Simulation & Surgical Training: Fundamentals of Robotic Surgery

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Grants Leadership

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Florida Hospital Nicholson Center

Source: US Department of Defense

PI: Richard Satava, MD
Minimally Invasive Robotics Assoc

Source: Intuitive Surgical Inc.

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### Congressional/DoD Research Project

#### Robotic Curriculum

**Curriculum Development:**
- Define Robotic Surgery outcomes
- Develop Robotic Surgery curriculum
- Develop specific training tasks

**Curriculum Validation:**
- Validate training tasks
- Identify testing measures
- Set passing criteria

#### Telesurgery

**Communication Latency:**
- Map surgical movements to latency
- Redesign for latency tolerance
- Introduce instruments for safety
- Target city-pairs by latency

**Automatic Surgery:**
- Record movements in simulator
- Execute movements with robot
- Measure accuracy of outcome

#### Simulation

**Surgical Rehearsal:**
- Patient-specific rehearsal simulator
- Simulated patient physiology
- Measure impact on surgical perform

**Military-use Validation:**
- Identify military constraints
- Validate simulator for military-use
- Define deployable package
Intuitive Surgical’s Training Pathway

### Surgeon and OR Team Pathway

<table>
<thead>
<tr>
<th>Phase</th>
<th>Content</th>
<th>Trainer</th>
</tr>
</thead>
<tbody>
<tr>
<td>I: Introduction</td>
<td>Product Training</td>
<td>Intuitive Surgical</td>
</tr>
<tr>
<td>II: Preparation</td>
<td>Clinical Training</td>
<td>Independent Surgeons &amp; Societies/Academic</td>
</tr>
<tr>
<td>III: Post System</td>
<td>Clinical Training</td>
<td>Independent Surgeons &amp; Societies/Academic</td>
</tr>
<tr>
<td>IV: Advanced</td>
<td>Continuing</td>
<td>Independent Surgeons &amp; Societies/Academic</td>
</tr>
<tr>
<td>Beyond the Pathway</td>
<td>Clinical Education</td>
<td>Independent Surgeons &amp; Societies/Academic</td>
</tr>
</tbody>
</table>

- Phases I-II focus on product training, while phases III-IV focus on clinical training.
- Beyond the pathway, skills are honed with continuing clinical education.
Create and develop a validated multi-specialty, technical skills competency based curriculum for surgeons to safely and efficiently perform basic robotic-assisted surgery.

**Note: The intent is to create a curriculum that is device-independent.** This is admittedly difficult given the single approved surgical robot at this time. Therefore, significant attention is being paid to material that is device-flexible in anticipation of future robots.
Participating Organizations

- American Association Gynecologic Laparoscopy (AAGL)
- American College of Surgeons (ACS)
- American Congress of OB-Gyn (ACOG)
- American Urologic Association (AUA)
- American Academy of Orthopedic Surgeons (AAOA)
- American Assn of Thoracic Surgeons (AATS)
- American Assn of Colo-Rectal Surgeons (ASCRS)
- American Assn of Gynecologic Laparoscopists (AAGL)
- Florida Hospital Nicholson Center
- U.S. Department of Defense (DoD)
- U.S. Department of Veterans Health Affairs (VHA)
- Minimally Invasive Robotic Association (MIRA)
- Society for Robotic Surgery (SRS)
- Society of American Gastrointestinal and Endoscopic Surgeons (SAGES)
- American Board of Surgery (ABS)
- Accreditation Council of Graduate Med Education (ACGME)
- Association of Surgical Educators (ASE)
- Residency Review Committee (RRC) – Surgery
- Royal College of Surgeons-Ireland (RCSI)
- Royal College of Surgeons-London (RCSL)

* Funding Sources
+ Executive Committee
Development of Curriculum from common template
“Sweet*  Tree”

<table>
<thead>
<tr>
<th>Society Advanced Individual Procedures</th>
<th>Nephrectomy</th>
<th>Hysterectomy</th>
<th>R Colectomy</th>
<th>Etc .....</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cystectomy</td>
<td>Oophorectomy</td>
<td>Sigmoidectomy</td>
<td>Etc .....</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Society Core Advanced Skills</th>
<th>F_UroRS Advanced</th>
<th>F_GynRS Advanced</th>
<th>F_ColoRS Advanced</th>
<th>F???RS..etc Advanced</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Society Core Basic Skills Template</th>
<th>F_UroRS</th>
<th>F_GynRS</th>
<th>F_ColoRS</th>
<th>F???RS..etc</th>
</tr>
</thead>
</table>

| Core Template All societies agree      | FRS               |                  |                   |                      |

