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LITERATURE REVIEW ON HOSPITAL COSTS FOR PATIENTS UNDERGOING COLECTOMY

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Background
- Colectomy is a surgical procedure to remove all or part of the colon.
- In an open colectomy, one long incision is made in the wall of the abdomen and doctors can see the colon directly. In a laparoscopic-assisted colectomy, several small incisions are made and a thin, lighted tube attached to a video camera is inserted through one opening to guide the surgery. Surgical instruments are inserted through the other openings to perform the surgery.
- The clinical benefits of laparoscopy have been demonstrated including decreased complications and mortality. A dramatic increase in the rate of laparoscopic partial colectomy from 2% in 1996 to 31% in 2009.
- The impact of increasing use of laparoscopy on hospital costs across countries have not been thoroughly investigated.
- Most published studies comparing the costs of laparoscopic vs open procedures were conducted only within respective countries.

Objective
- This study aims to identify the range of direct hospital costs associated with a minimally invasive or open colectomy procedure across different countries.

Methods
- A PubMed search was performed using the keywords (Colectomy[MeSH] AND (Cost OR economics) AND [laparoscopic OR open]) NOT (robot) with results limited to publications of human subject studies in English.
- Studies comparing minimally invasive surgical techniques (laparoscopic or laparoscopic-assisted) to open surgical techniques were selected and studies of comparisons other than minimally invasive versus open procedures (e.g. robotic) were excluded.
- All abstracts were filtered, including meta-analysis, RCTs and observational studies excluding case studies.
- Key data abstracted: Country, year, setting, type of study, cost calculation method, approach, OR costs per minute and total direct cost reported.
- Operating room (OR) cost include OR time and equipment cost. Some studies may also include anesthesia cost and do not have the granularity to be teased out.
- We derived the unit cost for OR by dividing the OR cost over the mean OR time (minutes) and the unit total cost by dividing the total cost reported over the mean length of stay (days) reported in each study.
- All cost values were adjusted for inflation and reported as 2016 U.S. dollars.

Results
- Table 1. Selected Study Characteristics, Design, Cost and Cost Analysis Methodologies

<table>
<thead>
<tr>
<th>Citation/Year</th>
<th>Country/Setting</th>
<th>Type of Study</th>
<th>Cost Calculation Methodology</th>
<th>Approach</th>
<th>OR Cost (per Min)</th>
<th>Total Direct Cost Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>De Moya et al., 2007</td>
<td>Australia</td>
<td>Single Center</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 14.3</td>
<td>$ 68,000</td>
</tr>
<tr>
<td>Hinojosa et al., 2007</td>
<td>USA</td>
<td>National Database</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 19.2</td>
<td>$ 47,900</td>
</tr>
<tr>
<td>Delaney et al., 2008</td>
<td>USA</td>
<td>National Database</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 12.6</td>
<td>$ 15,100</td>
</tr>
<tr>
<td>Crawford et al., 2015</td>
<td>USA</td>
<td>National Database</td>
<td>Top-down (Payment)</td>
<td>Laparoscopic</td>
<td>$ 24,100</td>
<td></td>
</tr>
<tr>
<td>Aoki et al., 2016</td>
<td>Japan</td>
<td>National Database</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 43,700</td>
<td></td>
</tr>
<tr>
<td>Hardy et al., 2014</td>
<td>Canada</td>
<td>Single Center</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 43,000</td>
<td></td>
</tr>
<tr>
<td>Franks et al., 2006</td>
<td>UK</td>
<td>Multi-Center</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 14,600</td>
<td></td>
</tr>
<tr>
<td>Noblett et al., 2007</td>
<td>UK</td>
<td>Single Center</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 10,900</td>
<td></td>
</tr>
<tr>
<td>Bertini et al., 2011</td>
<td>Italy</td>
<td>Single Center</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 15,900</td>
<td></td>
</tr>
<tr>
<td>Jhrich et al., 2015</td>
<td>France</td>
<td>Single Center</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 20,000</td>
<td></td>
</tr>
<tr>
<td>Liu et al., 2012</td>
<td>China</td>
<td>Single Center</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 22,000</td>
<td></td>
</tr>
<tr>
<td>Peng et al., 2012</td>
<td>China</td>
<td>Single Center</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 5,950</td>
<td></td>
</tr>
<tr>
<td>Liang et al., 2006</td>
<td>Taiwan</td>
<td>Single Center</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 2,200</td>
<td></td>
</tr>
<tr>
<td>Shabbir et al., 2009</td>
<td>Singapore</td>
<td>Single Center</td>
<td>Top-down (Cost)</td>
<td>Laparoscopic</td>
<td>$ 4,870</td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Average Total Direct Cost Reported per Day

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost Calculation Methodology</th>
<th>OR Cost (per Min)</th>
<th>Total Direct Cost Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laparoscopic</td>
<td>$ 12.6</td>
<td>$ 15,100</td>
<td></td>
</tr>
<tr>
<td>Open</td>
<td>$ 14.6</td>
<td>$ 22,000</td>
<td></td>
</tr>
</tbody>
</table>

Conclusion
- Open procedures seem to result in lower hospital costs across studies conducted in several regions, which is consistent with the cost analysis of a recent meta-analysis. Asian-Pacific countries have reported lower direct hospital costs. Costs calculations are challenging even for common surgical procedures due to different costing methodologies and categories. A standardized costing methodology guideline is warranted and may shed light on the future considerations of reimbursement strategies.

References
- Remzi et al., 2010. Laparoscopic versus open colectomy for patients with American Society of Anesthesiology (ASA) classifications 3 and 4: the minimally invasive approach in invasive or open colectomy procedure across different countries.

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