

# **Blood Conservation – The Swedish Experience**

**Lori Heller, M.D.**

**Cardiac Anesthesiologist**

**Director, Swedish Blood Management Program**

# Some History



**Ancient Rome-Gladiators**

**Middle Ages “bloodletting”**

**1901 Karl Landsteiner  
discovered major types**





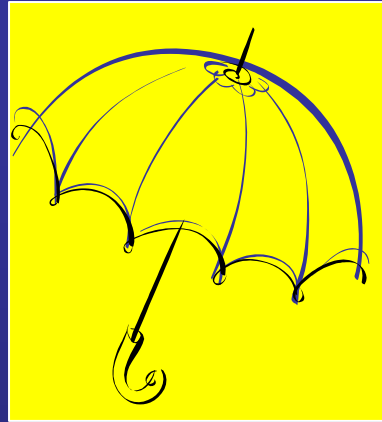
# The Beginning of Jehovah's Witnesses:

- 1861 initial movement
- 1931 “Jehovah's Witnesses”
- 5.1 million – 232 countries (Albania to Zimbabwe)
  - 5% growth per year
  - 64% US
  - 239% Latin America

# The Beginning of Bloodless:

- 1990's – Formal Bloodless Programs
- Providence - ABP started by Cardiac Surgeon
- January 1999 Open House

# The Beginning:



**Advanced Bloodless Program**

# Does Transfusion Improve Survival in the ICU?

- Hebert, *NEJM*. 1999;340:409. (TRICC)
  - 838 pts with Hb < 9
  - 25 ICUs from 1994-1997

Randomized to Hb “Transfusion Trigger”

7 (Restrictive)  
goal 7-9

10 (Liberal)  
goal 10-12

# Results

- Overall 30 d Mortality similar

18.7 vs. 23.3% (p= 0.11)

- Less ill (APACHE <20) →

8.7 vs. 16.1% (p=0.03)

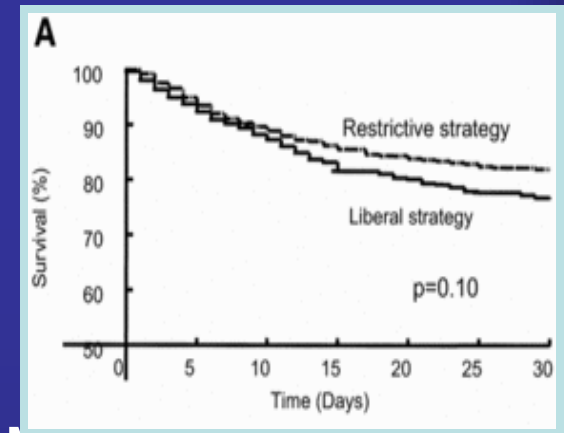
- Pts < 55 →

5.7 vs. 13.0 % (p=0.02)

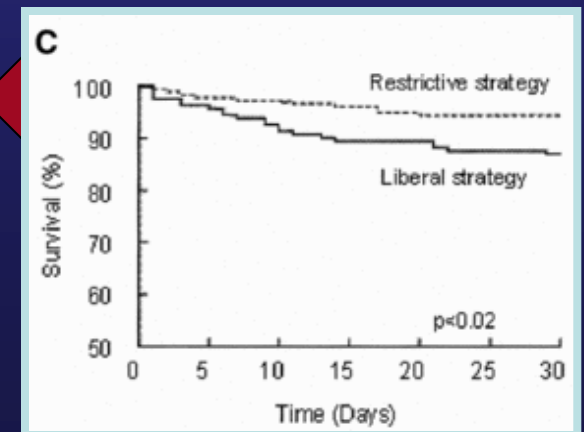
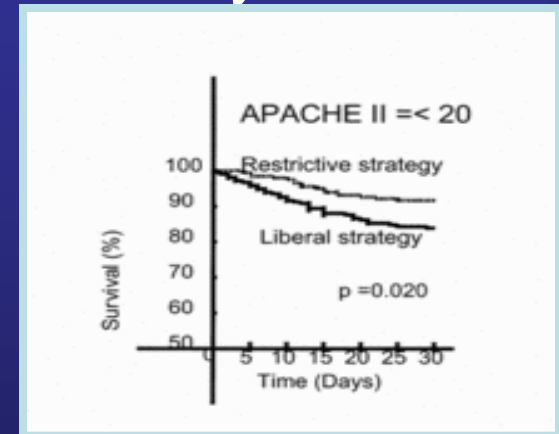
- Cardiac Disease →

20.5 vs 22.9% (p=.69)

Mortality rate during hospitalization significantly lower in restrictive group  
22.2% v 28.1% P = .05





Mortality





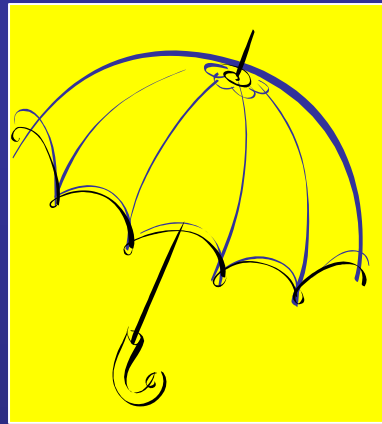
# Complications in the ICU

	Restrictive	Liberal	P value
Cardiac	13.2%	21.0%	<0.01 
MI	0.7%	2.9%	0.02 
Pulmonary Edema	5.3%	10.7%	<0.01 
ARDS	7.7%	11.4%	0.06
Septic Shock	9.8%	6.9%	0.13

# Conclusions TRICC

Restrictive strategy of red-cell transfusion is at least as effective as and possibly superior to a liberal transfusion strategy in critically ill patients, with the possible exception of patients with acute myocardial infarction and unstable angina.

# The Beginning:



**Blood Utilization Committee    Advanced Bloodless Program**

# Blood Utilization Committee

- Lab
- Safety Officers
- Blood Bank
- Physician representatives:
  - Hospitalists
  - Cardiac Surgery
  - Hematology
- Decision Support
- Blood Management
- Pharmacy
- Administration
- Epic

# **Evidence is overwhelming to transfuse with caution**

- **Improved patient outcomes**
- **Reduced morbidity and mortality**
- **Decreased LOS**
- **Decreased the strain on the blood shortage**
- **Considerable cost savings**

# Highest Users at Swedish

- **Internists: Hospitalists/Oncologists**
- **Orthopedic Surgeons**
- **Cardiac Surgeons**



## INDICATIONS for BLOOD TRANSFUSION

THESE ARE GUIDELINES ONLY

EACH PATIENT MUST BE CLINICALLY ASSESSED FOR TRANSFUSION APPROPRIATENESS.



### PACKED RED BLOOD CELLS:

One unit of packed red cells in an adult; will increase Hct by approx. 3% and Hgb by 1 g/dL.