* Adapted from Rob Sweet, MD, Professor of Urology, University Minnesota, 2010
The Metrics Drives the Process

<table>
<thead>
<tr>
<th>WHAT</th>
<th>Curriculum Development</th>
<th>Simulator Development</th>
<th>Validation Studies</th>
<th>Implement: Survey Training Certification</th>
<th>Issue Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcomes &amp; Metrics</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HOW</td>
<td>Consensus Conference</td>
<td>Standard Curriculum Template</td>
<td>Engineering Physical Simulator</td>
<td>Standard Validation Template</td>
<td>Current Procedures</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WHO</td>
<td>ABS SAGES ACS Specialty Societies</td>
<td>SAGES ACS Societies Academia</td>
<td>Industry with Academia Medical Input</td>
<td>ACS SAGES, Participating Societies</td>
<td>FLS SAGES/ACS</td>
</tr>
</tbody>
</table>

Creator: Rick Satava, MD, Univ of Washington
Consensus Conference Process

1. Outcomes Measures (Dec 12-13, 2011)
2.5 Curriculum Development (Aug 17-18, 2012)
3. Validation Criteria (December, 2012)
4. Validation Studies
5. Transition to Objective Testing Organization (est. July 2013)

• Expert Discussion and Contributions
• Modified Delphi Voting Mechanism
## #1 Outcomes Measures

<table>
<thead>
<tr>
<th>Pre-Operative</th>
<th>Intra-Operative</th>
<th>Post-Operative</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Settings</td>
<td>Energy Sources</td>
<td>Transition to Bedside Asst</td>
</tr>
<tr>
<td>Ergonomic Positioning</td>
<td>Camera Control</td>
<td>Undocking</td>
</tr>
<tr>
<td>Docking</td>
<td>Clutching</td>
<td></td>
</tr>
<tr>
<td>Robotic Trocars</td>
<td>Instrument Exchange</td>
<td></td>
</tr>
<tr>
<td>OR Set-up</td>
<td>Foreign Body Management</td>
<td></td>
</tr>
<tr>
<td>Situation Awareness</td>
<td>Multi-arm Control</td>
<td></td>
</tr>
<tr>
<td>Closed Loop Comms</td>
<td>Eye-hand Instrument Coord</td>
<td></td>
</tr>
<tr>
<td>Respond to System Errors</td>
<td>Wrist Articulation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Atraumatic Tissue Handling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Dissection – Fine &amp; Blunt</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cutting</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Needle Driving</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Suture Handling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Knot Tying</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Safety of Operative Field</td>
<td></td>
</tr>
</tbody>
</table>
Faculty Members: Outcomes Measures

- **Arnold Advincula, MD**
  American Assoc of Gynecologic Laparoscopists & ACOG
- **Rajesh Aggarwal, MD**
  Royal College of Surgeons - London
- **Mehran Anvari, MD**
  Minimally Invasive Robotic Association (MIRA)
- **John Armstrong, MD**
  USF Health, CAMLS (now Florida Surgeon General)
- **Paul Neary, MD**
  Royal College of Surgeons - Ireland
- **Wallace Judd, PhD**
  Authentic Testing Corp.
- **Michael Koch, MD**
  American Board of Urology
- **Kevin Kunkler, MD**
  US Army Medical Research & Materiel Command TATRC
- **Vipul Patel, MD**
  Global Robotics Institute - Florida Hospital Celebration Health
- **COL Robert Rush, MD**
  US Army Madigan Healthcare System
- **Richard Satava, MD**
  Minimally Invasive Robotic Association (MIRA)
- **Danny Scott, MD**
  Society of American Gastro and Endoscopic Surgeons (SAGES)
- **Mika Sinanan, MD**
  University of Washington
- **Roger Smith, PhD**
  Florida Hospital Nicholson Center
- **Dimitrios Stefanidis MD**
  Association for Surgical Education
- **Chandru Sundaram, MD**
  American Urological Association
- **Robert Sweet, MD**
  American Urological Association
- **Edward Verrier, MD**
  Joint Council on Thoracic Surgery Education
<table>
<thead>
<tr>
<th>Task Name</th>
<th>Description</th>
<th>Errors</th>
<th>Outcomes</th>
<th>Metrics</th>
<th>Importance Rating</th>
<th>Total Score</th>
<th>Rank Order</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needle driving</td>
<td>Accurate and efficient manipulation of the needle.</td>
<td>Tearing tissue, Troughing the needle, Needle scratching, Wrong angle on entry/exit, Adjacent organ injury, (more)</td>
<td>Accurate and efficient placement of needle through targeted tissue, Following the curve of the needle, without associated tissue injury</td>
<td>Time, accuracy, tissue damage, material damage</td>
<td>0</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Atraumatic handling</td>
<td>Haptic comprehension. Using graspers to hold tissue or surgical material without crushing or tearing.</td>
<td>Traumatic handling, Tissue damage or hemorrhage</td>
<td>Manipulates tissue and surgical materials without damage</td>
<td>Metric-respect for tissue, Stress and strain indentation and deformation</td>
<td>0</td>
<td>3</td>
<td>6</td>
</tr>
</tbody>
</table>

