Obstetric patients requiring intensive care

*Epworth Symposium 1/9/17*

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MBBS(Hons) FRACP FCICM PhD MHlthServMt

Divisional Director Critical Care & Investigative Services
Director ICU, RMH

VMO Intensivist Epworth Freemasons & Melbourne Private
Clinical Trials of Critically Ill Pregnant Woman
The Royal Women's Hospital
Resident Staff, 1959

Back Row: S. R. Cairns
          J. Davenport
          R. M. Berkley
          I. C. Ross
          R. A. L. Rance

Middle Row: J. G. Howard
           C. E. Carroll
           K. Thevarajah
           I. A. Mac Isaac
           B. W. Appleby
           P. P. Glenning
           K. A. Barham
           G. J. Bishop

Front Row: G. O. Smith
          F. R. Betheras
          W. I. H. Johnston
          J. C. Laver
          N. A. Beischer
          B. Sutherland
          J. H. Evans

Absent:  F. D. Adey
        N. M. Cruikshank
        Miss B. J. John
        D. W. Wilkie
        H. C. Butel
        J. F. Mainland
        I. R. Philpott

Anaes Reg.
Anaes Reg.
Anaes Reg.
Anaes Reg.
Anaes Reg.
Anaes Reg.
Anaes Reg.
Anaes Reg.
Prof Unit
Prof Unit
Prof Unit
Prof Unit
Prof Unit
Prof Unit
Prof Unit
Prof Unit
• ICU admission 2.7/1000 deliveries [0.27%], (1 per 370 deliveries)

• Indications
  – Hypertensive disorders of pregnancy
  – Obstetric haemorrhage
  – Sepsis
• ICU admission 11.8/1000 deliveries [1.18%], (1 per 370 deliveries)
### Table 1 Obstetric details (n = 249)

<table>
<thead>
<tr>
<th>Patient characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravidity†, n, median [IQR]; range</td>
<td>2 [1–3]; 1–10</td>
</tr>
<tr>
<td>Parity†, n, median [IQR]; range</td>
<td>0 [0–2]; 0–6</td>
</tr>
<tr>
<td>Gestational age‡, week, median; range</td>
<td></td>
</tr>
<tr>
<td>Postpartum</td>
<td>36 [32–38]; 19–41</td>
</tr>
<tr>
<td>Antepartum</td>
<td>28 [22–34]; 10–39</td>
</tr>
<tr>
<td>Ectopic pregnancy, n (%)</td>
<td>2 (0.8)</td>
</tr>
<tr>
<td>Miscarriage, n (%)</td>
<td>1 (0.4)</td>
</tr>
<tr>
<td>Antenatal, n (%)</td>
<td>12 (5)</td>
</tr>
<tr>
<td>Previous caesarean section¶, n (%)</td>
<td>73 (30)</td>
</tr>
<tr>
<td>Assisted reproductive technology</td>
<td></td>
</tr>
<tr>
<td>(of any type): n/180§</td>
<td></td>
</tr>
<tr>
<td>Delivery, n (%)</td>
<td></td>
</tr>
<tr>
<td>Spontaneous vaginal</td>
<td>23 (9.2)</td>
</tr>
<tr>
<td>Operative vaginal</td>
<td>19 (7.6)</td>
</tr>
<tr>
<td>Elective caesarean</td>
<td>49 (20)</td>
</tr>
<tr>
<td>Urgent or emergency caesarean</td>
<td>143 (57)</td>
</tr>
</tbody>
</table>

---

<table>
<thead>
<tr>
<th>Table 3 Reasons for intensive care unit admission</th>
<th>n/249 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstetric</td>
<td></td>
</tr>
<tr>
<td>Hypertensive diseases of pregnancy†</td>
<td>103 (41.0)</td>
</tr>
<tr>
<td>Obstetric haemorrhage</td>
<td>68 (27.0)</td>
</tr>
<tr>
<td>Puerperal sepsis</td>
<td>7 (2.8)</td>
</tr>
<tr>
<td>Other obstetric‡</td>
<td>5 (2.0)</td>
</tr>
<tr>
<td>Nonobstetric</td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>23 (9.2)</td>
</tr>
<tr>
<td>Cardiac</td>
<td>21 (8.4)</td>
</tr>
<tr>
<td>Sepsis</td>
<td>10 (4.0)</td>
</tr>
<tr>
<td>Analgesia-related complication</td>
<td>9 (3.6)</td>
</tr>
<tr>
<td>Other§</td>
<td>18 (7.2)</td>
</tr>
</tbody>
</table>

### Table 4 Intensive care unit therapies \( (n = 249) \)

<table>
<thead>
<tr>
<th>Intervention</th>
<th>( n ) (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial catheter</td>
<td>174 (70)</td>
</tr>
<tr>
<td>Magnesium sulphate infusion†</td>
<td>90 (36)</td>
</tr>
<tr>
<td>Central venous catheter</td>
<td>56 (22)</td>
</tr>
<tr>
<td>Mechanical ventilation</td>
<td>46 (18)</td>
</tr>
<tr>
<td>Cardiac monitoring (specific cardiac indication)</td>
<td>22 (8.8)</td>
</tr>
<tr>
<td>Inotropes/vasopressors</td>
<td>11 (4.4)</td>
</tr>
<tr>
<td>Plasmapheresis</td>
<td>3 (1.2)</td>
</tr>
<tr>
<td>Renal replacement therapy</td>
<td>2 (0.8)</td>
</tr>
<tr>
<td>Red cell transfusion</td>
<td></td>
</tr>
<tr>
<td>Prior to ICU</td>
<td>60 (24)</td>
</tr>
<tr>
<td>In ICU</td>
<td>42 (17)</td>
</tr>
<tr>
<td>Total of 4 or more red cell units</td>
<td>50 (20)</td>
</tr>
</tbody>
</table>