#### Indication:

- Patient is actively bleeding:
- Hct less than 21%
- Hct less than 24% in a patient with coronary artery disease, unstable angina, myocardial infarction or cardiogenic shock
- Rapid blood loss of greater than 1.5L - 2 L not responding to volume resuscitation
- Autologous RBC: Hct less than 27%
- Hct. greater than 24% Patient is *normovolemic*, but there is evidence to support the need for increased O<sub>2</sub> carrying capacity as indicated by:
  - ⇒ Tachycardia and/or hypotension not corrected by adequate volume replacement
  - ⇒ Mixed venous hemoglobin O<sub>2</sub> saturation less than 65%
  - ⇒ Acute respiratory failure or inadequate cardiac output, or inadequate oxygenation
  - ⇒ Oncology patient with bone marrow suppression

#### Indication:

- Fibrinogen less than 80-100mg/dl or actively bleeding

#### ORDERING OPTIONS

"HOLD" Sample sent to PSBC and is held up to 72 hours. Saves cost and time.

"Type and Screen" PSBC types/checks for antibodies. Sample valid for 72 hours.

"Routine Crossmatch" Complete crossmatch – requires 4-8 hours.

"Emergency Crossmatch" PSBC completes crossmatch before releasing. Requires 1-2 hours.

"Emergency Uncrossmatch" Type and RH specific units. Specific blood units released by PSBC: pre-transfusion testing is in progress.

Physician justification required. Takes ½ to 1 hr.

"TRUE emergency" O Neg/O Pos – hospital blood bank releases from O Neg stock first – 10 -15 minutes

#### BLOOD UTILIZATION REFERENCES

●Hebert PC, Wells G, Blajchman MA, Marshall J, Martin C, Pagliarello G, et al. A multicenter, randomized, controlled clinical trial of Transfusion requirements in critical care. NEJM 1999 Feb 11; 340(6):409-17. ●Goodnough LT, Anemia Transfusion and Mortality NEJM 2001 Oct 25; 345:1272-1274 ●Goodnough LT, Medical Progress -Transfusion Medicine; First of two parts. NEJM 1999 Feb 11; 340:438-447 ●Goodnough LT, Medical Progress -Transfusion Medicine; Blood Conservation; Second of two parts. NEJM 1999 Feb 18; 340

Please contact Blood Management at (206) 320-2358 with any questions or page (206) 994-9427

**Education**



# Service to Service

- **Orthopedics – Goal decrease autologous/allogeneic**
  - Grand Rounds
  - Dinners
  - Drive-by's
  - Physician Champion
  - Anemia Management
- **Medicine**
- **Cardiac Surgery**
  - Program
  - ESA funding

# Can't forget those nurses:

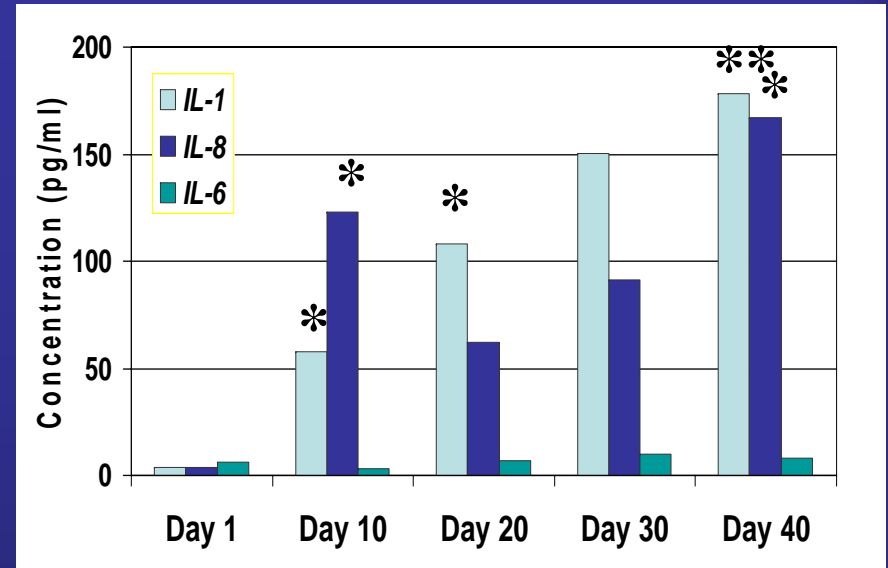
- PACU
- Floor
- ICU

# OR the residents.....

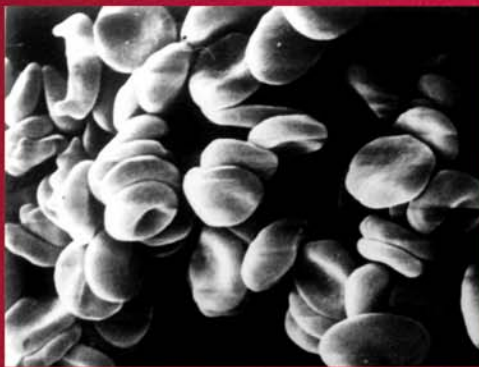
- **Monthly lectures for medicine**
- **Yearly for surgery**

# Storage Defects and Microvascular Perfusion

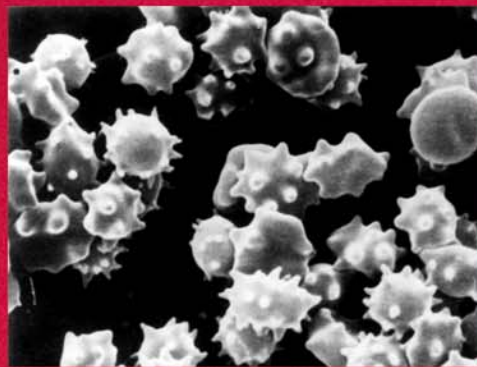
- Decreased 2,3- DPG, ADP
- Poor deformability
- Build-up of cytokines, free hemoglobin, K<sup>+</sup>



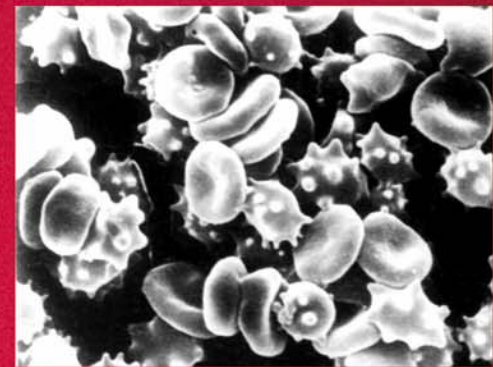
Kristiansson, *Acta Anesth Scand* 1996; 4



