In The Middle Of The Road

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\[ DO_2 = CO \times [(1.34 \times Hb \times SaO_2) + 0.003 \times PaO_2] \]
"Physiological" model

- Basis for assessment and Rx
- Abnormal numbers indicate severity
- Normalization of numbers parallels disease resolution
Normalizing physiology

- Normalization → therapeutic end-point
- Certain variables (supra-normal parameters) linked with survival → “survivor levels” targeted
Optimizing physiology

- Survivor levels
- CI > 4.5 L/min/sqm
- DO2 > 600 mls/min/sqm
Normalizing/Optimizing

- What is “normal”?
- Demonstration of benefit required
- Potential for harm
"EBM" model (RCTs & beyond)

- Physiological model tested for > 20 years
- RCTs compared "normal" & "supra-normal" targets; intensive vs. less intensive Rx

→ No difference in mortality
→ Higher mortality
Conclusions. The use of dobutamine to boost the cardiac index and systemic oxygen delivery failed to improve the outcome in this heterogeneous group of critically ill patients. Contrary to what might have been expected, our results suggest that in some cases aggressive efforts to increase oxygen consumption may have been detrimental. (N Engl J Med 1994;330:1717-22.)
Conclusions. Hemodynamic therapy aimed at achieving supranormal values for the cardiac index or normal values for mixed venous oxygen saturation does not reduce morbidity or mortality among critically ill patients. (N Engl J Med 1995;333:1025-32.)
Endpoints of Resuscitation of Critically Injured Patients: Normal or Supranormal?
A Prospective Randomized Trial

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Figure 1. Effect of age on the ability to achieve optimal hemodynamic values.
Results

- No survival benefit overall

- Survivors achieved optimal values → values indicate better physiologic reserve

- In the treatment group, if optimal values not achieved → higher mortality (50% vs. 19%) → aggressive attempts to optimize patients with no physiological reserve are harmful
\[ D_{O2} = CO \times [(1.34 \times Hb \times SaO2) + 0.003 \times PaO2] \]
Clinical practice guideline: Red blood cell transfusion in adult trauma and critical care*

Lena M. Napolitano, MD; Stanley Kurek, DO; Fred A. Luchette, MD; Howard L. Corwin, MD; Philip S. Barie, MD; Samuel A. Tisherman, MD; Paul C. Hebert, MD, MHSc; Gary L. Anderson, DO; Michael R. Bard, MD; William Bromberg, MD; William C. Chiu, MD; Mark D. Cipolle, MD, PhD; Keith D. Clancy, MD; Lawrence Diebel, MD; William S. Hoff, MD; K. Michael Hughes, DO; Imtiaz Munshi, MD; Donna Nayduch, RN, MSN, ACNP; Rovinder Sandhu, MD; Jay A. Yelon, MD; for the American College of Critical Care Medicine of the Society of Critical Care Medicine and the Eastern Association for the Surgery of Trauma Practice Management Workgroup

**Conclusions:** Evidence-based recommendations regarding the use of RBC transfusion in adult trauma and critical care will provide important information to critical care practitioners. (Crit Care Med 2009; 37:3124–3157)
Table 5. Studies examining oxygen delivery, oxygen consumption and lactate before and after

