Quantifying the Impact

Clinical economics references from leading thoracic surgeons
About clinical benefits and costs

From a hospital perspective, clinical benefits may result in the potential cost reductions noted below; however, these clinical benefits and costs may vary per hospital and be higher or lower than mentioned during this presentation.

This data comparison is not casematched for patient complexity and/or disease status and may not be comparable across these surgical modalities.

Individuals' outcomes may depend on a number of factors, including but not limited to patient characteristics, disease characteristics, and/or surgeon experience.

Cost estimates seen here have been independently generated by Intuitive. using cost modeling methodology based on national averages and have not been published or peer-reviewed. Cost calculations include intraoperative instrument and accessory costs. Costs related to da Vinci® system acquisition, yearly service costs and other intraoperative and post-operative hospital costs are not included/considered.
About clinical benefits and costs

When considering cost-effectiveness of an advanced technology like the da Vinci system, we recommend that hospitals perform a full cost-benefit analysis, considering not just the operating room costs but the costs associated with hospital stays, procedure-related complications and hospital re-admissions.

In order to provide benefit and risk information, Intuitive reviews the highest available level of evidence on representative da Vinci procedures. Intuitive strives to provide a complete, fair and balanced view of the clinical literature. However, a quoted article may not be reflective of the broader literature and our materials should not be seen as a substitute for a comprehensive literature review for inclusion of all potential outcomes. We encourage patients and physicians to review the original publications and all available literature in order to make an informed decision. Clinical studies are available at pubmed.gov.
Lobectomy

Mark Dylewski, MD
South Miami Hospital
Miami, FL

G. Kimble Jett, MD
The Heart Hospital Baylor Plano
Plano, TX

Samuel Kim, MD
Banner – University Medical Center Tucson
Tucson, AZ

Baiya Krishnadasan, MD
St. Joseph Medical Center
Towson, MD

Dao Nguyen, MD
University of Miami
Miami, FL

Walter Scott, MD
Albany Medical Center
Albany, NY

Roy Williams, MD
Mount Sinai Medical Center
Miami Beach, FL

James Wudel, MD
Wake Forest Baptist Medical Center
Winston-Salem, NC
Surgeon Profile

Mark Dylewski, MD
South Miami Hospital
Miami, FL

Da Vinci® System Training
2006

Residency
University of California Medical Center, Davis (General)
Albany Medical College, New York (General Surgery)
Fellowship: Albany Medical College, New York (Thoracic)

Memberships
Cardiothoracic Surgery Network (CTSNet)
General Thoracic Surgical Club (GTSC)
Southern Thoracic Surgical Association (STSA)
Society of Thoracic Surgeons (STS)
Background Information
Published results of Mark Dylewski, MD vs. published results

Study Design
- Retrospective, 4-year (from 2006-2010) review of robotic-assisted lung resections for 200 consecutive patients.

Patient Population
- Patients with peripherally located pulmonary nodules clinically suspicious for malignant disease, isolated pulmonary metastasis, clinically resectable NSCLC, and other pathologic tumors

Analysis
- Review of results and complications for total endoscopic robotic-assisted lung resections

Study Limitations
- No comparison to open or video-assisted thoracoscopic approaches
- Single institution review

Outcomes/Results
Robotic video-assisted pulmonary resection was accomplished in 197 of 200 patients. A total of 154 patients underwent lobectomy; 4 patients required bilobectomy, and 35 patients underwent segmentectomy. Three patients underwent a sleeve lobectomy, and 3 patients had an en-bloc resection with lobectomy. One patient received a left pneumonectomy.

Values are n (range/%)
- OR time, mean/median: 180 / 175 min (82-370)
- Length of ICU stay, median: 0 days (0-15)
- Length of hospital stay, median: 3 days (1-44)
- Conversion for difficulty: 2 (1.0)
- Conversion for bleeding: 1 (0.5)
- Transfusion for bleeding: 2 (1.0)
Study Design

- A retrospective, database study with the objective of providing a comparative analysis of perioperative clinical outcomes from elective robotic-assisted lobectomy (RL), VATS lobectomy (VL), and open lobectomy (OL).

Patient Population

- The Premier Healthcare Database was analyzed for lobectomies performed from January 1, 2011 to September 30, 2015. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes were used to identify surgical approaches (RL, VL, and OL), complications, and conversions to OL.

Outcomes Measured / Evaluated

- Peri-operative complications, conversion to open, length of stay, peri-operative blood transfusions, discharge status. Propensity score matching (1:1) for patient and hospital characteristics allowed comparison of RL versus OL (n = 2,775 each) and RL versus VL (n = 2,951 each).

  - The following covariates were used for matching: patient characteristics—age, sex, race, Elixhauser comorbidity score, and type of malignancy; and hospital characteristics—payor type, census region, hospital size (number of beds), type of hospital facility (academic or community), and location of the facility (urban or rural).

Results / Conclusions

- Postoperatively and at 30 days when compared to VL and OL. RL was associated with a reduced LOS when compared to VL and OL.

  - Patients in the RL group were more likely to be discharged home than to a transitional health care facility, when compared to VL and OL.

  - RL had fewer conversions when compared to VATs lobectomy.