Patients may have received multiple interventions.  
†13 of 90 received no other critical care interventions in ICU.
The Maternal Mortality Ratio (MMR) from 2011 to 2015 was 8.9 per 100,000 women who gave birth.
<table>
<thead>
<tr>
<th>Cause of death</th>
<th>Maternal deaths included in mortality ratio</th>
<th>Late maternal deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct (due to a complication of the pregnancy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obstetric haemorrhage</td>
<td>3</td>
<td>N=1</td>
</tr>
<tr>
<td>Thromboembolism</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Anaesthetic related death</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Amniotic fluid embolus</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Early pregnancy death – ectopic pregnancy</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sepsis</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Post partum sepsis – Streptococcus Group A</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Indirect (related to a pre-existing or newly diagnosed condition exacerbated by pregnancy)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac disease</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Non-obstetric haemorrhage (includes intracerebral bleeding)</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Psychosocial</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Sepsis – acute pyelonephritis</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Complications of heart transplant for the treatment of peripartum cardiomyopathy</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Carcinoma of the cervix</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Bronchopneumonia with associated substance abuse and domestic violence</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Mixed drug toxicity</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Undetermined</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
General Principles of Care in the ICU
Physiological changes make recognition of pathophysiology challenging
Hemodynamic changes in normal pregnancy

Normal pregnancy is characterized by an increase in cardiac output, a reduction in systemic vascular resistance, and minimal change in mean blood pressure. These changes are associated with a 10 to 15 beat/min increase in heart rate.

Airway maybe more challenging
Vena caval obstruction – lateral position
Nutrition complex
DVT risk increased
Highly emotionally charged and stressful for patients, families & caregivers
Physiological Targets

- Limited information
- Extrapolation from other patient groups
  - “Adequate” PaO2, >90 mmHg
  - ? Match maternal alkalosis, PaCo2 35-40
  - Sedation – BZD, opiates & propofol
  - MAP > 65 mmHg
  - Hb > 70 g/L unless bleeding
  - DVT prophylaxis
  - Stress ulcer prophylaxis
• Preeclampsia is one of several hypertensive disorders in pregnancy (HDP)
• It is classically defined by the development of hypertension plus proteinuria, after 20 weeks’ gestation
YOU DO UNDERSTAND THE MEANING OF "HELLP SYNDROME"?

MY HUSBAND'S GIVEN ME AS MUCH HELP AS HE'S GOING TO GIVE ME
Treatment principals Pre-eclampsia

• Delivery definitive
• Other considerations
  – Fetal lung maturation
  – MgSO4
Do women with pre-eclampsia, and their babies, benefit from magnesium sulphate? The Magpie Trial: a randomised placebo-controlled trial

*Lancet 2002; 359: 1877–90*

The Magpie Trial Collaborative Group*
Treatment principals Pre-eclampsia

- Anti-Hypertensives
  - Aim SBP 130-160
  - DPB 80-90
  - Iv hydralazine, labetalol
  - (NOT ACEI, atenolol)
PPH: Definition

- Loss > 1L c-section
- Loss > 500 ml vaginal
PPH: Risk Factors

- Abnormal placental implantation
- Multiple Pregnancy
- Prev PPH
- Obesity
- C-section
Figure 18. Postpartum haemorrhage by method of birth, all women giving birth in 2014 and 2015

- 1500+ mL
- 1000–1499 mL
- 500–999 mL

Percentage of women

- Unassisted vaginal birth
- Assisted vaginal birth
- Caesarean section

Victoria's mothers, babies and children 2014 and 2015
PPH: Causes

- Atony
- Retained products/abnormal implantation
- Trauma
- Coagulopathy
Effective Management of Postpartum Haemorrhage (PPH) involves:

- Recognition
- Communication
- Resuscitation
- Monitoring
- Investigation and directed treatment
• ‘Critical bleeding’ may be defined as major haemorrhage that is life threatening and likely to result in the need for massive transfusion.
• VITAL SIGNS ARE VITAL
Table 3.1 Estimated blood loss based on patient’s initial presentation

<table>
<thead>
<tr>
<th>Class of haemorrhagic shock</th>
<th>I</th>
<th>II</th>
<th>III</th>
<th>IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood loss (mL)</td>
<td>Up to 750</td>
<td>750–1500</td>
<td>1500–2000</td>
<td>&gt; 2000</td>
</tr>
<tr>
<td>Blood loss (% blood volume)</td>
<td>Up to 15</td>
<td>15–30</td>
<td>30–40</td>
<td>&gt; 40</td>
</tr>
<tr>
<td>Pulse rate (per minute)</td>
<td>&lt; 100</td>
<td>100–120</td>
<td>120–140</td>
<td>&gt; 140</td>
</tr>
<tr>
<td>Blood pressure</td>
<td>Normal</td>
<td>Normal</td>
<td>Decreased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Pulse pressure (mm Hg)</td>
<td>Normal or increased</td>
<td>Decreased</td>
<td>Decreased</td>
<td>Decreased</td>
</tr>
<tr>
<td>Respiratory rate (per minute)</td>
<td>14–20</td>
<td>20–30</td>
<td>30–40</td>
<td>&gt; 35</td>
</tr>
<tr>
<td>Urine output (mL/hour)</td>
<td>&gt; 30</td>
<td>20–30</td>
<td>5–15</td>
<td>Negligible</td>
</tr>
<tr>
<td>Central nervous system/mental status</td>
<td>Slightly anxious</td>
<td>Mildly anxious</td>
<td>Anxious, confused</td>
<td>Confused, lethargic</td>
</tr>
</tbody>
</table>

