Cost-Effectiveness Research in Neonatology and Pediatric Critical Care between 1983-2013: A Systematic Review

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Abstract:

Introduction: In 2005, critical care costs were $81.7 billion in the United States. For an infant in the NICU, average daily costs exceed $3,500 and a single visit can cost more than $1 million.

Methods: A systematic review of the English language literature between 1980-2013 was conducted with an open-access cost-effectiveness analysis (CEA) registry, 4,007 CEA's were reviewed. Manuscripts that evaluated the cost-effectiveness of critical care interventions among neonates and pediatric patients (<18 years) were selected.

Results: Thirty-eight CEA's were included. Interventions were associated with cost savings and cost per QALY ranging from $986 to $2,500,000. Scenarios that were not cost-effective (QALY >$50,000) were often confounded by birth weight and gestational age.

Discussion: The pediatric cost-effectiveness literature is largely focused around the neonatal period. Cost-effective interventions include selective palivizumab prophylaxis, screening for retinopathy of prematurity (ROP) and surgical repair of life-threatening congenital defects.

Background:

- Critical Care Costs in the US
  - Total costs (2005): $81.7 billion
  - 13.4% of all hospital costs
  - 0.66% gross domestic product (GDP)
- Neonatal/Pediatric ICU Costs
  - Daily cost per bed: $3,500
  - H-CLP KID registry (long-term NICU stays)
- Average patient weight: 1470 g (SD 112 g) at birth
  - Average length of stay: 228 days
  - Average cost per stay: $703,356 (SD $19,846)
- Improved survival rates of extremely low-birth weight (ELBW) neonates (<1,000 g)
  - 41% of NICU stays >6 months
- Utilization of high-cost interventions
  - Extracorporeal membrane oxygenation (ECMO)
  - Palivizumab
  - Inhaled nitric oxide
- What is an acceptable cost for care?
  - 50,000 per quality-adjusted life-year (QALY) or life-year (LY); £30,000 in UK Pounds
- Less consensus on international standard in Pediatrics

Methods:

- 4,007 original CEA's published between 1980-2013 reviewed
- Maintained in open-access cost analysis registry
- Two reviewers with advanced training selected critical care interventions/treatments
- QALY/LY ratios summarized by intervention category in 2015 USD and USD value in year of analysis for comparison

Results:

- Thirty-eight CEA's identified
- Treatment categories included: general NICU care, cardiac and respiratory failure and Palivizumab prophylaxis
- >80 cost-effectiveness ratios
- Cost-saving/Dominant interventions:
  - Prophylactic intravenous, NICU vaccination booster campaign, ECMO for respiratory failure
- Cost-effective interventions:
  - Surgical repair of life-threatening congenital defects, selective Palivizumab use, ECMO for bridge to transplant
- Dominated interventions (increased cost with worse outcomes): Universal vs. selective resuscitation of neonates born at 20-23 6/7 weeks
- Majority of results based upon Markov/Monte Carlo outcomes simulations with registry/clinical trial data

Conclusions:

- Unexpected interventions, such as ECMO, found to be cost-effective or cost saving
- Additional research needed to verify clinical effectiveness of several interventions (i.e. inhaled Nitric Oxide by gestational age)
- Reliance on outcomes models noted; should be followed up with clinical trial if model demonstrates that the intervention is cost-effective
- Literature volume inadequate given the rising cost of critical care and rapid development of new interventions

References:


Figure 1. PRISMA diagram detailing manuscript selection process

Table 1. Summary of CEA results

<table>
<thead>
<tr>
<th>Study, year, cost</th>
<th>Intervention</th>
<th>Cost/QALY ($ USD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=308</td>
<td>Palivizumab prophylaxis for NICU infants</td>
<td>$350,000</td>
</tr>
<tr>
<td>N=308</td>
<td>Palivizumab prophylaxis for NEU workers</td>
<td>$250,000</td>
</tr>
<tr>
<td>N=308</td>
<td>Palivizumab prophylaxis for neonates &lt;12 weeks gestational age</td>
<td>$300,000</td>
</tr>
</tbody>
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- Palivizumab prophylaxis for NICU infants dominated, but remains cost-effective by 2015 USD
- Palivizumab prophylaxis for NEU workers remains cost-effective by 2015 USD
- Palivizumab prophylaxis for neonates <12 weeks gestational age remains cost-effective by 2015 USD

Manuscripts excluded:

- (n=3,966)
- (n=4,007)