HEALTH ECONOMICS OF GOAL-DIRECTED PERFUSION

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SORIN HEARTLINK™ – Re-defining Perfusion

PATIENT BENEFIT
- Reduced AKI occurrence
- Limited use of Transfusions
- Focusing neurological protection
- Shorter ICU and Hospital Stay

CLINICAL BENEFIT
- Minimized impact on hemodilution
- Goal-Directed Perfusion
- GME Handling Non emulsified blood removal
- Enhanced Biocompatibility

SORIN SOLUTION
- S5 HLM
- FLEXThERM
- INSPIRE
- CONNECT GDP Monitor
- XTRA

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What is a Health Economic Analysis?

Berlin Marathon Sep 27th 2015

Nike runner missed world record because his shoes disintegrated

Eliud Kipchoge won the Berlin Marathon even as his shoes fell apart

Eliud Kipchoge won the Berlin Marathon over the weekend, a remarkable achievement even before considering the fact that he ran much of the race with insoles that were falling out of his Nike shoes.

The 30-year-old elite Kenyan runner won the race at a 2:04:00 personal best, defying footwear problems, according to the Berlin Marathon’s official website. The insoles were falling out of his shoes by around the 10-mile mark, though Kipchoge was reportedly aware of the issue early in the race.
What is a Health Economic Analysis?

**Scenario 1**
No shoes malfunction
- Normal health condition
- World record achieved?
- Clinical outcomes of scenario 1 “translated” in economic terms

**Scenario 2**
Shoes malfunction
- “It was not easy,” Kipchoge told Runner's World. “There are blisters on the left foot and my big toe is cut, with lots of blood.”
- World record missed
- Clinical outcomes of scenario 2 “translated” in economic terms

Kipchoge's quote: “It was not easy,” Kipchoge told Runner's World. “There are blisters on the left foot and my big toe is cut, with lots of blood.”
Objective of the GDP Health Economic Analysis

- Economic evaluation of the application of Goal-Directed Perfusion (GDP) strategy with respect to “Traditional Perfusion” (TP) via an ad-hoc simulation model

- ARTERIAL PUMP FLOW SETTING
  - GOAL-DIRECTED PERFUSION (GDP)
    - Hematocrit
    - DO2
- TRADITIONAL PERFUSION (TP)
  - BSA
  - Temperature
Comparison between traditional and goal directed perfusion in cardiopulmonary by-pass. A differential cost analysis in US

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ABSTRACT
OBJECTIVES: High oxygen delivery (DO2) during cardiopulmonary bypass (CPB) is associated with better renal outcome in cardiac surgery. Traditional perfusion (TP) techniques, targeted on body surface area and CPB temperature, achieves high DO2 in about 50% of the cases while a goal directed perfusion (GDP) approach can lead to more than 90% of cases achieving high DO2 with a consequent reduction in Acute Kidney Injury (AKI) rate of about 40%. Aim of this study is to perform an economic evaluation of GDP strategy with respect to TP in US. METHODS: A Discrete Event Simulation model was developed to compare TP and GDP strategy in patients undergoing CPB. The patient's pathways from operation to discharging from hospital was simulated. AKI incidence, in-hospital mortality, hospital length of stay, transfusions were correlated to probability to achieve high DO2 target using published correlations. National perspective was adopted to calculate costs associated to each event while GDP strategy was exploited the introduction of Sorin Heartlink (HL) Cardi GDP Card and Sorin Connect (electronic data management system). RESULTS: GDP strategy saved more than 3 days in hospital and 11% of AKI episodes. The cost saving is $ 3,137 (95% CI, 1,122-4,951); the cost of HL Cardi GDP Card-Connect ($ 180, 95% CI 113-249) is more than offset by savings in hospital stay that result the main driver in cost ($ 3,222, 95% CI, 1,235-4,950). Deterministic sensitivity analysis shows that the total savings are mainly influenced by nadir haematocrit during CPB and hospital LOS/cost/per day both in ICU and in ward. CONCLUSIONS: GDP seems to improve significantly the main outcomes related to CPB surgery, when compared to TP techniques. Additional costs due to perform GDP strategy have no impact on the total cost since completely offset by the savings in hospital cost.