Source: Adapted from American College of Surgeons (ACS) Committee on Trauma (2008). Reproduced with permission from ACS. Note: Values are estimated for a 70 kg male.
Optimizing Crisis Resource Management to Improve Patient Safety and Team Performance

A handbook for all acute care health professionals

Peter G. Brindley, Pierre Cardinal
Editors
Crisis Resource Management

- Awareness & attention
- Decision making
- Communication
- Task management
- Leadership & followership
- Teamwork

This photo is the aftermath of a 90 minute complex team resuscitation and is intended for reflection. Despite what looks like chaos, the patient survived and ONLY because great teamwork complemented great equipment and great training. This resuscitation required mastery of all of the topics discussed in this book: awareness and attention, decision-making, communication, task management, leadership and followership, and teamwork. The patient is alive and the team remained strong in large part because Crisis Resource Management was optimized.
INTUBATION CHECKLIST

NOTIFY ICU CONSULTANT AND TEAM LEADER PRIOR TO INTUBATION!

DIFFICULT AIRWAY RISK?
HISTORY OF DIFFICULT AIRWAY
MOUTH OPENING <5cm
IMMOBILIZED NECK

IF ANY OF THE ABOVE QUESTIONS IS ANSWERED WITH YES
CALL FOR ASSISTANCE (INTENSIVIST, RGN, ANESTHETICS #311)
CONSIDER AIRWAY PREEMPTIVE INTUBATION / AIRWAY LARYNGOSCOPY

PATIENT POSITION
☐ SNIFING POSITION (IF NO CONTRAINDICATION) OR
☐ FLAT WITH INLNE STABILIZATION

STAFF/TASK ALLOCATION
☐ PERSONAL PROTECTIVE EQUIPMENT (FACE MASK, EYE PROTECTION, APRON, GLOVES)
☐ AIRWAY, ☐ AIRWAY ASSISTANCE, ☐ DRUGS, ☐ CICLOIDAL (optional), ☐ INLNE STABILIZATION

MONITORING/EQUIPMENT
☐ ECG
☐ CAPNOGRAPHY (ON AND FUNCTIONING -- BEDSIDE MONITOR PREFERRED)
☐ PULSE OXIMETER / O2 TONE SWITCHED ON
☐ INVASIVE BP (PREFERABLE) AND/OR NON-INVASIVE (SET TO 2 MIN INTERVALS)
☐ SUCTION TURNED ON AND TESTED / YANKAUER ATTACHED AND WITHIN REACH
☐ BMV TESTED / OXYGEN ATTACHED AND ON PULL FLOW
☐ C-MAC / LARYNGOSCOPE TESTED (INCLUDING SPARE LARYNGOSCOPE)
☐ ETT OPENED, STYLET INSERTED AND 10CC CLUFF BLOCKER SYRINGE ATTACHED, ETT TIE
☐ GUIDE, BOUCHE AND LARYNGEAL MASK AVAILABLE

DRUGS AND FLUIDS
☐ PATENT IV ACCESS (PREFERABLY 2) WITH FLUID BAG ATTACHED AND RUNNING
☐ ALLERGIES (?) / CONTRAINDICATIONS FOR SUXAMETHONIUM (K+5mMol/L), IMMOBILIZATION, Hx of MH
☐ DRUGS AND DOSE COMMUNICATED WITH TEAM
☐ METARAMINOL
☐ PRE-OXYGENATION > 2MIN WITH TIGHT FITTING MASK AND 100% O2
☐ CALL FOR HELP IF SPO2 REMAINS <90% PRE-INDUCTION

DIFFICULT AIRWAY ALGORITHM
☐ DA ALGORITHM DISCUSSED WITH TEAM (SEE OVERLEAF)

*The Royal Melbourne Hospital

Last updated 2021/03/31 document.library.mednet.asu.edu
Practical approach to Critical bleeding

• Call for help
  – Obstetric back up
  – Anaesthetic back up
  – Alert Blood Bank by phone
  – Alert Theatre

• If signs of shock (e.g. SBP <80) give blood
Management of bleeding: Resuscitation

• Big lines
  – Preferably 2 x 14-16G peripheral jelcos
  – Flow = \frac{\text{Change in Pressure}}{\text{Resistance}}
  – \text{Resistance} = \frac{8 \times \text{viscosity} \times \text{length}}{\pi \times r^4}
<table>
<thead>
<tr>
<th>Catheter</th>
<th>Flow Rate ml/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jelco 20G</td>
<td>60</td>
</tr>
<tr>
<td>Jelco 18G</td>
<td>100</td>
</tr>
<tr>
<td>Jelco 16G</td>
<td>225</td>
</tr>
<tr>
<td>Jelco 14G</td>
<td>315</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>CVC (18G)</td>
<td>16.6</td>
</tr>
<tr>
<td>CVC (16G)</td>
<td>38.3</td>
</tr>
<tr>
<td>Sheath (9 Fr)</td>
<td>550</td>
</tr>
</tbody>
</table>
In a shocked patient Activate a Massive Transfusion Protocol
In haemorrhagic shock early use of FFP and Platelets is associated with reduced mortality.