Day 1



Day 21

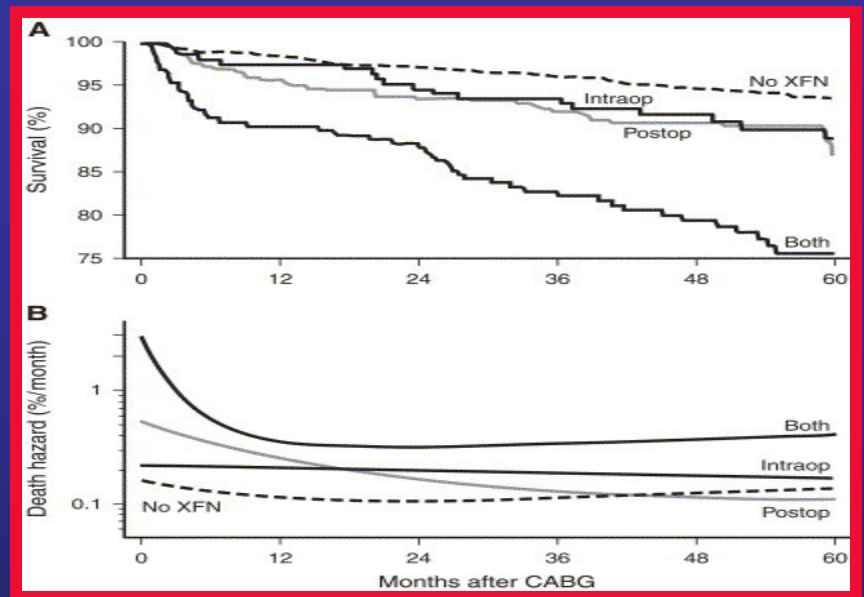
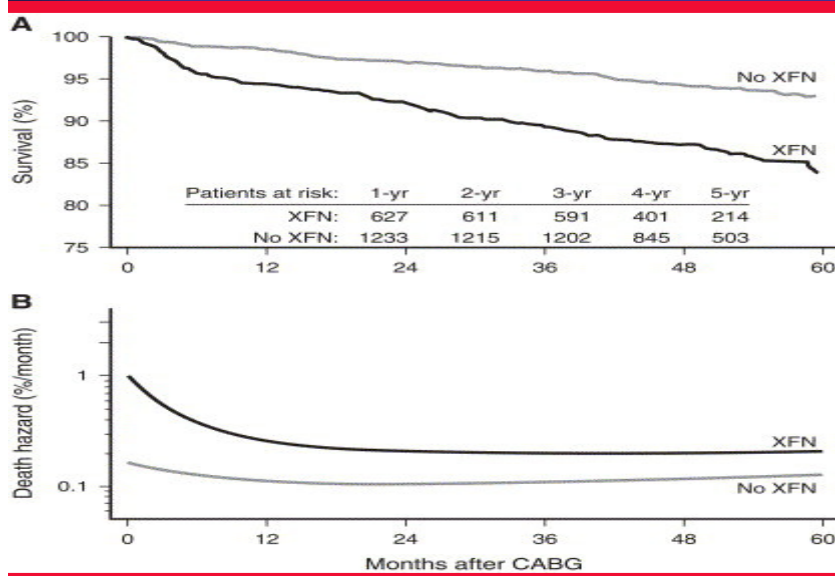


Day 35

Hovav, *Transfusion* 1999;39

# WHAT ABOUT CARDIAC SURGERY?

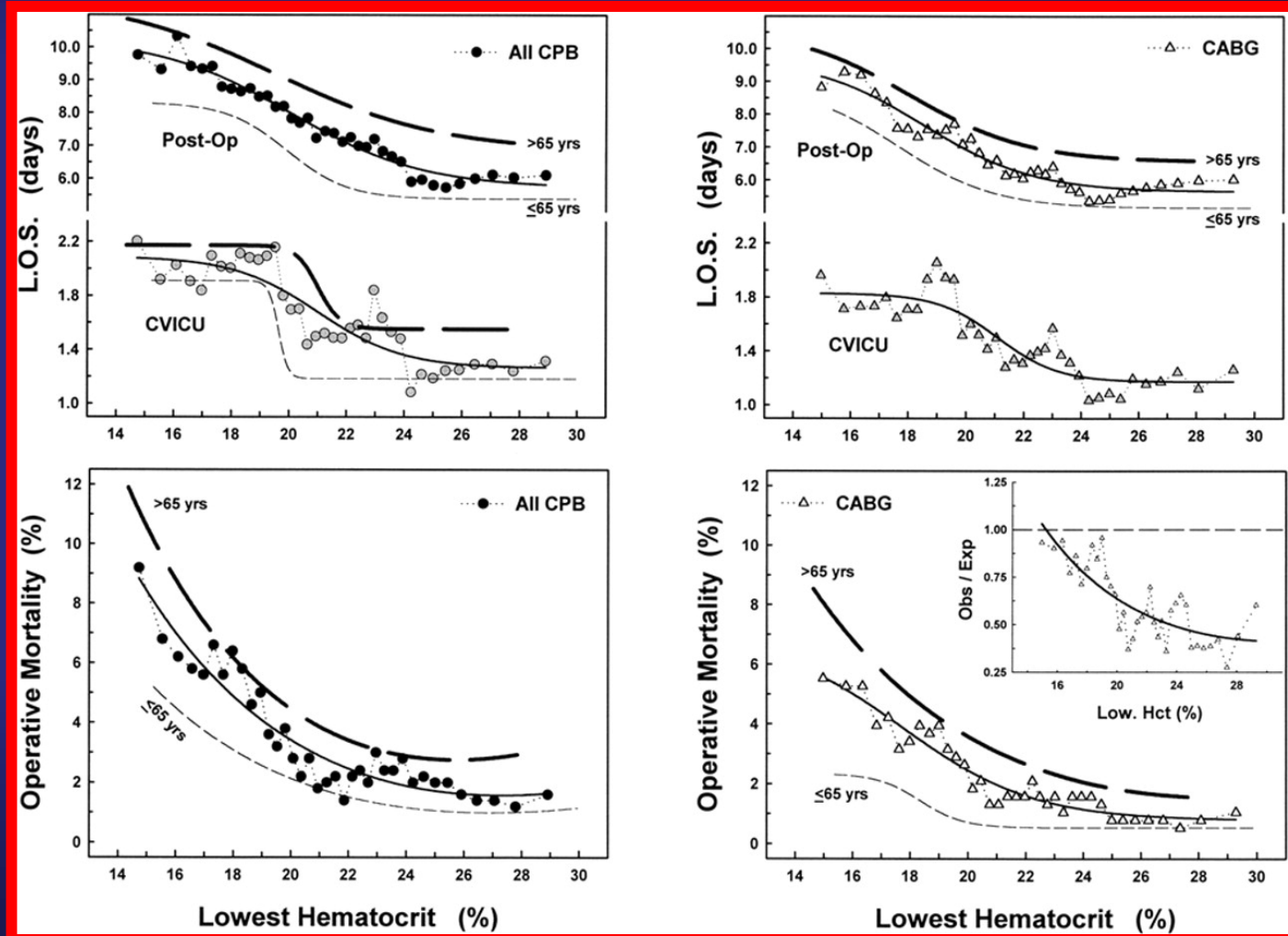
1915 pts first time CABG, 34% transfused