  - RL had a lower in-hospital and 30-day mortality when compared to OL.

Study Limitations

- Oncologic data, such as size of the tumor, stage, recurrence, and survival, could not be extracted from the Premier Healthcare Database. As anticipated in any large administrative database, there is potential for coding errors.
Clinical Outcomes and Estimated Cost Savings
Published results of Mark Dylewski, MD vs. published results

<table>
<thead>
<tr>
<th>Clinical Outcomes</th>
<th>Open (n=2,775)</th>
<th>VATS (n=2,951)</th>
<th>Da Vinci (n=200)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Stay</td>
<td>3.0</td>
<td>6.0</td>
<td>7.0</td>
</tr>
<tr>
<td>(days)</td>
<td>$1,475 (per bed day)(^a)</td>
<td>$1,116 (per transfusion)(^b)</td>
<td>$2,060 (per conversion)(^c)</td>
</tr>
<tr>
<td>In-hospital Transfusions</td>
<td>1.0</td>
<td>6.9</td>
<td>9.8</td>
</tr>
<tr>
<td>(percentage)</td>
<td>$1,475 (per bed day)(^a)</td>
<td>$1,116 (per transfusion)(^b)</td>
<td>$2,060 (per conversion)(^c)</td>
</tr>
<tr>
<td>Conversions</td>
<td>1.5</td>
<td>N/A</td>
<td>13.1</td>
</tr>
<tr>
<td>(percentage)</td>
<td>$1,475 (per bed day)(^a)</td>
<td>$1,116 (per transfusion)(^b)</td>
<td>$2,060 (per conversion)(^c)</td>
</tr>
<tr>
<td>In-hospital Complications</td>
<td>26.0</td>
<td>38.7</td>
<td>44.0</td>
</tr>
<tr>
<td>(percentage)</td>
<td>$1,475 (per bed day)(^a)</td>
<td>$1,116 (per transfusion)(^b)</td>
<td>$2,060 (per conversion)(^c)</td>
</tr>
<tr>
<td>O.R. Time</td>
<td>175</td>
<td>248</td>
<td>235</td>
</tr>
<tr>
<td>(minutes)</td>
<td>$21 (per minute)(^d)</td>
<td>$23,322 (per complication)(^e)</td>
<td>$21 (per minute)(^d)</td>
</tr>
</tbody>
</table>

Estimated Potential Savings per Procedure
$11,456 vs Open $9,225 vs VATS

Data presented for robotic-assisted surgery reflect a single surgeon experience that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Cost estimates have been independently generated by Intuitive using cost modeling methodology based on national averages and have not been published or peer-reviewed. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and post-operative hospital costs are not included/considered.

Surgeon Profile

G. Kimble Jett, MD
The Heart Hospital Baylor Plano
Plano, TX

Da Vinci® System Training
2011

IDN System
Baylor Scott and White Health

Residency
Massachusetts General Hospital (General)
Emory University (Thoracic)
National Heart Institute, NIH (Cardiac)

Memberships
Society of Thoracic Surgeons (STS)
Background Information

Clinical Outcomes and Estimated Cost Savings

G. Kimble Jett, MD: single-surgeon unpublished vs. published results

**Design**
- Unmatched comparison of surgeon provided data (for da Vinci RAS) and published results

**Patient Population**
- Surgeon’s patients who had lobectomy procedures

**Outcomes Measured / Evaluated**
- Length of stay
- In-hospital transfusions
- In-hospital complications
- OR time

**Results / Conclusions**
- Results were provided by surgeon
- Length of stay: 2.7 days
- In-hospital transfusions: 3.0%
- In-hospital complications: 14.0%
- OR time: 167 minutes

**Cost Methodology**
- Cost savings from da Vinci RAS vs. other modality = (∆ LOS days x LOS cost) + (∆ OR Time min x OR cost) + (∆ Transfusions% x Transfusions cost) + (∆ Conversion% x Conversions cost) + (∆ Complication% x Complications cost) + (∆ Readmission% x Readmissions cost)

- Cost estimates have been independently generated by Intuitive Surgical using cost modeling methodology based on national averages and have not been published or peer-reviewed.

**Limitations**
- Data presented reflect a single surgeon experience (data is not collected under formalized study, DATA IS NOT PEER REVIEWED AND NOT PUBLISHED) that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Cost estimates have been independently generated by Intuitive using cost modeling methodology based on national averages and have not been published or peer-reviewed. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and postoperative hospital costs are not included/considered.
Study Information

Lobectomy: published results for comparison with surgeon’s unpublished experience

Study Design
- A retrospective, database study with the objective of providing a comparative analysis of perioperative clinical outcomes from elective robotic-assisted lobectomy (RL), VATS lobectomy (VL), and open lobectomy (OL).

Patient Population
- The Premier Healthcare Database was analyzed for lobectomies performed from January 1, 2011 to September 30, 2015. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes were used to identify surgical approaches (RL, VL, and OL), complications, and conversions to OL.

Outcomes Measured / Evaluated
- Peri-operative complications, conversion to open, length of stay, peri-operative blood transfusions, discharge status. Propensity score matching (1:1) for patient and hospital characteristics allowed comparison of RL versus OL (n = 2,775 each) and RL versus VL (n = 2,951 each).

