Robotics In Surgery
Is It Worth The Investment?
Robots in Surgery

- Definition
- Surgical assisting devices
- Surgeon-computer-instrument interface
- Minimally invasive surgery
Da Vinci surgical system

- NASA Ames research centre - space surgery
- DARPA – battlefield surgery
- 1994 – first robotic operation – intestinal anastomosis
Da Vinci surgical system

• 1994 - Intuitive Surgical
• 1997 – First robotic procedure: cholecystectomy
• 2000 – 200 patient trial
• 2005 - 350 units sold
• 2006 – 70,000 operations done
A matter of cost

- €1,000,000 initial cost
- €110,000 maintenance cost per annum
- Can the benefits of robotic surgery pay for its costs?
Methods

• Cost benefit analysis
• Da Vinci
• For individual surgical procedures
• Cholecystectomies, adrenalectomies, gastric bypass surgery, cardiac bypass grafting, prostatectomies etc.
Methods

• Comparison against traditional open surgery and standard minimally invasive surgery
• Hospital stay, operation time, cost of equipment
• Pubmed and Google Scholar
• Nissen fundoplication and Radical retropubic prostatectomy
Results: Initial Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost (Euro)</th>
</tr>
</thead>
<tbody>
<tr>
<td>da Vinci™ system including</td>
<td>956,550</td>
</tr>
<tr>
<td>• Surgeon console</td>
<td></td>
</tr>
<tr>
<td>• Surgical cart housing robotic arms</td>
<td></td>
</tr>
<tr>
<td>• 3-D digital camera</td>
<td></td>
</tr>
<tr>
<td>• Installation and testing</td>
<td></td>
</tr>
<tr>
<td>Endoscopes</td>
<td>16,500</td>
</tr>
<tr>
<td>• 0° endoscope</td>
<td>16,500</td>
</tr>
<tr>
<td>• 30° endoscope</td>
<td></td>
</tr>
<tr>
<td>Sony 20’ monitor</td>
<td>3,800</td>
</tr>
<tr>
<td>Starter set of multispecialty training</td>
<td>11,815</td>
</tr>
<tr>
<td>instruments</td>
<td></td>
</tr>
<tr>
<td>Starter set of accessories and disposables</td>
<td>16,645</td>
</tr>
<tr>
<td>Delivery cost</td>
<td>10,000</td>
</tr>
<tr>
<td>TOTAL</td>
<td>1,031,810</td>
</tr>
</tbody>
</table>

- Initial purchase cost - €1,031,810
- €737 per procedure
Results: Maintenance costs

- Maintenance costs
- €110,000 per year
- €550 per procedure
Theatre, hospital, and convalescence costs

- Theatre cost, €100.90 per hour
- Hospital stay cost, €432 per day
- Time away from work, €83 per day
# Nissen Fundoplication

<table>
<thead>
<tr>
<th>Item (average values)</th>
<th>Open method</th>
<th>Standard minimally-invasive surgery</th>
<th>Robotic surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time</td>
<td>0.8 hours (50 minutes)</td>
<td>1.0 hours (60 minutes)</td>
<td>1.8 hours (107 minutes)</td>
</tr>
<tr>
<td>Hospital stay time</td>
<td>6.1 days</td>
<td>2.2 days</td>
<td>2.2 days</td>
</tr>
<tr>
<td>Convalescence time</td>
<td>35 days</td>
<td>12 days</td>
<td>12 days</td>
</tr>
<tr>
<td>Disposable equipment costs</td>
<td>Not Applicable*</td>
<td>€1006</td>
<td>€1558</td>
</tr>
</tbody>
</table>


Nissen Fundoplication

- Versus open surgery
- Shorter hospital stay, shorter time to return to work
- Longer operating time, cost of disposable equipment, cost of maintenance, cost of initial purchase
- Cost savings of €647.90 per procedure
Nissen Fundoplication

• Versus standard minimally invasive surgery
• No cost benefit
• Longer operating time, cost of disposable equipment, cost of maintenance, cost of initial purchase
• Increased cost of €1919.70 per procedure
## Radical retropubic prostatectomy

<table>
<thead>
<tr>
<th>Item (average values)</th>
<th>Open method</th>
<th>Standard minimally-invasive surgery</th>
<th>Robotic surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operative time</td>
<td>2.7 hours (163 minutes)</td>
<td>4.1 hours (246 minutes)</td>
<td>2.5 hours (148 minutes)</td>
</tr>
<tr>
<td>Hospital stay time</td>
<td>3.5 days</td>
<td>1.3 days</td>
<td>1.2 days</td>
</tr>
<tr>
<td>Convalescence time</td>
<td>47 days</td>
<td>47 days</td>
<td>30 days</td>
</tr>
<tr>
<td>Disposable equipment costs</td>
<td>€75</td>
<td>€533</td>
<td>€1705</td>
</tr>
</tbody>
</table>


Radical retropubic prostatectomy

• Versus open surgery
• Shorter operating time, shorter hospital stay, shorter time to return to work
• Cost of disposable equipment, cost of maintenance, cost of initial purchase
• Cost savings of €492.20 per procedure
Radical retropubic prostatectomy

- Versus standard minimally invasive surgery
- Shorter operating time, shorter hospital stay, shorter time to return to work
- Cost of disposable equipment, cost of maintenance, cost of initial purchase
- Increased cost of €843.40 per procedure
Discussion

- Cost effective compared to open surgery
- Expensive new technology
- Potential for major improvements
Conclusions

• Should the CUH buy a da Vinci surgical robot?
• Probably not advisable
• Current prices are prohibitive but the technology has tremendous potential