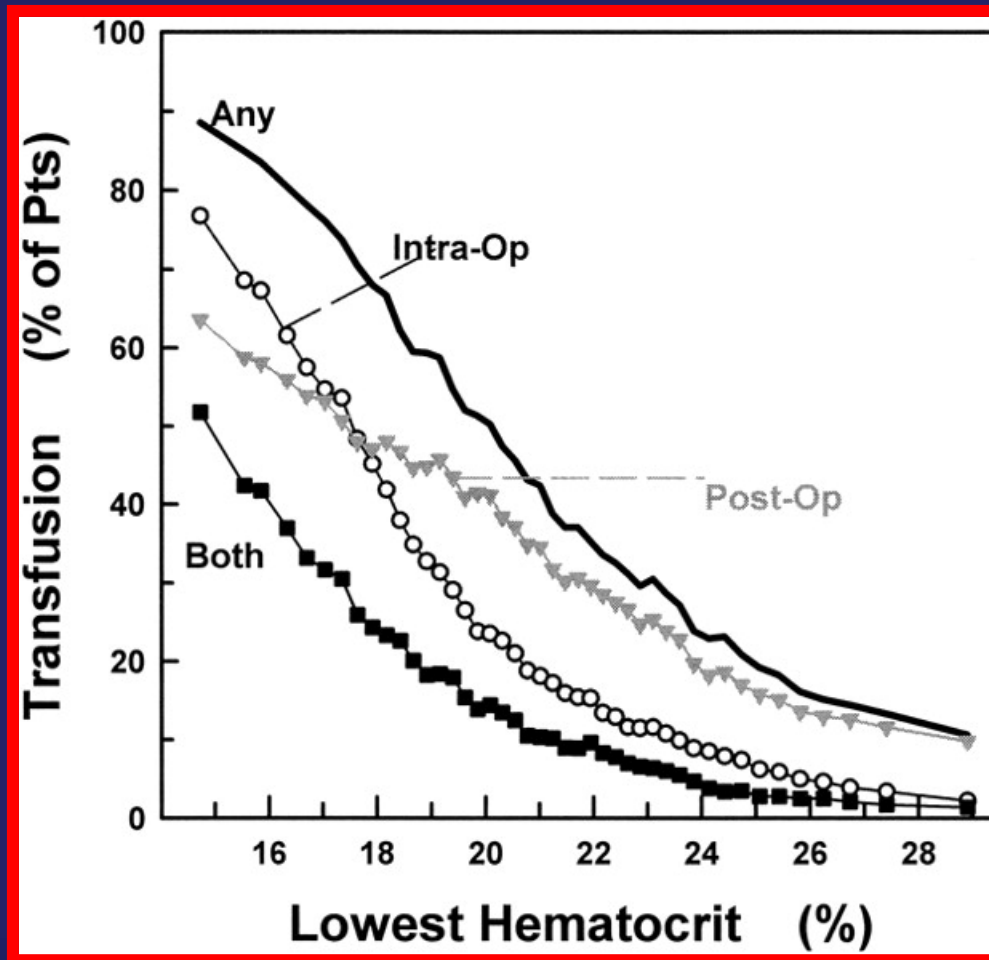
- After adjusting for confounding factors, transfusion was still associated with a 70% increase in mortality (risk ratio = 1.7; 95% CI=1.4–2.0;  $P=0.001$ ).

# Nadir HCT on Bypass-Should transfusion practice be changed?

Habib R. H. et al.; J Thorac Cardiovasc Surg 2003;125:1438-1450

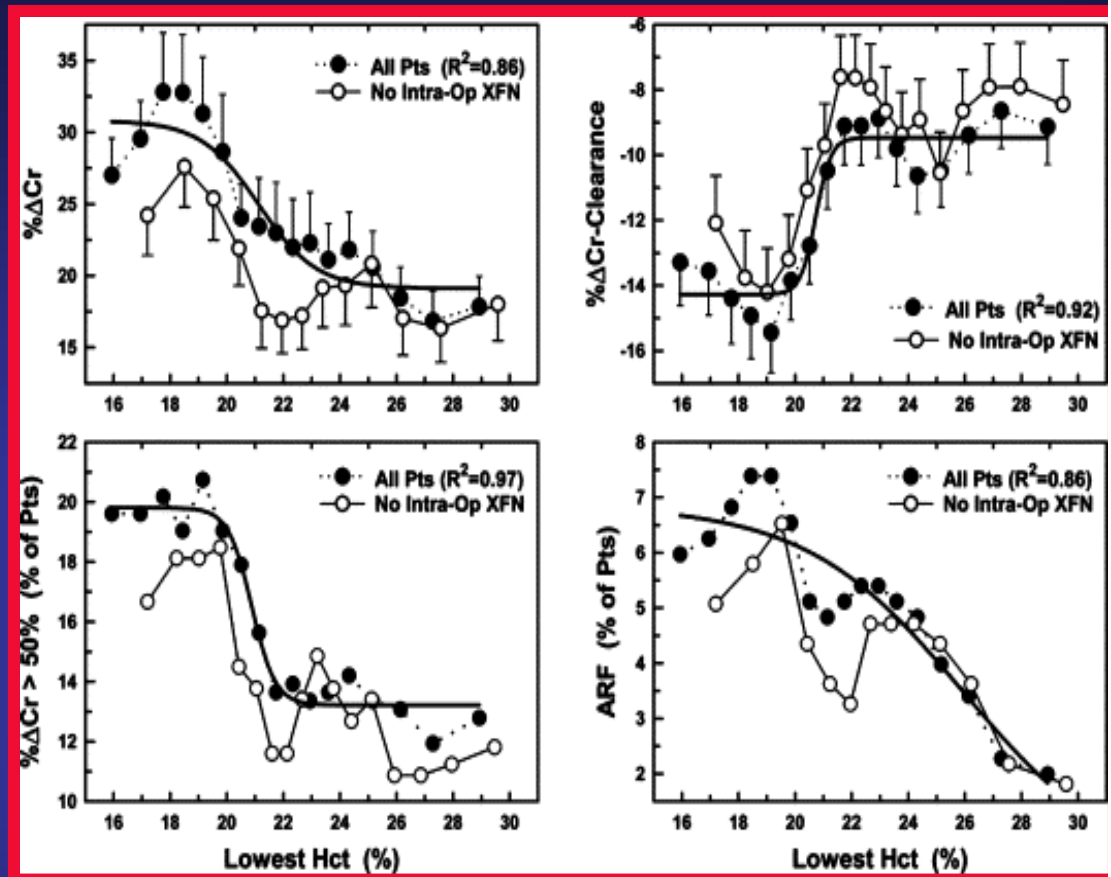


# Confounding By Indication



Habib R. H. et al.; J Thorac  
Cardiovasc Surg  
2003;125:1438-1450

- Retrospective review  
1760 CABG pts
- Impact CPB time, nadir hct, tx on renal function
- Nadir Hct <24 assoc w/  
renal dysfunction and  
ARF