Study Limitations
- Oncologic data, such as size of the tumor, stage, recurrence, and survival, could not be extracted from the Premier Healthcare Database. As anticipated in any large administrative database, there is potential for coding errors.
Clinical Outcomes and Estimated Cost Savings
G. Kimble Jett, MD: single-surgeon unpublished vs. published results

Estimated Potential Savings per Procedure
$14,843 vs Open  $12,373 vs VATS

Data presented reflect a single center experience (data is not collected under formalized study, DATA IS NOT PEER REVIEWED AND NOT PUBLISHED) that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Cost estimates have been independently generated by Intuitive using cost modeling methodology based on national averages and have not been published or peer-reviewed. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and post-operative hospital costs are not included/considered.

Surgeon Profile

Samuel Kim, MD
Banner – University Medical Center Tucson
Tucson, AZ

Da Vinci® System Training
2012

Residency
Hospital of the University of Pennsylvania (General)
Massachusetts General Hospital (Cardiothoracic)

Memberships
Cardiothoracic Surgery Network (CTSNet)
Society of Thoracic Surgeons (STS)
Western Thoracic Surgical Association (WTSA)
Background Information
Samuel Kim, MD: A single surgeon’s unpublished experience

Design
• Surgeon provided data for all cohorts

Patient Population
• Surgeon’s patients who had lobectomy procedures

Outcomes Measured / Evaluated
• Length of stay
• Blood transfusions
• Conversions
• OR time

Results / Conclusions
• Results were provided by surgeon
• Length of stay:
  • Da Vinci: 3.2 days
  • VATS: 4.6 days
  • Open: 6.8 days
• Blood transfusions:
  • Da Vinci: 0.0%
  • VATS: 5.0%
  • Open: 2.0%
• Conversions:
  • Da Vinci: 1.0%
  • VATS: 7.0%
  • Open: N/A
• OR time:
  • Da Vinci: 106 minutes
  • VATS: 138 minutes
  • Open: 205 minutes

Cost Methodology
• Cost savings from da Vinci RAS vs. other modality = (Δ LOS days x LOS cost) + (Δ OR Time min x OR cost) + (Δ Transfusions% x Transfusions cost) + (Δ Conversion% x Conversions cost) + (Δ Complication% x Complications cost) + (Δ Readmission% x Readmissions cost)

Limitations
Data presented reflect a single surgeon experience (data is not collected under formalized study, DATA IS NOT PEER REVIEWED AND NOT PUBLISHED) that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Cost estimates have been independently generated by Intuitive using cost modeling methodology based on national averages and have not been published or peer-reviewed. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and postoperative hospital costs are not included/considered.
Clinical Outcomes and Estimated Cost Savings
Samuel Kim, MD: a single surgeon’s unpublished experience

Estimated Potential Savings per Procedure
$7,411 vs Open  $2,916 vs VATS

All cases represent the surgeon’s own data.

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Surgeon Profile

Baiya Krishnadasan, MD
St. Joseph Medical Center
Townson, MD

Da Vinci® System Training
2009

Residency
University of Washington, Seattle (General)
Research Fellowship, Cardiothoracic Surgery
University of Washington, Seattle (Thoracic)

Memberships
Cardiothoracic Surgery Network (CTSNet)
General Thoracic Surgical Club (GTSC)
Society of Thoracic Surgeons (STS)
Western Thoracic Surgical Association (WTSA)
Background Information

Clinical Outcomes and Estimated Cost Savings
Baiya Krishnadasan, MD: single-surgeon unpublished vs. published results

Design
• Unmatched comparison of surgeon provided data (for da Vinci RAS) with published results

Patient Population
• Surgeon’s patients who had lobectomy procedures (Jan 2009 – Oct 2018)

Outcomes Measured / Evaluated
• Length of stay
• OR time
• In-hospital blood transfusions
• Major complications
• In-hospital mortality

Results / Conclusions
• Surgeon provided summary data for da Vinci Si (N=325) and da Vinci Xi (N=89) separately. Results for the total data set (N=414) were combined using the methodology below.

  • Mean LOS (days)=(2.5 days x 325 + 2.3 days x 89) / 414= 2.5 days
  • OR time (min)=(137 min x 325 + 131 min x 89) / 414= 136 min
  • Transfusions = (0.9% x 325 + 1) / 414 = 1%
  • Mortality = (0.6% x 325 + 0) / 414 = 0.5%

Methodology
• Cost savings from da Vinci RAS vs. other modality = (∆ LOS days x LOS cost) + (∆ OR Time min x OR cost) + (∆ Transfusions% x Transfusions cost)
• No cost is calculated for mortality.
• Cost estimates have been independently generated by Intuitive using cost modeling methodology based on national averages and have not been published or peer-reviewed.

Limitations
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Study Information

Lobectomy: published results for comparison with surgeon’s unpublished experience


Study Design
- A retrospective, database study with the objective of providing a comparative analysis of perioperative clinical outcomes from elective robotic-assisted lobectomy (RL), VATS lobectomy (VL), and open lobectomy (OL).