Initiate MEP 1

Blood Bank Telephone
27275 or 27276

Unknown patient protocol activated if relevant
Commence documentation on the Massive Transfusion Sheet

MEP 1 contents
- 4 units O Rh (D) Negative Red Cells
- 2 units FFP = 1 bag
- 4 units of Platelets = 1 pool
- Massive Transfusion Fluid Balance Sheet
**Blood Support Protocol**  
**Epworth Freemasons Clarendon Street**

### LIFE THREATENING

**Blood required immediately**  
(no blood crossmatched)

- Give on-site O NEG uncrossmatched blood
- Notify Melbourne Pathology 9287 7715
- Request replacement O NEG immediately

**State LIFE THREATENING**

- Send EDTA sample to lab
- Use LIFE THREATENING label

Additional O NEG uncrossmatched approx. 5-10 minutes (plus courier time)

To request Haematologist assistance contact 9287 7715

### URGENT

**Blood required within 2 hours**

- Notify Melbourne Pathology 9287 7715
- Send EDTA sample to lab
- Use URGENT label

### ROUTINE

**Blood required within next 12 hours**

- Send EDTA sample to lab

### AVAILABILITY OF GROUP COMPATIBLE CROSSMATCHED BLOOD

**No antibodies**

- 10 minutes with existing group and hold
- 50 minutes with new specimen (plus courier time)

**With antibodies**

- 2 hours minimum (dependent on availability of suitable blood) (plus courier time)

### ACCESSING BLOOD PRODUCTS

#### PLATELETS

- Notify Melbourne Pathology 9287 7715
- Request anticipated time of arrival
- FFP/CRYOPRECIPITATE

- Notify Melbourne Pathology 9287 7715
- 30-40 minutes thawing/processing (plus courier time)

#### COLLOIDS

- 4% Albumin available in Theatre and ICU
- (Supplied by APOBS - VIC blood bank)
- Gelofusine available in Theatre
- (Supplied by Hospital Stores)

### COLLOIDS

- 4% Albumin available in Theatre and ICU  
  (Supplied by APOBS - VIC blood bank)
- Gelofusine available in Theatre  
  (Supplied by Hospital Stores)

### LABELLING REQUIREMENTS

Blood banking standards require conformity to the labeling requirements below as dictated by the Australian and New Zealand Society of Blood Transfusion (ANZBCT) and endorsed by the National Association of Testing Authorities (NATA).

- For plasma, platelets and cryoprecipitate:
  - The sample tube MUST be labeled with:
    1. Patient's family name (or full)
    2. Patient's given name (or full)
    3. Date of birth
    4. Centre and date of collection
    5. Signature or initials of the collector

- The request form and sample must match. Please use abbreviations only in the name of the patient's name.

- Samples that do not conform to these labeling requirements will not be processed.

Please note: These procedures do not apply to autologous blood.

Addressograph labels must be affixed to the collector and the date and time of collection written on the label.
<table>
<thead>
<tr>
<th>Evidence statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothermia, metabolic acidosis, thrombocytopenia and coagulopathy may be independently associated with increased mortality.(^{15, 61, 63-68})</td>
</tr>
</tbody>
</table>

(See evidence matrix 1 in Appendix E.)

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Consistency</th>
<th>Clinical Impact</th>
<th>Generalisability</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

[✓✓✓✓ = A ✓✓✓ = B ✓✓ = C X = D (See table 2.2)]
ICU Care of Obstetric Haemorrhage

• Keep patient ventilated while they are cold, acidotic and risk of ongoing bleeding
• Central line; monitoring, inotropes, infusions
• Arterial Line; continuous BP reading & ABG
• IDC
• Pulse oximetry & continuous ECG

• Major concern is “Has the bleeding stopped?”
In women with major obstetric haemorrhage, in addition to clinical observations, the following parameters should be measured early and frequently:

- temperature
- acid–base status
- ionised calcium
- haemoglobin
- platelet count
- PT/INR
- APTT
- fibrinogen level

With successful treatment, values should trend towards normal.
Values indicative of critical physiologic derangement include:

- temperature <35°C
- pH <7.2, base excess worse than -6, lactate >4 mmol/L
- ionised calcium <1.1 mmol/L
- platelet count <50 × 10⁹/L
- PT >1.5 × normal
- INR >1.5
- APTT >1.5 × normal
- fibrinogen level <2.0 g/L.
Monitor for adequate perfusion

- MAP > 65 mmHg, SBP <120 mmHg
- Urine output > 0.5 ml/kg/hr
- Peripheral temperature
- Lactate < 2 mmol/L
- Hb > 8

- Post initial resuscitation avoid non blood products
- Diuretics frequently required
Other management

- Keep warm
- Watch ionised calcium
- Specific therapies to contract uterus
  - Oxytocin, ergometrine and prostaglandins
- Sedation
- Stress ulcer prophylaxis
- Breastfeeding
AIMS IN ICU

• Warm & well perfused
• INR < 1.5, APTT < 40, FIB > 2.0, Hb > 8
• If still bleeding, mechanical cause
Difficult bleeding