Keywords: Cardiopulmonary bypass; Traditional perfusion; Goal directed perfusion
Goal-Directed Perfusion vs. Traditional Perfusion

Goal-Directed Perfusion: reaching DO2 threshold

Reference: "Comparison between traditional and goal directed perfusion in cardiopulmonary by-pass. A differential cost analysis" Poster session - International Society for Pharmacoeconomics and Outcomes Research (ISPOR)
Goal-Directed Perfusion: a simulation model

- Reaching DO2 threshold
- Risk of Acute Kidney Injury (AKI) and need for Renal Replacement Therapy (RRT)
- Post-op length of stay (LOS) in ICU
- Post-op length of stay (LOS) in hospital

Goal-Directed Perfusion: impact on resources and costs

- Incidence of AKI
- Length of Stay in ICU
- Length of Stay in hospital
- GDP
  - Impact on use of resources

Goal-Directed Perfusion Impact on cost

- Connect cost
- GDP Monitor cost

Goal-Directed Perfusion: benefits

**GDP Impact on resources utilization**

- **Incidence of AKI**
  
  -10.9 p.p. in the AKI episodes

- **Length of Stay in ICU**
  
  -1.11 day in the ICU

- **Length of Stay in hospital**
  
  -3.38 days in the hospital

Goal-Directed Perfusion: detailed view on resource consumption endpoints

<table>
<thead>
<tr>
<th>Outcome [Mean (95% CI)]</th>
<th>TP strategy</th>
<th>GDP strategy</th>
<th>Delta (GDP vs. TP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DO2 target achieved (%)</td>
<td>26.9 (19.6-35.4)</td>
<td>91.4 (64.8-100.0)</td>
<td>-64.4 (-93.2--36.4)</td>
</tr>
<tr>
<td>Hospital stay (days)</td>
<td>16.15 (15.05-17.05)</td>
<td>12.77 (11.22-14.36)</td>
<td>3.38 (1.53-4.99)</td>
</tr>
<tr>
<td>ICU stay (days)</td>
<td>3.63 (3.16-4.16)</td>
<td>2.52 (2.06-3.14)</td>
<td>1.11 (0.40-1.72)</td>
</tr>
<tr>
<td>AKI episode (%)</td>
<td>24.5 (15.7-34.5)</td>
<td>13.6 (6.5-20.7)</td>
<td>10.9 (1.3-21.8)</td>
</tr>
<tr>
<td>Need for RRT (%)</td>
<td>4.2 (1.8-7.1)</td>
<td>1.7 (0.0-3.1)</td>
<td>2.5 (0.2-5.7)</td>
</tr>
<tr>
<td>Operative mortality (%)</td>
<td>3.6 (1.8-5.9)</td>
<td>2.5 (1.1-4.1)</td>
<td>1.1 (-0.2-2.7)</td>
</tr>
<tr>
<td>PRC transfused (n.)</td>
<td>2.48 (2.0-2.92)</td>
<td>2.49 (2.0-2.93)</td>
<td>0.01 (0.00-0.01)</td>
</tr>
</tbody>
</table>

Goal-Directed Perfusion: rising costs for GDP strategy

- GDP Impact on costs
- Connect cost
- GDP Monitor cost

Cost of Connect purchase (assuming a 10 yrs lifetime)

Cost per procedure

Goal-Directed Perfusion: summary of economic impact: 20% saving, over 3,100US$ in absolute terms

<table>
<thead>
<tr>
<th></th>
<th>Costs ($) [Mean (95% CI)]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TP strategy</td>
</tr>
<tr>
<td>Hospital stay</td>
<td>14,999 (10,098-18,755)</td>
</tr>
<tr>
<td>ICU stay</td>
<td>4,737 (2,773-6,772)</td>
</tr>
<tr>
<td>Renal complication</td>
<td>134 (1-340)</td>
</tr>
<tr>
<td>Transfusion</td>
<td>734 (441-1,021)</td>
</tr>
<tr>
<td>GDP monitor*</td>
<td>NA</td>
</tr>
<tr>
<td>Total cost</td>
<td>15,367 (10,985-19,670)</td>
</tr>
</tbody>
</table>

-20.4%

Deterministic sensitivity analysis: results are robust

Goal-Directed Perfusion: %saving results for other countries show model consistency cross-border
Goal-Directed Perfusion (GDP) seems to improve significantly patient outcomes in cardiac surgery with CPB, when compared to Traditional Perfusion (TP) techniques.

Savings drivers:
- Patients’ LOS in the hospital
- Cost per day in ICU and in ward
- Probability of reaching DO$_2$ threshold (nadir HCT during CPB)

Additional costs related to GDP are more than offset by the savings, resulting in a net saving for the hospital in the range of 20-25%.

Additional evidence will have to be collected:
- Transfusion impact across strategies
- Collection of real-life evidence data, both in prospective multi-center RCT (e.g., GIFT) and in retrospective propensity-score matched single-center analyses.