Patient Population
- The Premier Healthcare Database was analyzed for lobectomies performed from January 1, 2011 to September 30, 2015. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes were used to identify surgical approaches (RL, VL, and OL), complications, and conversions to OL.

Outcomes Measured / Evaluated
- Peri-operative complications, conversion to open, length of stay, peri-operative blood transfusions, discharge status. Propensity score matching (1:1) for patient and hospital characteristics allowed comparison of RL versus OL (n = 2,775 each) and RL versus VL (n = 2,951 each).
- The following covariates were used for matching: patient characteristics—age, sex, race, Elixhauser comorbidity score, and type of malignancy; and hospital characteristics—payor type, census region, hospital size (number of beds), type of hospital facility (academic or community), and location of the facility (urban or rural).

Results / Conclusions
- Postoperatively and at 30 days when compared to VL and OL. RL was associated with a reduced LOS when compared to VL and OL.
- Patients in the RL group were more likely to be discharged home than to a transitional health care facility, when compared to VL and OL.
- RL had fewer conversions when compared to VATs lobectomy.
- RL had a lower in-hospital and 30-day mortality when compared to OL.

Study Limitations
- Oncologic data, such as size of the tumor, stage, recurrence, and survival, could not be extracted from the Premier Healthcare Database. As anticipated in any large administrative database, there is potential for coding errors.
Clinical outcomes and estimated cost savings
Baiya Krishnadasan, MD: single-surgeon unpublished vs. published results

Note: Comparisons were made among unmatched patient populations.
*Dr. Baiya Krishnadasan provided data (Jan 2009 – Oct 2018)
Individuals’ outcomes may depend on a number of factors, including but not limited to patient characteristics, disease characteristics, and/or surgeon experience.
Data presented reflect a single center experience (data is not collected under formalized study, DATA IS NOT PEER REVIEWED AND NOT PUBLISHED) that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Cost estimates have been independently generated by Intuitive using cost modeling methodology based on national averages and have not been published or peer-reviewed. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and post-operative hospital costs are not included/considered.

Estimated Cost Savings
$7,642 vs VATS $8,891 vs open

<table>
<thead>
<tr>
<th>Cost</th>
<th>VATS (n=2,951)²</th>
<th>Open (n=2,775)²</th>
<th>Dr. Baiya Krishnadasan 2009 - 10/2018 Lobectomy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of stay (Mean days)</td>
<td>7.0</td>
<td>6.0</td>
<td>2.5</td>
</tr>
<tr>
<td>O.R. time (min)</td>
<td>235</td>
<td>248</td>
<td>136</td>
</tr>
<tr>
<td>In-hospital transfusions (%)</td>
<td>9.8</td>
<td>6.9</td>
<td>1.0</td>
</tr>
<tr>
<td>In-hospital mortality (%)</td>
<td>1.7</td>
<td>1.2</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Cost:
$1,475 (per bed day)*
$21 (per minute)b
$1,116 (per transfusion)c

Note: Comparisons were made among unmatched patient populations.
*Dr. Baiya Krishnadasan provided data (Jan 2009 – Oct 2018)
Individuals’ outcomes may depend on a number of factors, including but not limited to patient characteristics, disease characteristics, and/or surgeon experience.
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Dao Nguyen, MD, FACS
University of Miami
Miami, FL

Da Vinci® System Training
2012

Residency
McGill University (General)
McGill University (Cardiothoracic)
Fellowship: MD Anderson Cancer Center Thoracic Oncology

Memberships
American Association of Thoracic Surgery (AATS)
Cardiothoracic Surgery Network (CTSNet)
General Thoracic Surgical Club (GTSC)
Society of Thoracic Surgeons (STS)
Background Information
Clinical Outcomes and Estimated Cost Savings
Dao Nguyen, MD: single-surgeon unpublished vs. published results

Design
• Unmatched comparison of surgeon provided data (for da Vinci RAS) and published results

Patient Population
• Surgeon’s patients who had lobectomy procedures

Outcomes Measured / Evaluated
• Length of stay
• Blood transfusions
• Complications
• OR time

Results / Conclusions
• Results were provided by surgeon
• Length of stay: 3.2 days
• Blood transfusions: 1.0%
• Complications: 23.0%
• OR time: 228 minutes

Cost Methodology
• Cost savings from da Vinci RAS vs. other modality = (Δ LOS days x LOS cost) + (Δ OR Time min x OR cost) + (Δ Transfusions% x Transfusions cost) + (Δ Conversion% x Conversions cost) + (Δ Complication% x Complications cost) + (Δ Readmission% x Readmissions cost)

Limitations
Data presented reflect a single surgeon experience (data is not collected under formalized study, DATA IS NOT PEER REVIEWED AND NOT PUBLISHED) that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Cost estimates have been independently generated by Intuitive Surgical using cost modeling methodology based on national averages and have not been published or peer-reviewed. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and postoperative hospital costs are not included/considered.
Study Information

Lobectomy: published results for comparison with surgeon’s unpublished experience


Study Design

- A retrospective, database study with the objective of providing a comparative analysis of perioperative clinical outcomes from elective robotic-assisted lobectomy (RL), VATS lobectomy (VL), and open lobectomy (OL).