<table>
<thead>
<tr>
<th>Author and Year</th>
<th>Study Population</th>
<th>n</th>
<th>Amount Transfused (units)</th>
<th>↑ Hb</th>
<th>↑ Do₂</th>
<th>↑ Vo₂</th>
<th>↓ Lactate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shah et al (123)</td>
<td>Posttrauma critically ill patients</td>
<td>8</td>
<td>1 or 2 units</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Kahn et al (124)</td>
<td>Acute respiratory failure</td>
<td>15</td>
<td>7–10 mL/kg</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>NA</td>
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<tr>
<td>Gilbert et al (113)</td>
<td>Septic adults</td>
<td>54</td>
<td>Δ 20 g/L</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Dietrich et al (125)</td>
<td>Medical shock (septic/cardiac)</td>
<td>32</td>
<td>577 mL</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Conrad et al (116)</td>
<td>Septic shock</td>
<td>19</td>
<td>Δ 3 g/dL</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Ronco et al (126)</td>
<td>PCP pneumonia</td>
<td>5</td>
<td>1.5 units</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>NA</td>
</tr>
<tr>
<td>Fenwick et al (127)</td>
<td>ARDS</td>
<td>24</td>
<td>1.5 units</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td>Mink et al (114)</td>
<td>Septic shock 2 mo-6 yrs</td>
<td>8</td>
<td>8–10 mL/kg × 1–2 hrs</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
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<tr>
<td>Lucking et al (115)</td>
<td>Septic shock 4 mos-15 yrs</td>
<td>7</td>
<td>10–15 mL/kg × 1–3 hrs</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>NA</td>
</tr>
<tr>
<td>Ronco et al (128)</td>
<td>ARDS</td>
<td>17</td>
<td>1.5 units</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
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<tr>
<td>Steffes et al (117)</td>
<td>Postoperative and posttrauma</td>
<td>21</td>
<td>1–2 units</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td>Babineau et al (129)</td>
<td>Postoperative</td>
<td>31</td>
<td>328 ± 9 mL</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Silverman et al (118)</td>
<td>Septic shock 21–88 yrs</td>
<td>21</td>
<td>2 units</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Marik et al (119)</td>
<td>Septic adults</td>
<td>23</td>
<td>3 units</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
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<tr>
<td>Lorente et al (120)</td>
<td>Septic adults</td>
<td>16</td>
<td>2 units</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Gramm et al (131)</td>
<td>Septic shock 46 ± 3 yrs</td>
<td>19</td>
<td>2 units</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>NA</td>
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<tr>
<td>Casutt et al (132)</td>
<td>Postoperative 32–81 yrs</td>
<td>67</td>
<td>368 ± 10 mL</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
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<tr>
<td>Fernandes et al (50)</td>
<td>Septic shock 18–80 yrs</td>
<td>10</td>
<td>1 units</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Walsh et al (133)</td>
<td>Euvolemic anemic critically ill patients</td>
<td>22</td>
<td>2 units</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
<td>No</td>
</tr>
<tr>
<td>Suttner et al (47)</td>
<td>Volume-resuscitated mechanically ventilated</td>
<td>51</td>
<td>1 or 2 units vs. 100% Fio₂</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>patients</td>
<td></td>
<td>(n = 17 each)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mazza et al (134)</td>
<td>SIRS/Sepsis</td>
<td>29</td>
<td>1–3 units</td>
<td>Yes</td>
<td>NA</td>
<td>NA</td>
<td>No</td>
</tr>
</tbody>
</table>
1. RBC transfusion is indicated for patients with evidence of hemorrhagic shock. (Level 1)

3. A “restrictive” strategy of RBC transfusion (transfuse when Hb < 7 g/dL) is as effective as a “liberal” transfusion strategy (transfusion when Hb < 10 g/dL) in critically ill patients with hemodynamically stable anemia, except possibly in patients with acute myocardial ischemia. (Level 1)

7. Consider transfusion if Hb < 7 g/dL in resuscitated critically ill trauma patients. There is no benefit of a “liberal” transfusion strategy (transfusion when Hb < 10 g/dL) in resuscitated critically ill trauma patients. (Level 2)

9. RBC transfusion should not be considered as an absolute method to improve tissue oxygen consumption in critically ill patients. (Level 2)
“Middle of the road”

- Less is more
- Less aggressive manipulation of physiology
  → better outcomes
Middle of the road – less is more

- **Ventilation:** 6 mls/kg vs. 12 mls/kg
- **Sedation:** less/daily interruption/no sedation
- **CPP:** 60 mmHg vs. 70, DECRA
- **Fluids:** negative balance
- **Dialysis:** 25 mls/kg/hr vs. 40 mls/kg/hr
- **Glucose:** tight control kills
The “sweet spot” for physiological targets in critically ill patients

Titrating various therapies to achieve a target range or a threshold level of a physiological variable is an integral component of managing critically ill patients in the intensive care unit. There are many examples of this type of titration. Indeed, with the possible exception of early goal-directed therapy in sepsis (an unblinded single centre study), there are no studies in which either of these approaches have improved patient-centred outcomes such as poorer survival.
B. U-shaped curve with additional data points for tidal volumes of 0 mL/kg and much higher than 12 mL/kg
He who walks in the middle of the road gets hit from both sides.