Robotic Surgery and Surgical Simulation

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Chief Technology Officer
## Florida Hospital Nicholson Center
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- Leading research in exploration of telesurgery and applying simulation devices to surgical education
- CTO for U.S. Army Simulation, Training and Instrumentation (PEO STRI)
- CTO and Vice President at Titan Systems Inc.
- Research Scientist for Texas A&M University
- Serves as a Graduate Faculty Scholar at the University of Central Florida
- Visiting Lecturer at Georgia Institute of Technology
- Faculty at the Florida Hospital College of Health Sciences

- Published 5 Books (Chapter contributions to 10 books)
- 150 technical and management papers

- B.S. in Applied Mathematics
- M.S. in Statistics
- Master's and Doctorate in Business Administration
- Ph.D. in Computer Science.

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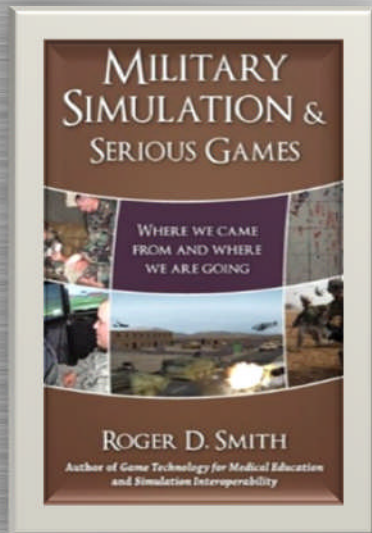
- Technical, Social and Economic importance of simulation and gaming
- Focus on techniques, tools and technologies
- Historical summary and future possibilities
- Explores and contrasts Military and Commercial gaming evolutions

- The traditional Halstedian apprenticeship model of 'see one, do one, teach one' is no longer adequate to train surgeons, since good laparoscopic skills cannot be developed by merely watching an expert." - A. Pearson, M.D.

- "There is no excuse for the surgeon to learn on the patient." - William Mayo, 1927

- Dr. Smith's Book proposes 4 hypotheses:
  1. Virtual Reality and gaming can reduce costs for surgical training
  2. VR and gaming can improve repetitive practice to assess patient symptoms
  3. VR and game training environments can reduce training times (for equal skill)
  4. VR and gaming can reduce medical errors
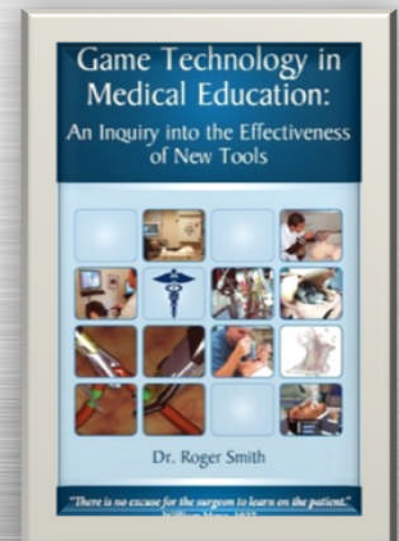
Florida Hospital

- 8 Campus Hospital System in Orlando, Florida
- 34 Regional Campuses across Florida
- 2,188 beds
- Largest provider of healthcare in Florida
- Largest by some measures in the entire United States

Nicholson Center

- **Surgical Education**
  - **Robotic Surgery**
  - **Laparoscopic Techniques**
  - **Orthopedic Equipment**