Patient Population

- The Premier Healthcare Database was analyzed for lobectomies performed from January 1, 2011 to September 30, 2015. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes were used to identify surgical approaches (RL, VL, and OL), complications, and conversions to OL.

Outcomes Measured / Evaluated

- Peri-operative complications, conversion to open, length of stay, peri-operative blood transfusions, discharge status.

Propensity score matching (1:1) for patient and hospital characteristics allowed comparison of RL versus OL (n = 2,775 each) and RL versus VL (n = 2,951 each).

- The following covariates were used for matching: patient characteristics—age, sex, race, Elixhauser comorbidity score, and type of malignancy; and hospital characteristics—payor type, census region, hospital size (number of beds), type of hospital facility (academic or community), and location of the facility (urban or rural).

Results / Conclusions

- Postoperatively and at 30 days when compared to VL and OL. RL was associated with a reduced LOS when compared to VL and OL.

- Patients in the RL group were more likely to be discharged home than to a transitional health care facility, when compared to VL and OL.

- RL had fewer conversions when compared to VATs lobectomy.

- RL had a lower in-hospital and 30-day mortality when compared to OL.

Study Limitations

- Oncologic data, such as size of the tumor, stage, recurrence, and survival, could not be extracted from the Premier Healthcare Database. As anticipated in any large administrative database, there is potential for coding errors.
Clinical Outcomes and Estimated Cost Savings
Dao Nguyen, MD, FACS: single-surgeon unpublished vs. published results

Data presented for robotic-assisted surgery reflect a single surgeon experience that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and post-operative hospital costs are not included/considered.

Surgeon Profile

Walter Scott, MD
Albany Medical Center
Albany, NY

Da Vinci® System Training
2002

Residency
University of North Carolina, Chapel Hill (General)
University of Utah (Cardiothoracic)

Memberships
Cardiothoracic Surgery Network (CTSNet)
Eastern Cardiothoracic Surgical Society (ECTSS)
General Thoracic Surgical Club (GTSC)
Southern Thoracic Surgical Association (STSA)
Society of Thoracic Surgeons (STS)
Background Information

Clinical Outcomes and Estimated Cost Savings
Walter Scott, MD: single-surgeon unpublished vs. published results

Design
- Unmatched comparison of surgeon provided data (for da Vinci RAS) and published results

Patient Population
- Surgeon’s patients who had lobectomy procedures

Outcomes Measured / Evaluated
- Length of stay
- Complications
- OR time

Results / Conclusions
- Results were provided by surgeon
- Length of stay: 4.0 days
- Complications: 37.9%
- OR time: 157 minutes

Cost Methodology
- Cost savings from da Vinci RAS vs. other modality = (Δ LOS days × LOS cost) + (Δ OR Time min × OR cost) + (Δ Transfusions% × Transfusions cost) + (Δ Conversion% × Conversions cost) + (Δ Complication% × Complications cost) + (Δ Readmission% × Readmissions cost)

Limitations
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Lobectomy: published results for comparison with surgeon’s unpublished experience


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Patient Population
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Results / Conclusions
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• Patients in the RL group were more likely to be discharged home than to a transitional health care facility, when compared to VL and OL.
• RL had fewer conversions when compared to VATs lobectomy.
• RL had a lower in-hospital and 30-day mortality when compared to OL.

Study Limitations
• Oncologic data, such as size of the tumor, stage, recurrence, and survival, could not be extracted from the Premier Healthcare Database. As anticipated in any large administrative database, there is potential for coding errors.
Clinical Outcomes and Estimated Cost Savings
Walter Scott, MD: single-surgeon unpublished vs. published results

<table>
<thead>
<tr>
<th></th>
<th>Da Vinci (n=29)</th>
<th>VATS (n=2,951)</th>
<th>Open (n=2,775)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of Stay (days)</td>
<td>4.0</td>
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<td>7.0</td>
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<tr>
<td>In-hospital Complications (percentage)</td>
<td>37.9</td>
<td>38.7</td>
<td>44.0</td>
</tr>
<tr>
<td>O.R. Time (minutes)</td>
<td>157</td>
<td>248</td>
<td>235</td>
</tr>
</tbody>
</table>

Estimated Potential Savings per Procedure
$7,486 vs Open  $5,048 vs VATS

Data presented for robotic-assisted surgery reflect a single surgeon experience that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Cost estimates have been independently generated by Intuitive using cost modeling methodology based on national averages and have not been published or peer-reviewed. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and post-operative hospital costs are not included/considered.

Surgeon Profile

**Roy Williams, MD**
Mount Sinai Medical Center
Miami Beach, FL

**Da Vinci® System Training**
2002

**Residency**
SUNY Health Science Center at Brooklyn (General)
Fellowship: SUNY Health Science Center at Brooklyn (Thoracic)

**Memberships**
American College of Surgeons (ACS)
Background Information

Clinical Outcomes and Estimated Cost Savings
Roy Williams, MD: single-surgeon unpublished vs. published results

Cost Methodology
• Cost savings from da Vinci RAS vs. other modality = (∆ LOS days x LOS cost) + (∆ OR Time min x OR cost) + (∆ Transfusions% x Transfusions cost) + (∆ Conversion% x Conversions cost) + (∆ Complication% x Complications cost) + (∆ Readmission% x Readmissions cost)

Limitations
Data presented reflect a single surgeon experience (data is not collected under formalized study, DATA IS NOT PEER REVIEWED AND NOT PUBLISHED) that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Cost estimates have been independently generated by Intuitive using cost modeling methodology based on national averages and have not been published or peer-reviewed. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and postoperative hospital costs are not included/considered.
Study Design
• A retrospective, database study with the objective of providing a comparative analysis of perioperative clinical outcomes from elective robotic-assisted lobectomy (RL), VATS lobectomy (VL), and open lobectomy (OL).