• Return to theatre? Surgical assistance
• Tie off internal iliacs
• Consider hysterectomy
• Pack pelvis
• Consider radiological Embolisation
## PRACTICE POINTS – interventional radiology

| PP27  | Preventative IR may be appropriate in selected maternity patients; however, the risk of complications from this procedure should be balanced against the potential benefits. |
| PP28  | Although the role of therapeutic IR in the treatment of major obstetric haemorrhage is unknown, it may be considered in the overall approach to management. |
Activated Recombinant Factor VIIA (Novoseven)
Non-obstetric Traumatic Haemorrhage in a Pregnant patient
<table>
<thead>
<tr>
<th>Mechanism of injury</th>
<th>Estimated incidence/prevalence in pregnancy</th>
<th>Study design</th>
<th>Estimated incidence/prevalence outside of pregnancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor vehicle crashes</td>
<td>207/100,000 live births&lt;sup&gt;11&lt;/sup&gt;</td>
<td>Population-based cohort</td>
<td>1104/100,000 women&lt;sup&gt;199&lt;/sup&gt;</td>
</tr>
<tr>
<td>Falls and slips</td>
<td>48.9/100,000 live births&lt;sup&gt;24&lt;/sup&gt;</td>
<td>Retrospective case-control</td>
<td>3029/100,000 women&lt;sup&gt;100&lt;/sup&gt;</td>
</tr>
<tr>
<td>Burns</td>
<td>0.17/100,000 person-years&lt;sup&gt;27&lt;/sup&gt;</td>
<td>Retrospective case-control</td>
<td>2.6/100,000 person-years&lt;sup&gt;27&lt;/sup&gt;</td>
</tr>
<tr>
<td>Accidental poisoning</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Domestic violence</td>
<td>8307/100,000 live births&lt;sup&gt;101&lt;/sup&gt;</td>
<td>Review</td>
<td>5239/100,000 women&lt;sup&gt;1&lt;/sup&gt;</td>
</tr>
<tr>
<td>Suicide</td>
<td>2/100,000 live births&lt;sup&gt;94&lt;/sup&gt;</td>
<td>Retrospective cohort</td>
<td>8.8/100,000 population&lt;sup&gt;102&lt;/sup&gt;</td>
</tr>
<tr>
<td>Homicide</td>
<td>2.9/100,000 live births&lt;sup&gt;61&lt;/sup&gt;</td>
<td>Retrospective cohort</td>
<td>2.3/100,000 women&lt;sup&gt;103&lt;/sup&gt;</td>
</tr>
<tr>
<td>Penetrating trauma&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.27/100,000 live births&lt;sup&gt;652&lt;/sup&gt;</td>
<td>N/A</td>
<td>3.4/100,000 women&lt;sup&gt;652&lt;/sup&gt;</td>
</tr>
<tr>
<td>Toxic exposure</td>
<td>25.8/100,000 person-years&lt;sup&gt;103&lt;/sup&gt;</td>
<td>Retrospective cohort</td>
<td>115.3/100,000 person-years&lt;sup&gt;104&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Literature relating to incidence of burns during pregnancy is limited to most severe cases admitted to burn units and referral centers. Rate for accidental poisoning during pregnancy could not be calculated from available published literature. Domestic violence incidence includes all forms of partner violence, sexual, physical, and psychological.

N/A: not available.

<sup>a</sup> Rates exclude attempted suicides. Attempted suicide rate during pregnancy is approximately 40/100,000 pregnancies<sup>35</sup> and during postpartum period is 43.9/100,000 live births<sup>89</sup>. Rates include only causes leading to fatality.

<sup>b</sup> Rates calculated using 2009 US data from Centers for Disease Control and Prevention.

Domestic violence in Australia (intimate partner violence or family violence)

- Domestic violence may increase in pregnancy
- Estimated 1% - 20% Australian women experience violence in pregnancy / postpartum
Motor trauma in pregnancy, NSW, Australia

• Outcomes for those giving birth immediately were poor
  – increased risk of
    • placental abruption + other antepartum haemorrhage
    • preterm birth
    • caesarean section
    • perinatal death

• Women who remained undelivered following MVA (96%) had similar pregnancy outcomes to women not in MVAs
“...When caring for the pregnant patient who has suffered trauma, the primary management goal is to stabilize the condition of the mother, as fetal outcomes are directly correlated with early and aggressive maternal resuscitation...”

RMH Trauma Guidelines

Trauma Call

Primary Survey
A: Patent airway & C/spine protection
B: Ensure adequate breathing, circulation & oxygenation
C: Venous access 2 large bore cannulae; inspect for sources of bleeding
   (take baseline bloods (Xmatch, FBC, Coags, Biochem)
D: Conduct GCS
E: Commence hypothermia protocol: warm fluids & bare hugger

Massive Transfusion Trigger?
ABC Tool > or = 2
> 4 units ~ 4 Hours

No
Continue with Primary and secondary survey

Bolus 1 to 2 litres warm crystalloid solution

Yes
Minimise Crystalloid

Comence RBC's O Negative
(ensure bloods have been sent)

ABC Tool
Penetrating Mechanism
ED SBP < 90mmHg
ED HR > 120 bpm
Positive FAST
PREGNANT TRAUMA PATIENT – VIABLE FETUS > 24 WEEKS GESTATION

<table>
<thead>
<tr>
<th>PRIMARY SURVEY</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIRWAY: oxygen administration, prepare for difficult airway management, Manage Aspiration Risk, Maintain C-spine</td>
</tr>
<tr>
<td>BREATHING: if ICC required, insert 1-2 spaces higher</td>
</tr>
<tr>
<td>CIRCULATION: LEFT LATERAL TILT, manual uterus displacement, bilateral large IVC insertion, bloods including antibody screen / X-match / HCG</td>
</tr>
<tr>
<td>DISABILITY: neurological exam</td>
</tr>
<tr>
<td>ENVIRONMENT: active warming for temperature &lt;36.8</td>
</tr>
</tbody>
</table>
Considerations in pregnancy trauma cases

