > 2
 - severe abdomen AIS > 2
 - severe head AIS > 2 / GCS 8 or less
- Three times
 - spinal #
- Four times
 - cord injuries
 - severe lower limb #
 - pelvic #
- multiple system injuries 2x - 4x



Incidence & “*high-risk times*”

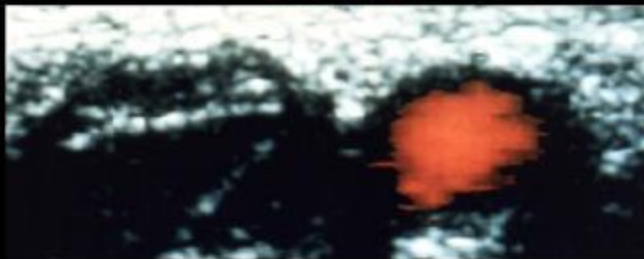
- Velmahos et al 2000, J Trauma 49:132-8
 - DVT 11.8%
 - PE 1.5%
- O'Malley et al, 1990, J Trauma 30:748-50
 - 2 - 3 % & most < 1 week

DVT prophylaxis...

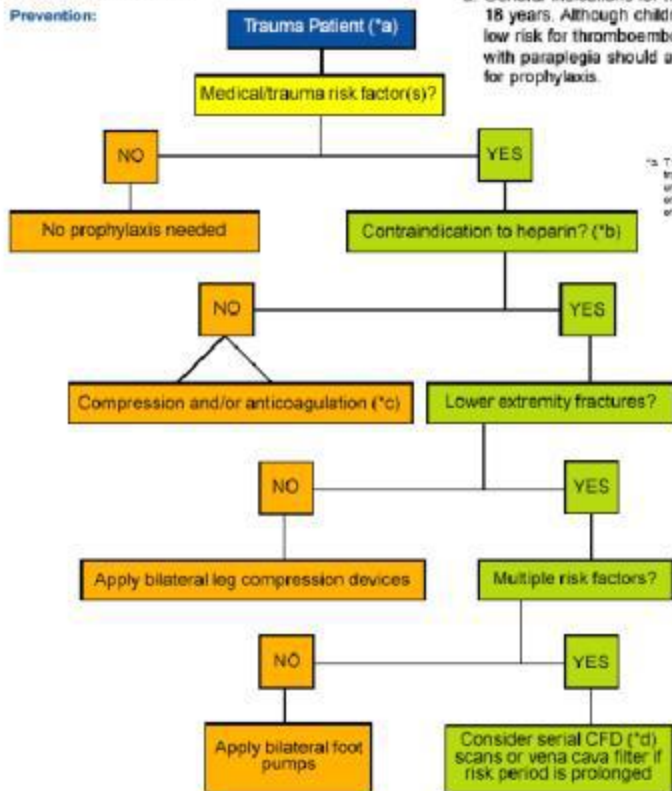


Prevention of Thromboembolic Complications in Injured Patients

American College of Surgeons
Committee on Trauma
June 1998

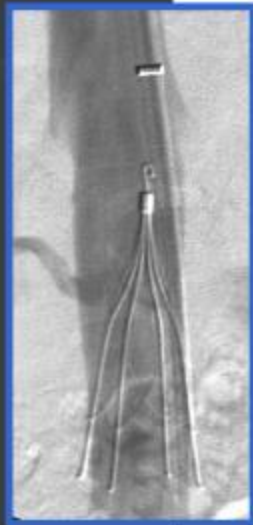


Prevention:



*a. General indications for trauma patients over the age of 18 years. Although children are generally considered at low risk for thromboembolic complications, older teens with paraplegia should also be considered candidates for prophylaxis.

*b. The current contraindications to anticoagulation after trauma include head injury with increased intracranial pressure, unstable spinal cord injuries, uncorrected coagulopathy, ongoing hemorrhage, known heparin allergy, or the use of an epidural catheter for analgesia or anesthesia.