**TRANSFUSION INCREASED RENAL INJURY AT HCT <24**



# Not Transfused v. Transfused

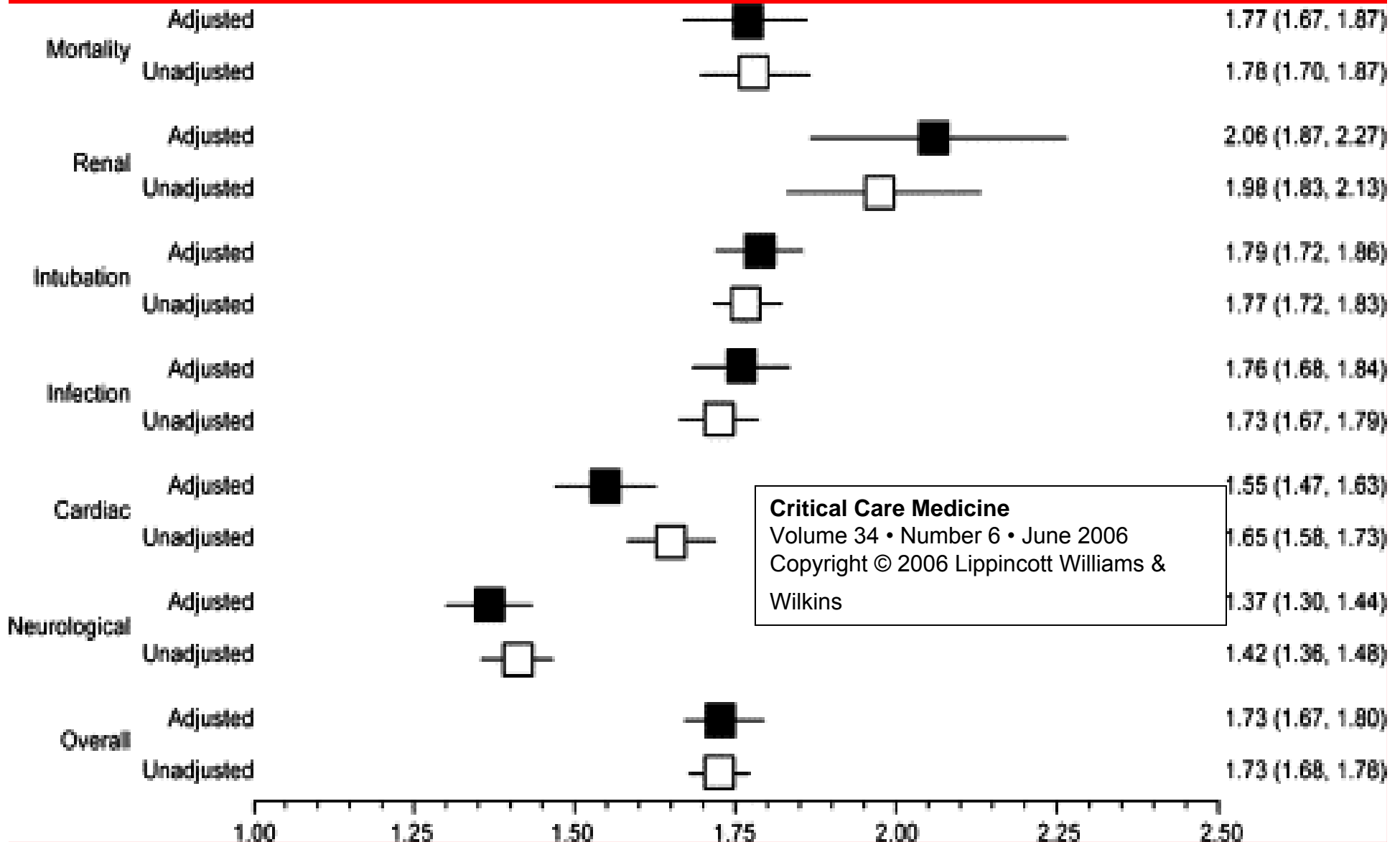
**Renal Injury**      14.4% v. 26%

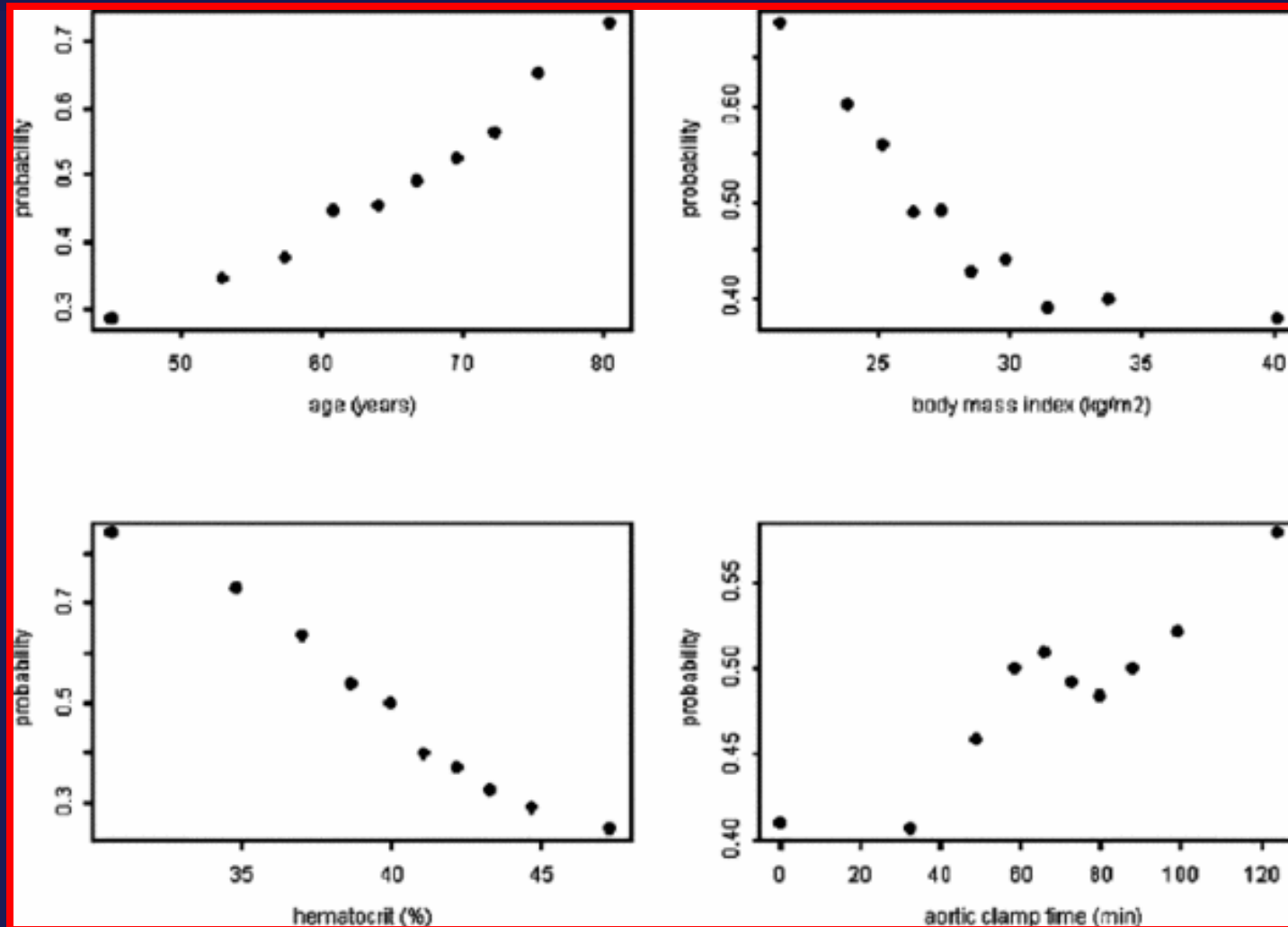
**LOS**                6.3 v. 8.1

**ARF**                3.4% v. 12%

**Mortality**        1.4% v. 3.8%

# Odds Ratios-Transfusion M/M





**Critical Care Medicine**

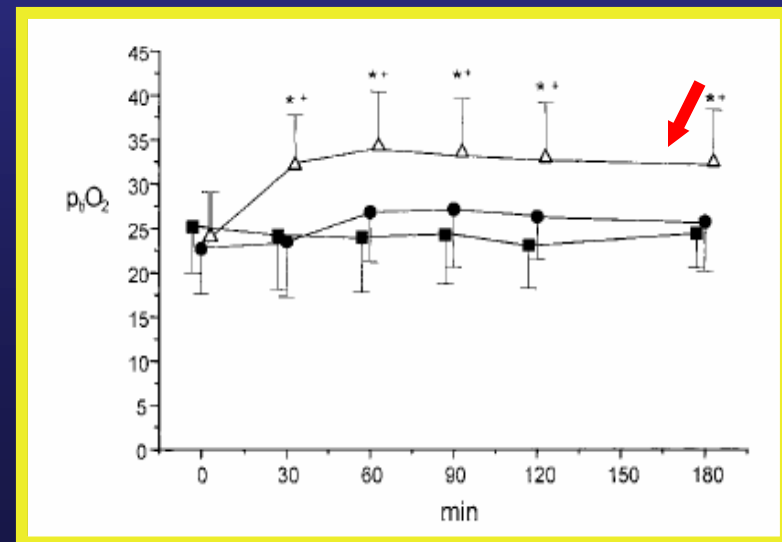
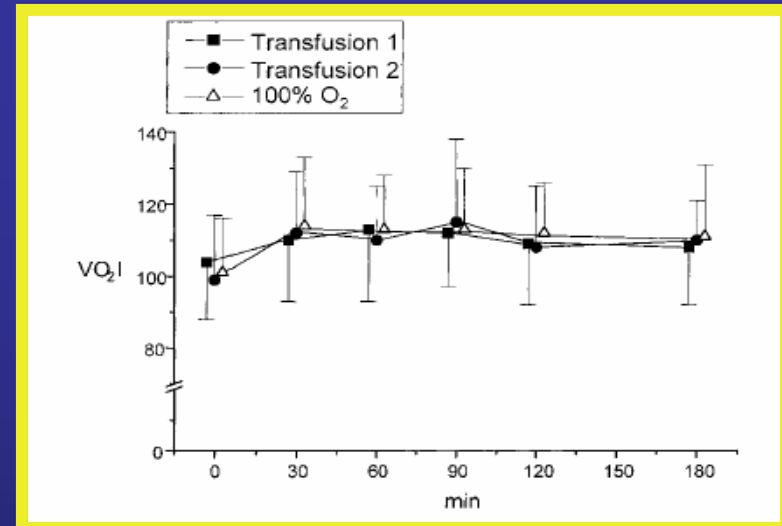
Volume 34 • Number 6 • June 2006

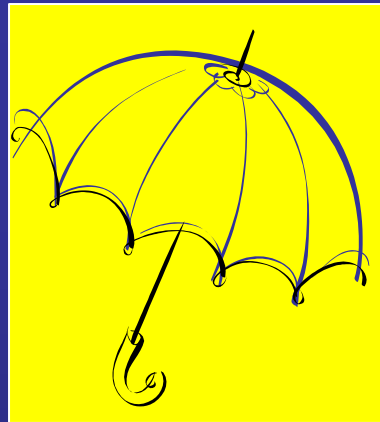
Copyright © 2006 Lippincott Williams & Wilkins

# Influence of RBC transfusion vs. 100% O<sub>2</sub> ventilation after CABG

*-Suttner, Anesth Analg 2004;99*

- Prospective, randomized trial of 51 post- elective CABG patients with nadir Hb 7.5- 8.5 gm/dL
- Treatment arms:
  - Transfuse 1 U stored PRBC
  - Transfuse 2 U stored PRBC
  - Ventilate with 100% O<sub>2</sub> for 3 hrs
- Results
  - DO<sub>2</sub> ↑ all groups
  - VO<sub>2</sub> no change all groups