- Thoracostomy tubes placed 1-2 intercostal spaces above usual fifth intercostal space landmark to avoid abdominal placement
- In second- and third-trimester, consider delivery if total affected body surface burn area ≥ 50%
- Focused assessment with sonography for trauma is reliable during pregnancy
Sepsis
<table>
<thead>
<tr>
<th>Table 1. Risk factors for maternal sepsis in pregnancy as identified by the Confidential Enquiries into Maternal Deaths^{1,2}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obesity</td>
</tr>
<tr>
<td>Impaired glucose tolerance / diabetes</td>
</tr>
<tr>
<td>Impaired immunity/ immunosuppressant medication</td>
</tr>
<tr>
<td>Anaemia</td>
</tr>
<tr>
<td>Vaginal discharge</td>
</tr>
<tr>
<td>History of pelvic infection</td>
</tr>
<tr>
<td>History of group B streptococcal infection</td>
</tr>
<tr>
<td>Amniocentesis and other invasive procedures</td>
</tr>
<tr>
<td>Cervical cerclage</td>
</tr>
<tr>
<td>Prolonged spontaneous rupture of membranes</td>
</tr>
<tr>
<td>GAS infection in close contacts / family members</td>
</tr>
<tr>
<td>Of black or other minority ethnic group origin</td>
</tr>
<tr>
<td>Term</td>
</tr>
<tr>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>Infection</td>
</tr>
<tr>
<td>Bacteremia</td>
</tr>
</tbody>
</table>
| Systemic Inflammatory Response Syndrome (SIRS) | The systemic response to a variety of severe clinical insults. The response is manifest by 2 or more of the following:  
  Temperature > 38°C or < 36°C  
  Heart Rate > 90 beats/min  
  Respiratory Rate > 20 breaths/min or PaCO₂ < 32 torr  
  WBC > 12000 cells/mm³ or > 10% immature forms |
Sepsis should be defined as life-threatening organ dysfunction caused by a dysregulated host response to infection.

Adult patients with suspected infection can be rapidly identified as being more likely to have poor outcomes typical of sepsis if they have at least 2 of the following clinical criteria that together constitute a new bedside clinical score termed quick SOFA (qSOFA):

- respiratory rate of 22/min or greater
- altered mentation, or
- systolic blood pressure of 100mmHg or less.
Prognostic Accuracy of the SOFA Score, SIRS Criteria, and qSOFA Score for In-Hospital Mortality Among Adults With Suspected Infection Admitted to the Intensive Care Unit

Table 1. Sequential [Sepsis-Related] Organ Failure Assessment Score

<table>
<thead>
<tr>
<th>System</th>
<th>Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiration</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\text{Pao}_2/\text{FiO}_2), mm Hg (kPa)</td>
<td>(\geq 400) (53.3)</td>
<td>(&lt; 400) (53.3)</td>
<td>(&lt; 300) (40)</td>
<td>(&lt; 200) (26.7) with respiratory support</td>
<td>(&lt; 100) (13.3) with respiratory support</td>
<td></td>
</tr>
<tr>
<td>Coagulation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Platelets, (\times 10^3/\mu\text{L})</td>
<td>(\geq 150)</td>
<td>(&lt; 150)</td>
<td>(&lt; 100)</td>
<td>(&lt; 50)</td>
<td>(&lt; 20)</td>
<td></td>
</tr>
<tr>
<td>Liver</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\text{Bilirubin, mg/dL (\mumol/L)})</td>
<td>(&lt; 1.2) (20)</td>
<td>(1.2-1.9) (20-32)</td>
<td>(2.0-5.9) (33-101)</td>
<td>(6.0-11.9) (102-204)</td>
<td>(&gt; 12.0) (204)</td>
<td></td>
</tr>
<tr>
<td>Cardiovascular</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAP, mm Hg</td>
<td>MAP (\geq 70)</td>
<td>MAP &lt; 70</td>
<td>Dopamine &lt; 5 or dobutamine (any dose)</td>
<td>Dopamine 5.1-15 or epinephrine (\leq 0.1) or norepinephrine (\leq 0.1)</td>
<td>Dopamine &gt; 15 or epinephrine &gt; 0.1 or norepinephrine &gt; 0.1</td>
<td></td>
</tr>
<tr>
<td>Central nervous system</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Glasgow Coma Scale score</td>
<td>15</td>
<td>13-14</td>
<td>10-12</td>
<td>5-9</td>
<td>&lt;6</td>
<td></td>
</tr>
<tr>
<td>Renal</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\text{Creatinine, mg/dL (\mumol/L)})</td>
<td>(&lt; 1.2) (110)</td>
<td>(1.2-1.9) (110-170)</td>
<td>(2.0-3.4) (171-299)</td>
<td>(3.5-4.9) (300-440)</td>
<td>(&gt; 5.0) (440)</td>
<td></td>
</tr>
<tr>
<td>Urine output, mL/d</td>
<td>(&lt; 500)</td>
<td>(&lt; 200)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: \(\text{FiO}_2\), fraction of inspired oxygen; MAP, mean arterial pressure; \(\text{Pao}_2\), partial pressure of oxygen.