The Alfred experience with retrievable IVC filters

- July 1 2002 - March 30 2003

- 21 pts

- M 14 : F 7

- Av age 45.5 yrs (16-82)

- Av ISS 27.3 (9-59)



Risk factors (Mean 2.5 per pt)

■ Long bone #	17
■ Prolonged sedation	15
■ Spine # +/- cord injury	10
■ Pelvic #	10
■ Hx of DVT	1



Deployment of IVC filter

■ Venous approach

- 16 R femoral
- 3 L femoral
- 2 R internal jugular

■ Av time to insertion

- 77.8 hours (22-288)



Retrieval

- 20 / 21

- 1 failed at another hospital (day 20)

- Retrieved

- day 1 - 191 days (av 36.4 days)

- No complications

- No PE



In summary

■ Nurses role

- remind
- administer
- monitor

Nursing





Nurses....

- The greatest pt interface
- Monitoring
- Interventions

The Trauma Nurse Leader

- Innovation in Trauma Centre
- 89 E.F.T staff
– 10 % TNL





Why ?

- High volume
- High acuity
- High staff turn over
- High number of junior staff



What

- Command & control
- Operational
 - Including patient disposition
- Orientation
- Continuing professional development
 - research
 - education
 - QA
 - clinical service delivery



Operational controller

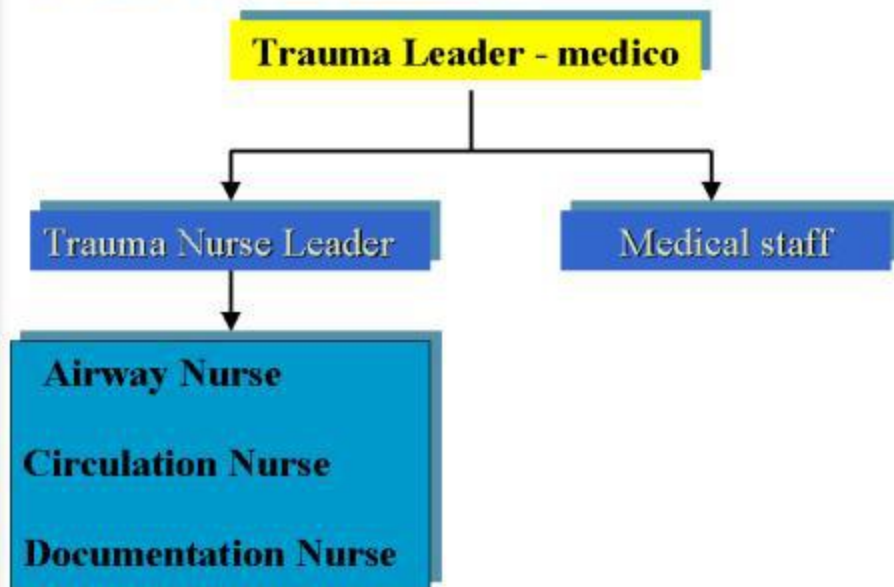
- Dedicated 4 trauma bay, Trauma Centre
- Helipad
- >1000 trauma callouts annually
 - frequently > 1 trauma call



Operational controller

- Coordinating movement of pts through trauma centre
- Appropriate resource utilisation / allocation
- Liaison with OR, Blood Bank, Radiology

Role delineation



Specific responsibilities

- Acts as Team Leader for helipad Response Team
 - conducts safety checks
 - identifies hazards
 - compliance
- Crash
 - scene controller until MFB arrives





Selection Criteria

- Critical Care qualified
- Extensive ED experience
- Leaders
- Communication skills
- Make the team work