Patient Population
• The Premier Healthcare Database was analyzed for lobectomies performed from January 1, 2011 to September 30, 2015. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes were used to identify surgical approaches (RL, VL, and OL), complications, and conversions to OL.

Outcomes Measured / Evaluated
• Peri-operative complications, conversion to open, length of stay, peri-operative blood transfusions, discharge status.

Propensity score matching (1:1) for patient and hospital characteristics allowed comparison of RL versus OL (n = 2,775 each) and RL versus VL (n = 2,951 each).

• The following covariates were used for matching: patient characteristics—age, sex, race, Elixhauser comorbidity score, and type of malignancy; and hospital characteristics—payor type, census region, hospital size (number of beds), type of hospital facility (academic or community), and location of the facility (urban or rural).

Results / Conclusions
• Postoperatively and at 30 days when compared to VL and OL. RL was associated with a reduced LOS when compared to VL and OL.
• Patients in the RL group were more likely to be discharged home than to a transitional health care facility, when compared to VL and OL.
• RL had fewer conversions when compared to VATs lobectomy.
• RL had a lower in-hospital and 30-day mortality when compared to OL.

Study Limitations
• Oncologic data, such as size of the tumor, stage, recurrence, and survival, could not be extracted from the Premier Healthcare Database. As anticipated in any large administrative database, there is potential for coding errors.
### Clinical Outcomes and Estimated Cost Savings

Roy Williams, MD: single-surgeon unpublished vs. published results

<table>
<thead>
<tr>
<th></th>
<th><strong>Length of Stay (days)</strong></th>
<th><strong>Conversions (percentage)</strong></th>
<th><strong>In-hospital Complications (percentage)</strong></th>
<th><strong>O.R. Time (minutes)</strong></th>
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</table>

**Estimated Potential Savings per Procedure**

- **$11,472** vs Open
- **$9,162** vs VATS

Data presented for robotic-assisted surgery reflect a single surgeon experience that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Cost estimates have been independently generated by Intuitive using cost modeling methodology based on national averages and have not been published or peer-reviewed. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and post-operative hospital costs are not included/considered.

Surgeon Profile

James Wudel, MD
Wake Forest Baptist Medical Center
Winston-Salem, NC

Da Vinci® System Training
2011

Residency
Vanderbilt University Medical Center (Internal Medicine)
Vanderbilt University Medical Center (General)
University of Michigan (Cardiothoracic)

Memberships
Cardiothoracic Surgery Network (CTSNet)
Society of Thoracic Surgeons (STS)
Background Information
Clinical Outcomes and Estimated Cost Savings
James Wudel, MD: single-surgeon unpublished vs. published results

Design
• Unmatched comparison of surgeon provided data (for da Vinci RAS) and published results

Patient Population
• Surgeon’s patients who had lobectomy procedures

Outcomes Measured / Evaluated
• Length of stay
• Blood transfusions
• Conversions
• Complications

Results / Conclusions
• Results were provided by surgeon
  • Length of stay: 3.5 days
  • Blood transfusions: 0.9%
  • Conversions: 0.9%
  • Complications: 12.0%

Cost Methodology
• Cost savings from da Vinci RAS vs. other modality = (∆ LOS days x LOS cost) + (∆ OR Time min x OR cost) + (∆ Transfusions% x Transfusions cost) + (∆ Conversion% x Conversions cost) + (∆ Complication% x Complications cost) + (∆ Readmission% x Readmissions cost)
• Cost estimates have been independently generated by Intuitive Surgical using cost modeling methodology based on national averages and have not been published or peer-reviewed.

Limitations
Data presented reflect a single surgeon experience (data is not collected under formalized study, DATA IS NOT PEER REVIEWED AND NOT PUBLISHED) that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Cost estimates have been independently generated by Intuitive using cost modeling methodology based on national averages and have not been published or peer-reviewed. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and postoperative hospital costs are not included/considered.
Study Information

Lobectomy: published results for comparison with surgeon’s unpublished experience


Study Design
- A retrospective, database study with the objective of providing a comparative analysis of perioperative clinical outcomes from elective robotic-assisted lobectomy (RL), VATS lobectomy (VL), and open lobectomy (OL).

Patient Population
- The Premier Healthcare Database was analyzed for lobectomies performed from January 1, 2011 to September 30, 2015. International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnosis and procedure codes were used to identify surgical approaches (RL, VL, and OL), complications, and conversions to OL.