**Total Score**: 33

**Rank Order**: 3
#2 Curriculum Development

<table>
<thead>
<tr>
<th>Didactic &amp; Cognitive</th>
<th>Psychomotor Skills</th>
<th>Team Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture-based</td>
<td>Principle-based</td>
<td>Checklist-based</td>
</tr>
<tr>
<td>Intro to Robotic System</td>
<td>Based on Physical Models (Virtual Models are Derivative)</td>
<td>#1: WHO Pre-Op</td>
</tr>
<tr>
<td>Pre-Operative Activity</td>
<td>3D Exam Tools</td>
<td>#2: Robotic Specific</td>
</tr>
<tr>
<td>Intra-Operative Activity</td>
<td>Use Tasks that have Evidence of Validity</td>
<td>#3: Undocking &amp; Debriefing</td>
</tr>
<tr>
<td>Post-Operative Activity</td>
<td>Multiple Outcomes Measured per Exercise</td>
<td>#4 Crisis Scenarios</td>
</tr>
<tr>
<td>Each Activity includes: Goals, Conditions, Metrics, Errors, Standards</td>
<td>Cost Effective Solution</td>
<td></td>
</tr>
</tbody>
</table>

- High Fidelity for Testing, Lower Fidelity for Training
- IRR Requires Ease of Administration
Faculty Members: Curriculum Develop

Arnold Advincula
• Vicenzo Ficarra
• C.Y. Liu
• Richard Satava

Abdulla Al Ansari
• Marvin Fried
• Col. Ernest Lockrow
• Steve Schwatzberg

David Albala
• Gerald Fried
• Fred Loffer
• Danny Scott

Richard Angelo
• Tony Gallagher
• Guy Maddern
• Roger Smith

James Borin
• Piero Giulianotti
• Scott Magnuson
• Hooman Soltanian

David Bouchier-Hayes
• Larry Glazerman
• Javier Magrina
• Dimitrios Stefanidis

Timothy Brand
• Teodar Grantcharov
• Michael Marohn
• Chandru Sundaram

Geoff Coughlin
• James Hebert
• David Maron
• Robert Sweet

Alfred Cuschieri
• Robert Holloway
• Martin Martino
• Amir Szold

Prokar Dasgupta
• Santiago Horgan
• W. Scott Melvin
• Raju Thomas

Ellen Deutsch
• Lenworth Jacobs
• Francesco Montorsi
• Oscar Traynor

Gerard Doherty
• Arby Kahn
• Alex Mottrie
• Thomas Whalen

Brian Dunkin
• Keith Kim
• Paul Neary
• Gregory Weinstein

Susan Dunlow
• Michael Koch
• Eduardo Parra-Davila

Gary Dunnington
• Rajesh Kumar
• Vipul Patel

Ricardo Estape
• Gyunsung Lee
• Gary Poehling

Peter Fabri
• Raymond Leveillee
• Sonia Ramamoorthy

Jeff Levy
• Koon Ho Rha

Testing Environments

Robot

Simulator
#3 Validation Conference

• Criteria
  – Validate the curriculum and passing criteria that will be used to grant certification

• Multi-Institutional Study
  – 10 independent sites
  – ACS AEI accredited
  – Faculty in at least 2 specialties
Conclusions

• Objective curriculum in robotic surgery is needed for certification
• Development of such a curriculum is underway by a multi-specialty working group of experienced surgeons
• Florida Hospital is actively supporting this effort with surgical experts and grant funding
Fundamentals of Robotic Surgery

Download Reports, Papers, and Presentations

http://www.SimulationFirst.com/frs
Thank You!