Ongoing requirements

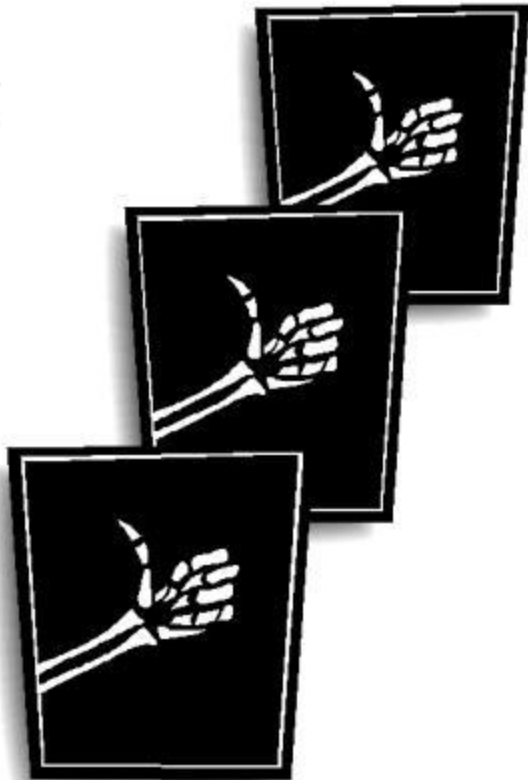
- Annual certification

- helipad
 - hot unloads
- ACLS

- Continuing professional development

Lou Lou rating

- Appropriate role recognition
- Career path
- Develops trauma nursing
- Exciting



Victorian Trauma Foundation



Nursing



\$\$\$\$

- Travelling scholarships
- Research & best practice
- Victorian Clinical Nursing Consortium
 - ED
 - Ward
 - OR

Trauma Systems





Trauma Systems Save Lives

- Matching health resources with patient needs







Victoria - leader in road safety

- 1970 - World **first**
 - mandatory 3 point restraint front & rear seat passengers in cars
- 1974 - Australian **first**
 - random breath testing
- 1980's - Australian **first**
 - speed cameras & red-light cameras
- 1990 - Australian **first**
 - compulsory bicycle helmets



Preventable major trauma deaths

■ Trauma centre	20 %
– (The Alfred 11-15 %)	
■ Metropolitan	41 %
■ Large regional	53 %
■ Small regional	62 %

Victorian Response to a 30% Avoidable Mortality



If you have an accident
you should be treated in
the best setting

Goals of the VSTS



- To deliver the right patient to the right hospital in the shortest amount of time
- To best match state resources with patient needs' ensuring the delivery of optimal care



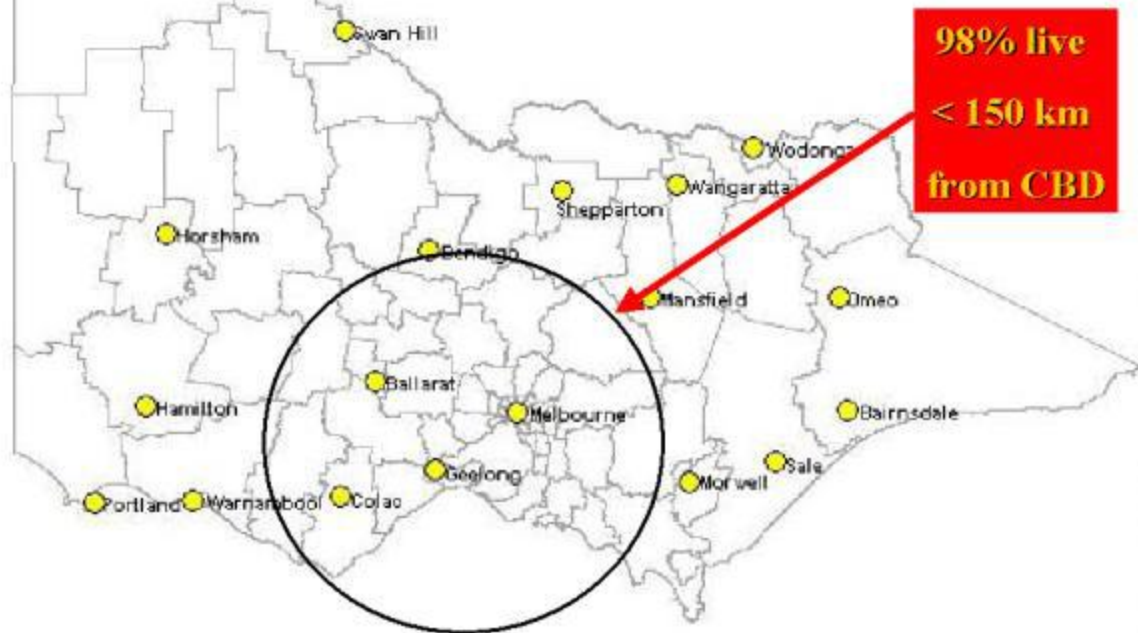
The goal of the Victorian Trauma System

The central message of the ROTES report is:

“The right patient to the right hospital in the shortest time”