Outcomes Measured / Evaluated
- Peri-operative complications, conversion to open, length of stay, peri-operative blood transfusions, discharge status.
- Propensity score matching (1:1) for patient and hospital characteristics allowed comparison of RL versus OL (n = 2,775 each) and RL versus VL (n = 2,951 each).
- The following covariates were used for matching: patient characteristics — age, sex, race, Elixhauser comorbidity score, and type of malignancy; and hospital characteristics — payor type, census region, hospital size (number of beds), type of hospital facility (academic or community), and location of the facility (urban or rural).

Results / Conclusions
- Postoperatively and at 30 days when compared to VL and OL, RL was associated with a reduced LOS when compared to VL and OL.
- Patients in the RL group were more likely to be discharged home than to a transitional health care facility, when compared to VL and OL.
- RL had fewer conversions when compared to VATs lobectomy.
- RL had a lower in-hospital and 30-day mortality when compared to OL.

Study Limitations
- Oncologic data, such as size of the tumor, stage, recurrence, and survival, could not be extracted from the Premier Healthcare Database. As anticipated in any large administrative database, there is potential for coding errors.
Clinical Outcomes and Estimated Cost Savings
James Wudel, MD: single-surgeon unpublished vs. published results

<table>
<thead>
<tr>
<th>Length of Stay (days)</th>
<th>In-hospital Transfusions (percentage)</th>
<th>Conversions (percentage)</th>
<th>In-hospital Complications (percentage)</th>
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<td>Da Vinci (n=135)</td>
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<td></td>
<td></td>
<td></td>
<td>Open (n=2,775)</td>
</tr>
<tr>
<td>Cost</td>
<td>$1,475 (per bed day)¹</td>
<td>$1,116 (per transfusion)²</td>
<td>$2,060 (per conversion)³</td>
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<tr>
<td></td>
<td>3.5</td>
<td>6.0</td>
<td>0.9</td>
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<tr>
<td></td>
<td>6.0</td>
<td>6.9</td>
<td>9.8</td>
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<td>7.0</td>
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<td></td>
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<td>44.0</td>
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</tbody>
</table>

Estimated Potential Savings per Procedure
$12,725 vs Open  $10,233 vs VATS

Data presented for robotic-assisted surgery reflect a single surgeon experience that may or may not be reproducible and is not generalizable. This data comparison is not case-matched for patient complexity and/or disease status and may not be comparable across these surgical modalities. As such, this data presentation should be considered as informational only and is not conclusive. Cost estimates have been independently generated by Intuitive using cost modeling methodology based on national averages and have not been published or peer-reviewed. Costs related to da Vinci system acquisition, yearly service costs and other intraoperative and post-operative hospital costs are not included/considered.

## Cost References & Methodology

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Clinical Metric</th>
<th>Resource(s)</th>
<th>Published Value(s) Used</th>
<th>Price Index Adjustment</th>
<th>Calculation</th>
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</thead>
<tbody>
<tr>
<td>a.</td>
<td>Length of stay</td>
<td>Halpern NA, Pastores SM. Critical care medicine in the United States 2000-2005: an analysis of bed numbers, occupancy rates, payer mix, and costs. Crit Care Med 2010;38(1):65-71. Table 5</td>
<td>$1,153/day (general ward)</td>
<td>From 2005 USD to 2018 USD, using Health care Services Price Index (Index 2012 = 100, Quarterly, Seasonally Adjusted)</td>
<td>$1,153 ÷ 84.474 x 108.036 = $1,475 (general ward)</td>
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<td></td>
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<td></td>
<td>$3,518/day (intensive care)</td>
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<td>$3,518 ÷ 84.474 x 108.036 = $4,499 (intensive care)</td>
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<tr>
<td>c.</td>
<td>Blood transfusions</td>
<td>Shander A, Hofmann A, Ozawa S, et al. Activity-based costs of blood transfusions in surgical patients at four hospitals. Transfusion 2010;50(4):753-65. Figure 2</td>
<td>Average of two US Hospitals: $726 (Rhode Island Hospital) and $1,183 (Englewood Hospital Medical Center) per RBC-unit transfusion</td>
<td>From 2008 USD to 2018 USD, using Health care Services Price Index (Index 2012 = 100, Quarterly, Seasonally Adjusted)</td>
<td>$[(726 + 1,183) ÷ 2 + 92.402 x 108.036 = $1,116</td>
</tr>
<tr>
<td>e.</td>
<td>Surgical site infection</td>
<td>Zimlichman E, Henderson D, Tamir O. Health care-associated infections: a meta-analysis of costs and financial impact on the U.S. health care system. JAMA Intern Med. 2013;173(22):2039-46. Table 1</td>
<td>$20,785</td>
<td>From 2012 USD to 2018 USD, using Health care Services Price Index (Index 2012 = 100, Quarterly, Seasonally Adjusted)</td>
<td>$20,785 + 100.549 x 108.036 = $22,333</td>
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## Cost References & Methodology (cont’d)

<table>
<thead>
<tr>
<th>Ref.</th>
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<tbody>
<tr>
<td>f.</td>
<td>Complications / reoperations</td>
<td>Healy MA, Mullard AJ, Campbell DA, et al. Hospital and payer costs associated with surgical complications. JAMA Surgery 2016;151(9):823-30. Figure 1b</td>
<td>Multiplier = (cost with complications – cost without complications) ÷ cost without complications</td>
<td>Not applied</td>
<td>Cost of Complication = Multiplier x MS-DRG Medicare Payment ($36,060 - $16,434) ÷ $16,434 = 1.2</td>
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DRG multiplier

<table>
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<tr>
<th>Procedure</th>
<th>MS-DRG</th>
<th>Medicare Discharges</th>
<th>Medicare Payment</th>
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<td>13,039</td>
<td>$29,784</td>
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<td>16,304</td>
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</table>

MS-DRG Medicare payment

Payments: Medicare Inpatient Prospective Payment System (IPPS) FY2018 Final Rule, Table 5 CN. Center for Medicare and Medicaid Services.