  - Tissue pO<sub>2</sub> ↑ with 100% O<sub>2</sub> ventilation only





# Swedish Blood Management



**Blood Conservation**

**Advanced Bloodless Program**

**Anemia Management Team**

**Blood Utilization Committee**

# Treat Preoperative Anemia

- Not donating
- Find Source
- ESA/Iron/B12/Folate

# Do you need an Anemia Management Consult?



## CONTACT

### Blood Management

Anemia Consult Pager 994-HELP (4357)

Mary Ghiglione, RNC Manager	Tel: 386-3544 Pager: 994-9427	Lori Heller, MD Medical Director	Tel: 215-3656 Pager: 540-8502
Joyce Ava Coordinator	Tel: 320-8094 Pager: 994-9427	Debbi Farmer, RPh Anemia Management	Tel: 320-2331 Pager: 994-4357

Anemia Management Orders/Pre-Surgery Guidelines (Form #49010)  
available at nurse stations

# Anemia Consults:

- Source of Anemia?
- Labs: HCT, Total Iron, Ferritin, %sat, TIBC, retic count, B12, Folate
- Procrit 40,000 u Qwk
- Iron – oral with Vit C or IV iron
  - IV = ferrlecit 125 mg qwk out pt or 125 mg qd x 3d as inpt