\(a\) Adapted from Vincent et al.\(c\)

\(b\) Catecholamine doses are given as \(\mu g/\text{kg/\text{min}}\) for at least 1 hour.

\(c\) Glasgow Coma Scale scores range from 3-15; higher score indicates better neurological function.
Table 1. Some immunomodulatory therapies tested in clinical trials.

<table>
<thead>
<tr>
<th>Immunomodulatory Therapies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment with anti-endotoxins</td>
</tr>
<tr>
<td>- Anti-endotoxin antibodies</td>
</tr>
<tr>
<td>- LPS analogs</td>
</tr>
<tr>
<td>- LPS elimination</td>
</tr>
<tr>
<td>- Bacterial lipopolysaccharide peptides</td>
</tr>
<tr>
<td>Treatment with antagonists to specific mediators</td>
</tr>
<tr>
<td>- TNF blockers</td>
</tr>
<tr>
<td>- TNF receptor antagonials</td>
</tr>
<tr>
<td>- IL-1 or IL-1RA</td>
</tr>
<tr>
<td>Coagulants</td>
</tr>
<tr>
<td>- Antithrombin</td>
</tr>
<tr>
<td>- Activated protein C</td>
</tr>
<tr>
<td>- Tissue factor pathway inhibitor</td>
</tr>
<tr>
<td>- PAF</td>
</tr>
<tr>
<td>- PAF antagonists</td>
</tr>
<tr>
<td>- PAF-acetyl hydrolase</td>
</tr>
<tr>
<td>- PLA2: PLA2 inhibitor</td>
</tr>
<tr>
<td>- Angioid acid metabolites</td>
</tr>
<tr>
<td>- Prostaglandin E1</td>
</tr>
<tr>
<td>- Ibuprofen</td>
</tr>
<tr>
<td>- Thromboxane inhibitors</td>
</tr>
<tr>
<td>- Ketocanazole</td>
</tr>
<tr>
<td>- Reactive oxygen species</td>
</tr>
<tr>
<td>- N-acetyl cysteine</td>
</tr>
<tr>
<td>- Selenium</td>
</tr>
<tr>
<td>- Bradykinin: Bradykinin antagonist</td>
</tr>
<tr>
<td>- Nitric oxide: iNOS</td>
</tr>
<tr>
<td>- Immunomodulation therapy</td>
</tr>
<tr>
<td>- Immunoglobulins</td>
</tr>
<tr>
<td>- Granulocyte colony-stimulating factor, IFN-γ</td>
</tr>
<tr>
<td>- Immunonutrition</td>
</tr>
<tr>
<td>- Non-specific interventions</td>
</tr>
<tr>
<td>- Corticosteroid therapy</td>
</tr>
<tr>
<td>- Pentoxifylline therapy</td>
</tr>
<tr>
<td>- High output hemofiltration</td>
</tr>
</tbody>
</table>

NOTE. LPS, lipopolysaccharide; PAF, platelet activating factor; IL, interleukin.

Clinical Trials of Immunomodulatory Therapies in Severe Sepsis and Septic Shock

Jean-Louis Vincent, Stephen Sun, and Marc-Jacques Dubois
Department of Intensive Care, Erasmus Hospital, Free University of Brussels, Belgium

Clinical Infectious Diseases 2002;34:1084-93
Efficacy and Safety of Recombinant Human Activated Protein C for Severe Sepsis

Gordon R. Bernard, M.D., Jean-Louis Vincent, M.D., Ph.D., Pierre-Francois Laterre, M.D., Steven P. LaRosa, M.D., Jean-Francois Dhainaut, M.D., Ph.D., Angel Lopez-Rodriguez, M.D., Jay S. Steinrub, M.D., Gary E. Garber, M.D., Jeffrey D. Helterbrand, Ph.D., E. Wesley Ely, M.D., M.P.H., and Charles J. Fisher, Jr., M.D., for the Recombinant Human Activated Protein C Worldwide Evaluation in Severe Sepsis (PROWESS) Study Group*
Figure 2. Kaplan–Meier Estimates of Survival among 850 Patients with Severe Sepsis in the Drotrecogin Alfa Activated Group and 840 Patients with Severe Sepsis in the Placebo Group. Treatment with drotrecogin alfa activated was associated with a significantly higher rate of survival (P=0.006 by the stratified log-rank test).
I. Recombinant Human Activated Protein C (rhAPC)

1. We suggest that adult patients with sepsis-induced organ dysfunction associated with a clinical assessment of high risk of death, most of whom will have Acute Physiology and Chronic Health Evaluation (APACHE) II $\geq 25$ or multiple organ failure, receive rhAPC if there are no contraindications (grade 2B except for patients within 30 days of surgery, for whom it is grade 2C). Relative contraindications should also be considered in decision making.
Drug withdrawal sends critical care specialists back to basics

Asher Mullard

The withdrawal of Lilly's antisepsis drug marks the latest U-turn in the treatment of severe sepsis, an area of critical care plagued by starts, stops, and confusion. Asher Mullard reports.

Lilly has pulled its antisepsis drug Xigris (drotrecogin alfa) from markets worldwide because the results of the post-marketing PROWESS SHOCK trial did not show efficacy. The move, which comes nearly 10 years after the drug was initially approved in the USA, brings a long controversial story to a close, but draws attention to the slow pace of progress for the treatment of sepsis.