Weighted by: Number of Medicare Inpatient Discharges from Medicare Charge Inpatient DRGALL DRG Summary Reports FY2016

No adjustment is needed, since using IPPS for FY2018 already. Weighted average of national average MS-DRG payment is used for greater generalizability.
## Cost References & Methodology (cont’d)

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Clinical Metric</th>
<th>Resource(s)</th>
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<th>Price Index Adjustment</th>
<th>Calculation</th>
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</thead>
<tbody>
<tr>
<td>f.</td>
<td>Complications / reoperations (cont’d)</td>
<td>Payments: Medicare Inpatient Prospective Payment System (IPPS) FY2018 Final Rule, Table 5 CN. Center for Medicare and Medicaid Services.</td>
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<td>Cost of Complication = Multiplier x MS-DRG Medicare Payment</td>
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<td>Procedure</td>
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## Cost References & Methodology (cont’d)

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<th>Ref.</th>
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<th>Resource(s)</th>
<th>Published Value(s) Used</th>
<th>Price Index Adjustment Calculation</th>
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<tr>
<td>g.</td>
<td>Readmissions</td>
<td>Healthcare Cost and Utilization Project (HCUP) by U.S. Agency for Healthcare Research and Quality (AHRQ) publishes Hospital Inpatient National Statistics (Years: 2014</td>
<td>From 2014 USD to 2018 USD, using Health care Services Price Index (Index 2012 = 100, Quarterly, Seasonally Adjusted)</td>
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<td>Procedure</td>
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<td># of Readmissions</td>
<td>$ Cost per Readmission</td>
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References


Important Safety Information

Financial Disclosure
All surgeons represented in this document have received compensation from Intuitive for consulting and/or educational services.

Dr. Oh discloses a financial relationship with Intuitive.

Surgical Risks
Risks associated with pulmonary resection (wedge resection, segmentectomy, lobectomy) include: persistent air leak, pneumonia, prolonged mechanical ventilation >48 hours, atrial fibrillation, acute respiratory distress syndrome (ARDS), chylothorax, re-intubation, arrhythmias, bronchopleural fistula, phrenic nerve injury, esophageal injury, difficulty breathing, collapsed lung, pulmonary volvulus, recurrent laryngeal nerve injury leading to vocal cord dysfunction.

The friable nature of pulmonary tissue enhances the risk of vascular, bronchiolar or other injury that will be difficult to control when using this device. Published clinical experience as well as clinical studies performed to support this marketing clearance have demonstrated that even surgeons considered expert in laparoscopy/thoracoscopy have substantial learning curves of 10 to 12 cases (Falk, et al., Total endoscopic computer enhanced coronary artery bypass grafting, Eur J Cardiothorac Surg 2000; 17: 38-45).

Important Safety Information
Serious complications may occur in any surgery, including da Vinci® Surgery, up to and including death. Examples of serious or life-threatening complications, which may require prolonged and/or unexpected hospitalization and/or reoperation, include but are not limited to, one or more of the following: injury to tissues/organs, bleeding, infection and internal scarring that can cause long-lasting dysfunction/pain.

Risks specific to minimally invasive surgery, including da Vinci® Surgery, include but are not limited to, one or more of the following: temporary pain/nerve injury associated with positioning; a longer operative time, the need to convert to an open approach, or the need for additional or larger incision sites. Converting the procedure could result in a longer operative time, a longer time under anesthesia, and could lead to increased complications. Contraindications applicable to the use of conventional endoscopic instruments also apply to the use of all da Vinci instruments.

For Important Safety Information, indications for use, risks, full cautions and warnings, please also refer to www.davincisurgery.com/safety and www.intuitivesurgical.com/safety.

Individuals’ outcomes may depend on a number of factors, including but not limited to patient characteristics, disease characteristics, and/or surgeon experience.
Important Safety Information

Da Vinci Xi® System Precaution Statement

The demonstration of safety and effectiveness for the specific procedure(s) discussed in this material was based on evaluation of the device as a surgical tool and did not include evaluation of outcomes related to the treatment of cancer (overall survival, disease-free survival, local recurrence) or treatment of the patient’s underlying disease/condition. Device usage in all surgical procedures should be guided by the clinical judgment of an adequately trained surgeon.

It is the responsibility of the owner of the da Vinci® surgical system to properly train and supervise its personnel to ensure that the instruments and accessories are properly cleaned, disinfected and sterilized as required by the User’s Manual. The da Vinci products should not be used in a clinical setting unless the institution has verified that these products are properly processed in accordance with the da Vinci System User’s Manual.

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