International research has demonstrated that the outcome of major trauma patients is **improved** when they receive **definitive** treatment at a **Major Trauma Service**

Victoria, geographically ideal for a Trauma System



Transfer Appropriateness Payment

> 10 transfers	Transfers	\$\$\$
Metropolitan	66	\$ 132,000.00
Regional	50	\$ 150,000.00
Total @\$2000	256	\$512,000.00

82% of major trauma cases are treated in a MTS

(VSTR, 01-02 annual report) from 49% 2001 (Aug 2001 DHS, Vic)

Major Trauma Advice & Referral Line ~ 1800 700 001



- Regardless of the transfer or destination
- For time critical cases

Trauma Line



An
immediate
Vital Link
with the
MTS



1800 700 001

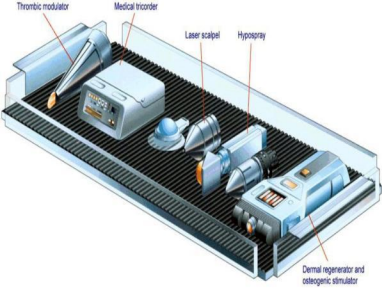
Trauma Advice & Referral Line





The future.....





Thrombic modulator

Medical tricorder

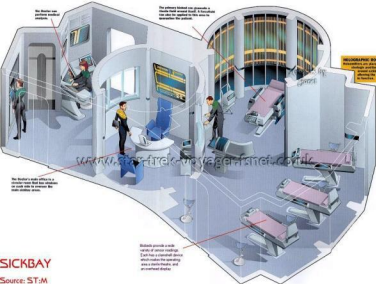
Laser scalpel

Hypospray

Dermal regenerator and
osteogenic stimulator



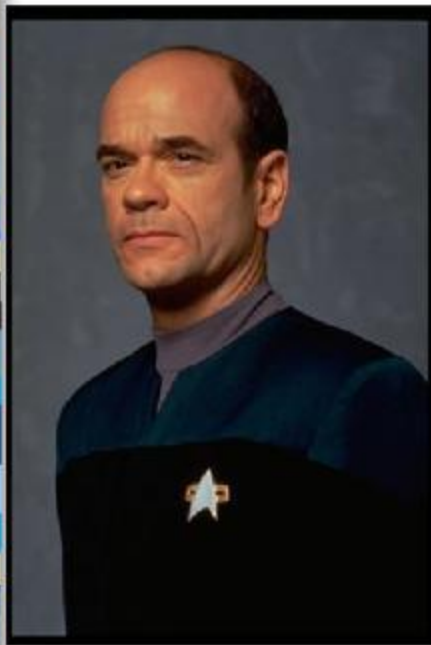




SICKBAY

Source: ST:M

Emergency Medical Hologram



“Please state the nature of the medical emergency....”



What would I like to see...

- Best matching of needs with resources
- Non-invasive monitoring
- Drug to treat TBI
- Levitation device !!!



Additional Slides....

Thank you...



Temperature regulation



- $1^{\circ}\text{C} = 6.7\%$ change in metabolism
- Brain temperature
 - $0.5 - 1^{\circ}\text{C} >$ core & jugular,
 - $0.3 - 1.9^{\circ}\text{C} >$ bladder,
 - $0.1 - 2^{\circ}\text{C} >$ rectal
- Deep white matter $0.5 - 1^{\circ}\text{C} >$ cortical
- Injured brain temperature $1 - 4^{\circ}\text{C} >$ core
- Greater difference with temperatures $>38^{\circ}\text{C}$

Kurth, Anesth, 2000

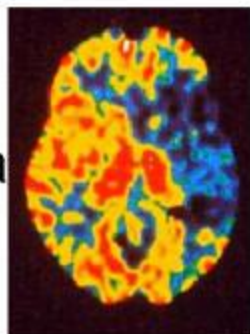
Brain temperature is dependent on

- Rate of local CBF
- Level of arterial temperature
- Age? Skull & scalp density



Effect of alterations in CBF

- CBF 50 - 20 ml/100Gm - brain temperature > rectal & core
- CBF < 20 ml/100Gm
 - brain temperature decreases .5-.9°C/hr



1998

Rumana et al

Values

Local brain oxygen levels, may not reflect what is happening in surrounding tissues