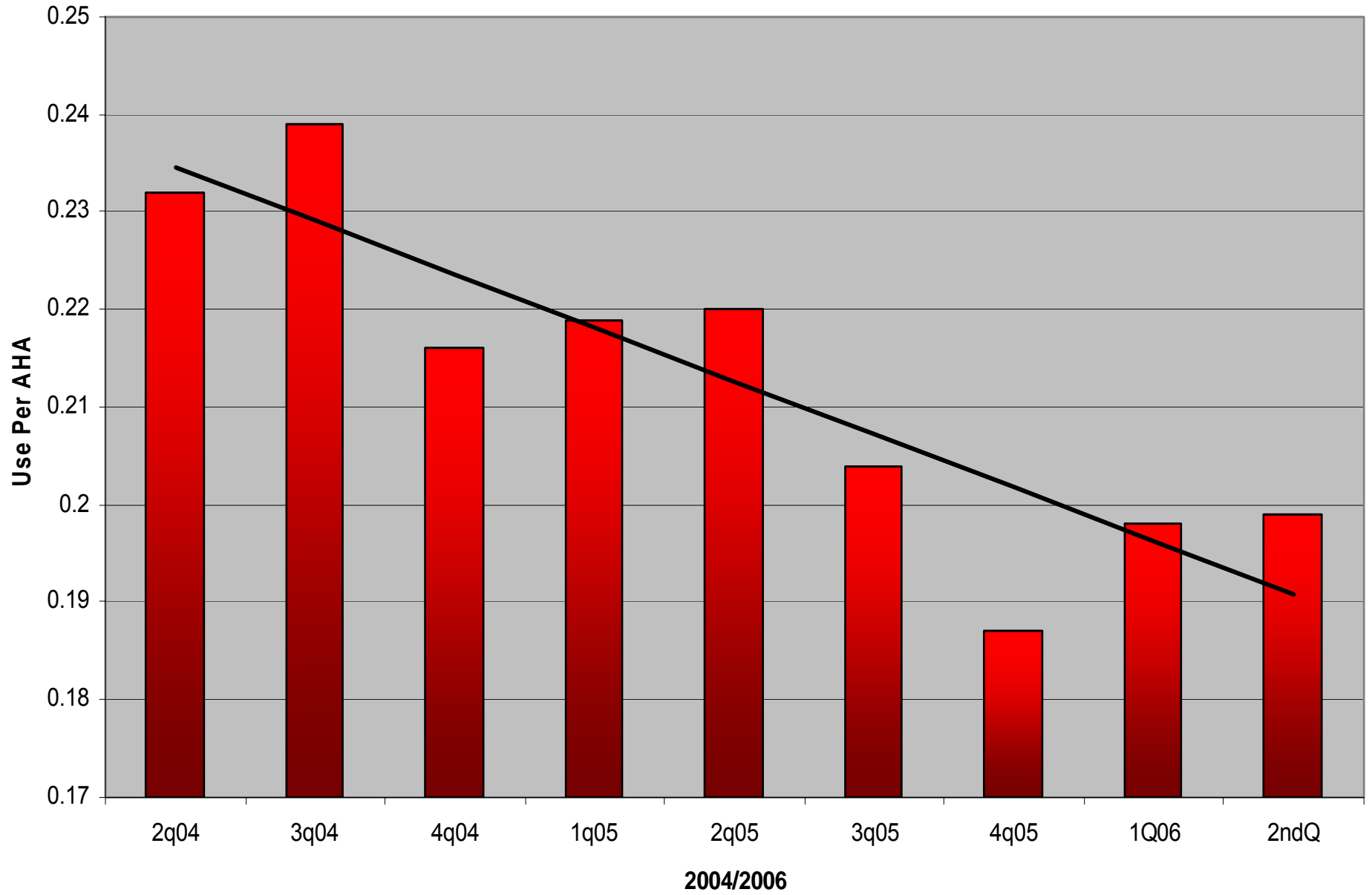
# In the OR

- ANH
- Hextend
- Warm
- Cell Saver
- All blood returned via arterial cannula
- Point of Care Testing
- Preop Iron testing
- Cerebral Oximetry
- Tolerate Anemia – each patient individual

# Post Op

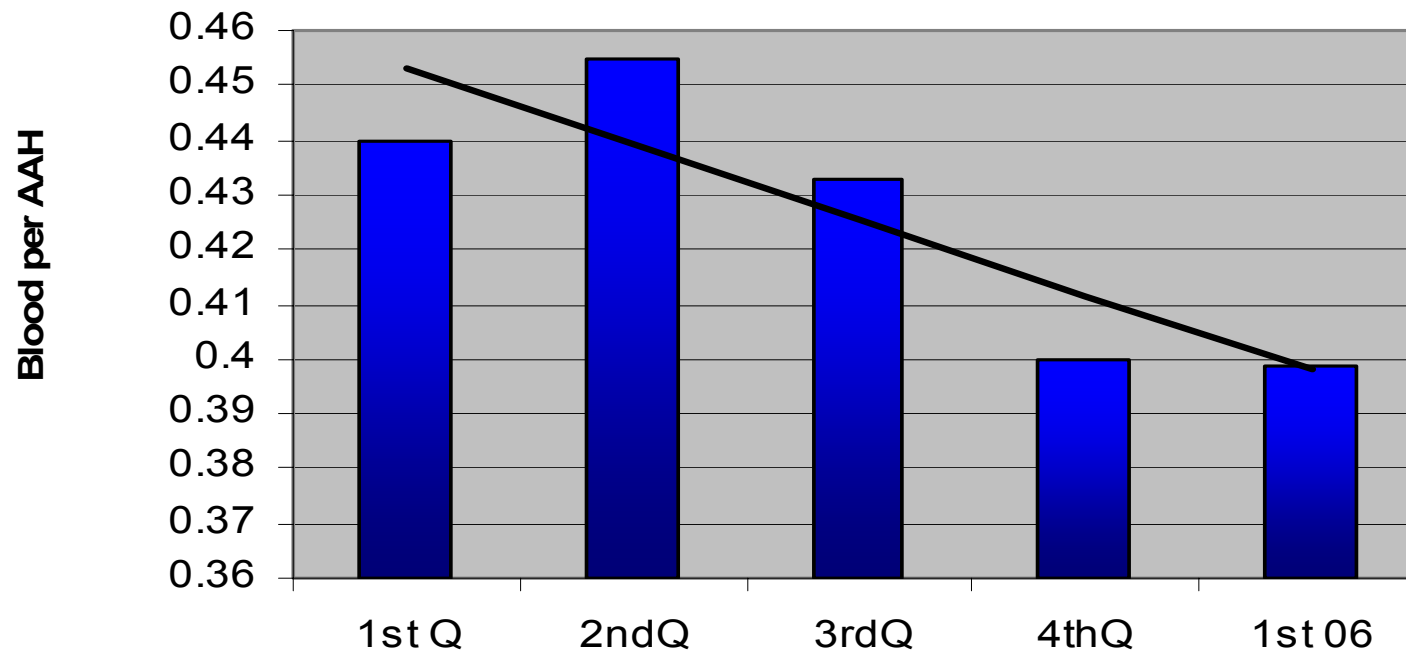
- Tolerate Anemia
- EPO/Iron/Vit B12/Folate