“This was an interesting saga for the field of critical care. It really brought out the relationship between pharma and physicians”, says Anthony Sufredini, Associate Chief of the Critical Care Medicine Department at the US National Institutes of Health.
• Single Centre
• 263 patients
• Severe sepsis or septic shock
  • SBP < 90 or
  • Lactate > 4 mmol/l

Rivers, E., Nguyen, B., Havstad, S., Ressler, J., Muzzin, A., Knoblich, B., Peterson, E.
and Tomlanovich, M. (2001), Early goal-directed therapy in the treatment of severe sepsis
Standard therapy

- CVP $8 - 12$ mmHg
- MAP $\geq 65$ mmHg
- Urine output $\geq 0.5$ ml/kg/hr

EGDT™

1. Edwards PreSep Central Venous Oximetry Catheter

2. $200

3. Dobutamine if MAP ≥ 65 mmHg
In-hospital mortality

• Standard 46.5%
• EGDT 30.5%

P = 0.009

Early, Goal-Directed Therapy for Septic Shock — A Patient-Level Meta-Analysis

The PRISM Investigators

3723 patients at 138 hospital in 7 countries

Hazard ratio, 0.98 (95% CI, 0.86–1.11)
P = 0.75

No. at Risk
EGDT 1857  1391  1287  1209  1119
Usual care 1880  1395  1295  1206  1110
Treatment of Sepsis

- Resuscitation
- Antibiotics
- Source control
- Organ support
- Specific therapies
## A Comparison of Albumin and Saline for Fluid Resuscitation in the Intensive Care Unit

The SAFE Study Investigators

### Table

<table>
<thead>
<tr>
<th>Patients</th>
<th>Albumin Group</th>
<th>Relative Risk (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>726/344</td>
<td>0.99 (0.91–1.09)</td>
</tr>
<tr>
<td>Trauma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>81/599</td>
<td>1.36 (0.99–1.86)</td>
</tr>
<tr>
<td>No</td>
<td>641/284</td>
<td>0.96 (0.88–1.06)</td>
</tr>
<tr>
<td>Severe sepsis</td>
<td>217/615</td>
<td>0.87 (0.74–1.02)</td>
</tr>
<tr>
<td>No</td>
<td>492/2720</td>
<td>1.05 (0.94–1.17)</td>
</tr>
<tr>
<td>ARDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>24/61</td>
<td>0.93 (0.61–1.41)</td>
</tr>
<tr>
<td>No</td>
<td>697/3365</td>
<td>1.00 (0.91–1.09)</td>
</tr>
</tbody>
</table>

**Notes:**

- **30.7%** indicates the percentage of patients in the albumin group.
- **35.3%** indicates the percentage of patients in the saline group.

**Figure:**

- The figure shows a comparison of albumin and saline in terms of relative risk. The graph indicates a trend towards saline being better in certain subsets, with relative risks close to 1.00 for both albumin and saline being better.
Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock.

Anand Kumar, MD; Daniel Roberts, MD; Kenneth E. Wood, DO; Bruce L. de Perio, MD; Satendra Sharma, MD; Robert Suppes, BSc; Daniel Feinstein, MD; Stuart Leventhal, MD; David Gurka, MD; Aseem Kumar, PhD; Mary Cheang, MSc

Objective: To determine the prevalence and impact on mortality of delays in initiation of effective antimicrobial therapy from initial onset of recurrent/persistent hypotension of septic shock.

Design: A retrospective cohort study performed between July 1989 and June 2004.

Setting: Fourteen intensive care units (four medical, four medical/surgical, six mixed medical/surgical) and ten hospital-based community centers (academic, six community) in Canada and the United States.

Patients: Medical records of 2,731 adult patients with septic shock.

Interventions: None.

Measurements and Main Results: The main outcome measure was survival to hospital discharge. Among the 2,154 septic shock patients (78.9% total) who received effective antimicrobial therapy only after the onset of recurrent or persistent hypotension, a strong relationship between the delay in effective antimicrobial initiation and in-hospital mortality was noted (adjusted odds ratio 1.119 [per hour delay], 95% confidence interval 1.103–1.136, p < .0001). Administration of an antimicrobial effective for isolated or suspected pathogens within the first hour of documented hypotension was associated with improved survival and reduced hospital mortality.

Conclusions: The timing of effective antimicrobial therapy is critical in determining survival outcomes in septic shock. Despite advances in identification of pathogens with increasing delays, only patients who received effective antimicrobial therapy within the first hour of documented hypotension survived to hospital discharge. (Crit Care Med 2006; 34:1599–1596)

Key Words: sepsis; antimicrobial; timing; delay; outcome
Survival 82.7%

Survival 42.0%
Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock*
Mortality Related to Severe Sepsis and Septic Shock Among Critically Ill Patients in Australia and New Zealand, 2000-2012

Kirs-Maija Kaukonen, MD, PhD, EDIC; Michael Bailey, PhD; Satoshi Suzuki, MD; David Plichter, FCICM; Rinaldo Bellomo, MD, PhD

Published online March 18, 2014.

Figure 1. Mean Annual Mortality in Patients With Severe Sepsis
• The most common organisms identified in pregnant women dying from sepsis are Lancefield group A beta-haemolytic *Streptococcus* and *E.Coli*. 
• amoxy/ampicillin 2 g IV, 6-hourly
• gentamicin IV
• metronidazole 500 mg IV, 12-hourly.

• TAZOCIN (Piperacillin/tazobactam)
Conclusions

- Critically ill obstetric patient are scary
- Robust young physiology helps
- Quick action and teamwork saves lives
Done and dusted: Dustin Martin to stay at Richmond until 2024