### RBC use All Campuses

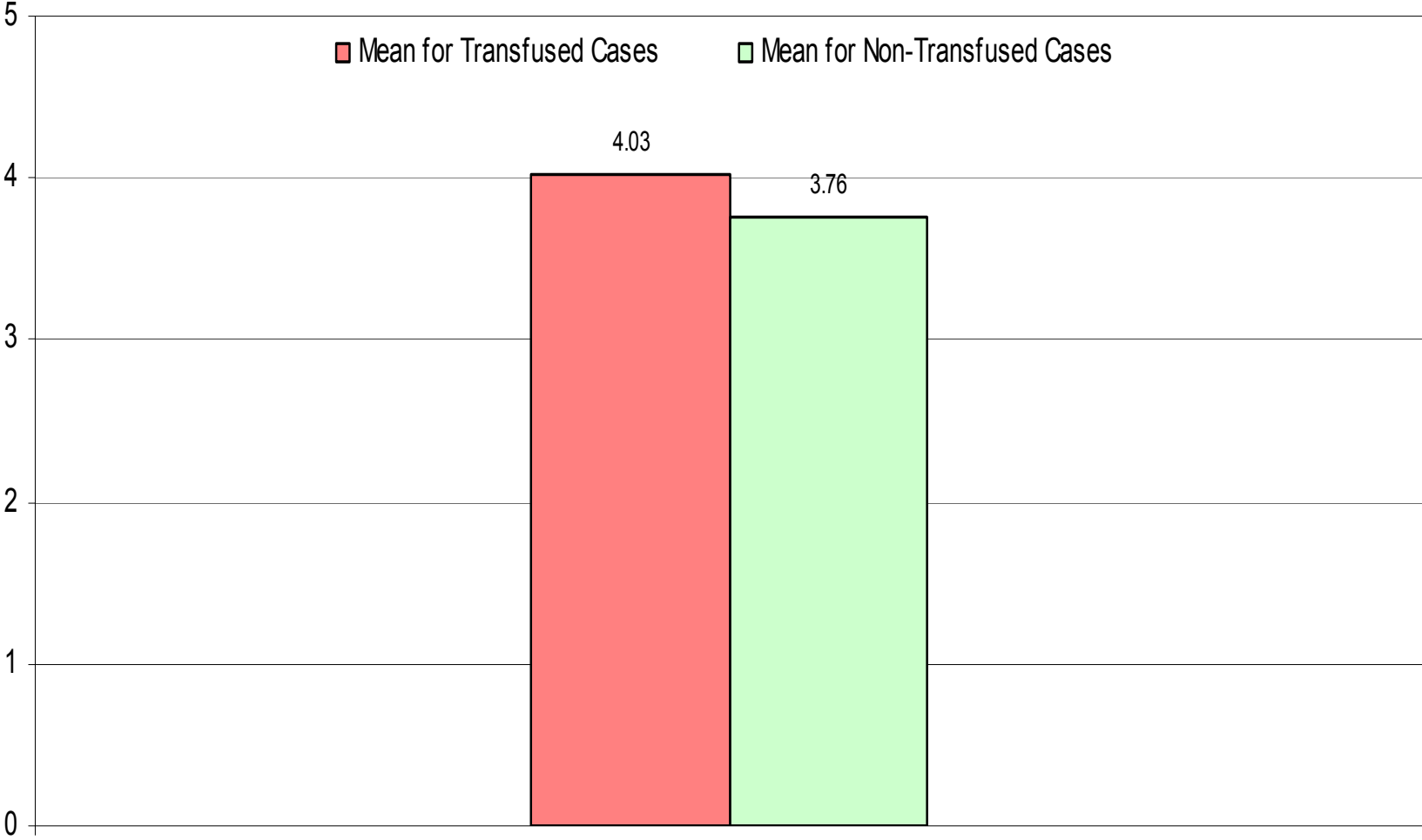


# 2005 All Blood Use/AAH

**SMC**  
**First Hill, Prov, Ballard**  
**2005-2006 All Blood Use Per AAH**

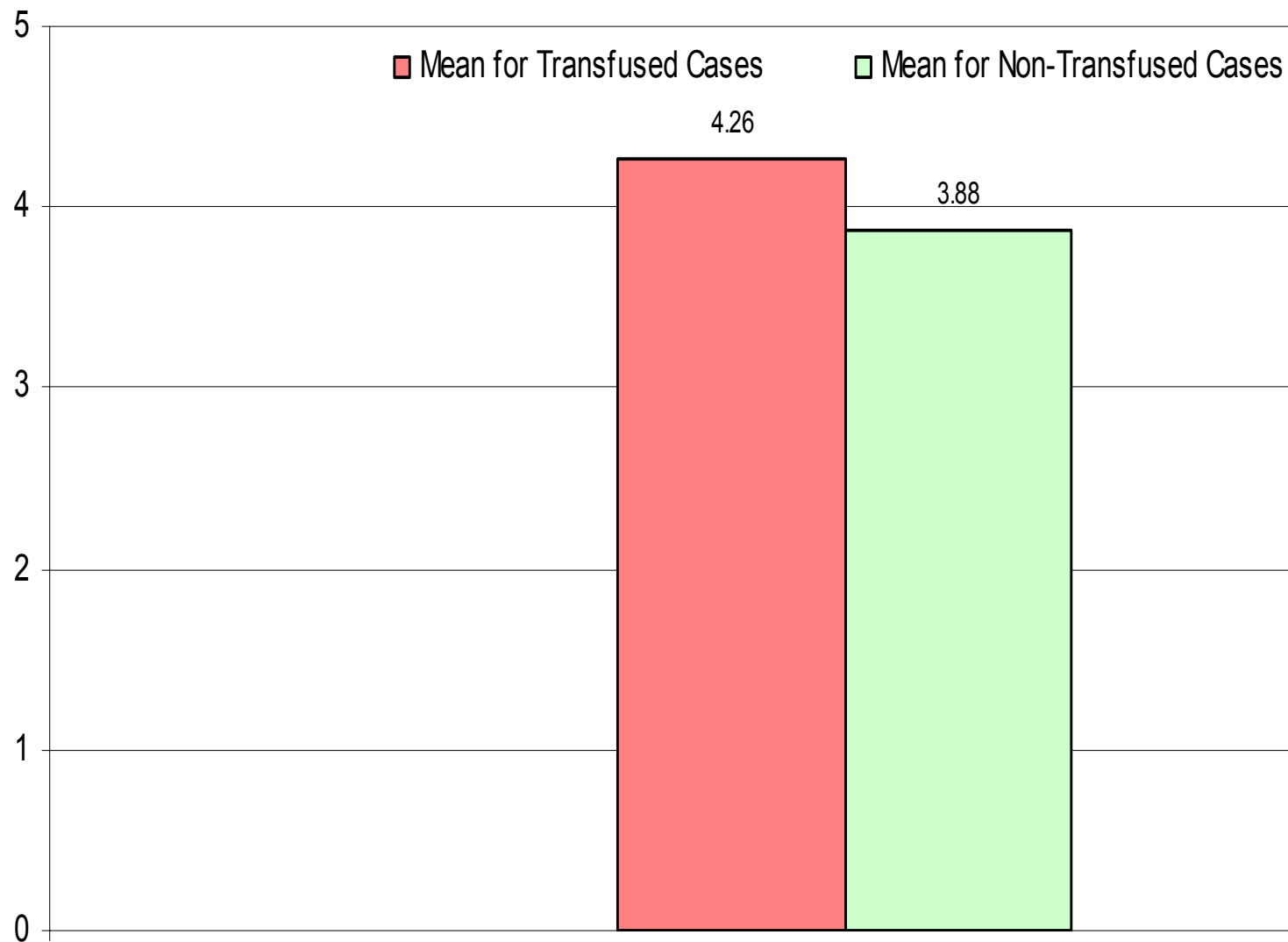


### Mean LOS\* for Transfused and Non-Transfused Cases Knee Cases, Quarters 3 & 4, 2005



\* Statistical difference between transfused and non-transfused

## Mean LOS\* for Transfused and Non-Transfused Cases Hip Cases, Quarters 3 & 4, 2005



\* Statistical difference between transfused and non-transfused

# Conclusions: Strategies at Swedish to reduce Transfusion

- Treat Anemia
- Stop Antiplatelet, Anticoagulant meds prior to surgery
- Acute Normovolemic Hemodilution
- Cell salvage intra op up to 4 hrs. post op
- Pharmaceutical agents
- Transfusion Order form (Adult/Infant/New Born)
- Point of Care Testing
- Utilization Review
- Education

# Conclusions:

- **Evidence Based Medicine – we are transfusing too often**
- **Helps to have the support of Blood Management Program**
- **But best practice can start with you.....**