- **Surgical Research**
  - **Robotic & Telesurgery**
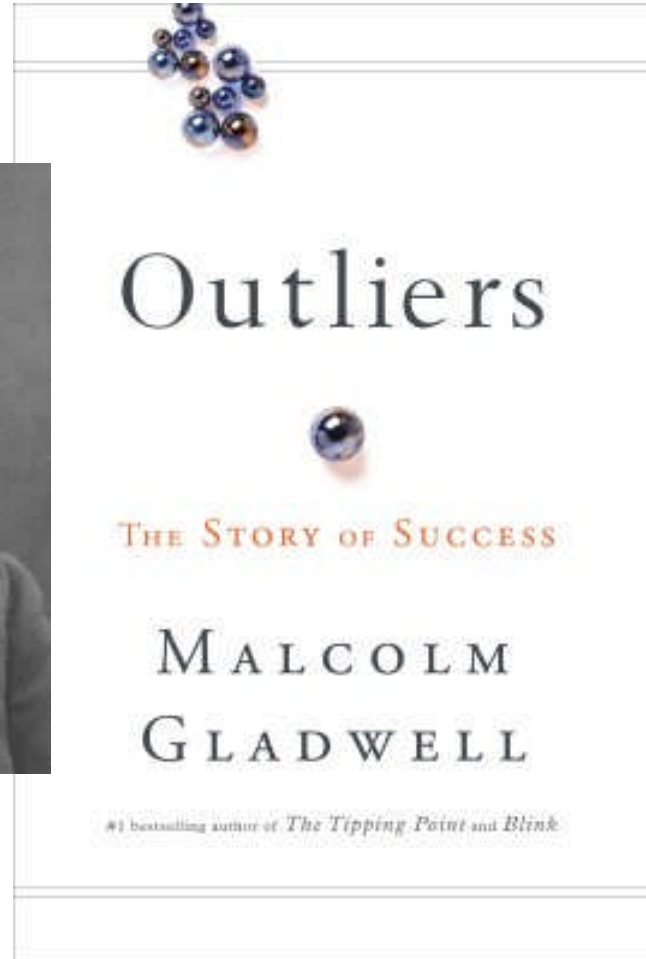 - **Surgical Education**
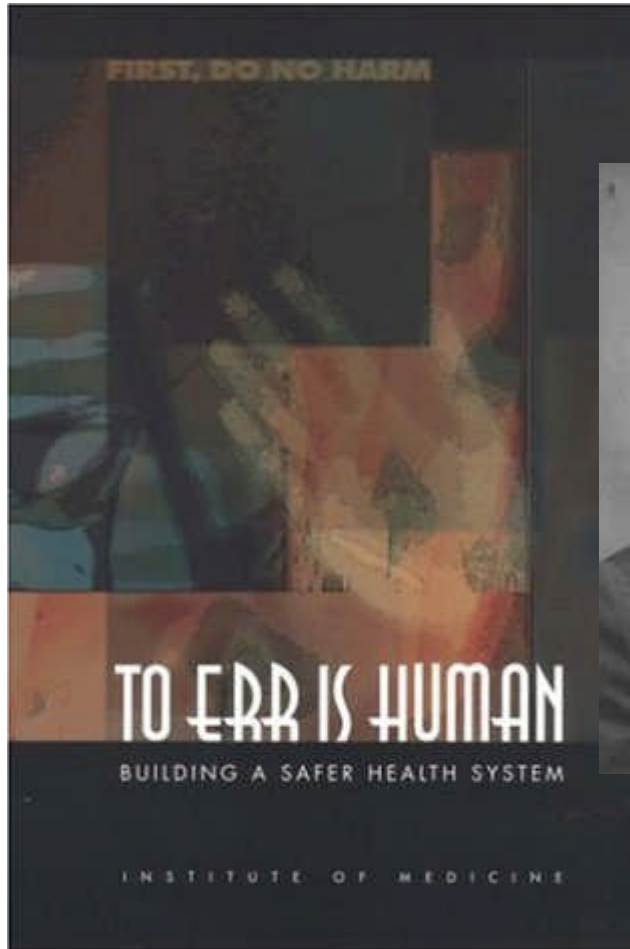 - **Automatic Surgery**

Errors Eliminate Profits

- **Minor Complication**
  - Revisit <u>eliminates all profit</u> from the original surgery

- **Major Complication**
  - Revisit <u>costs 3X the profit</u> from the original surgery
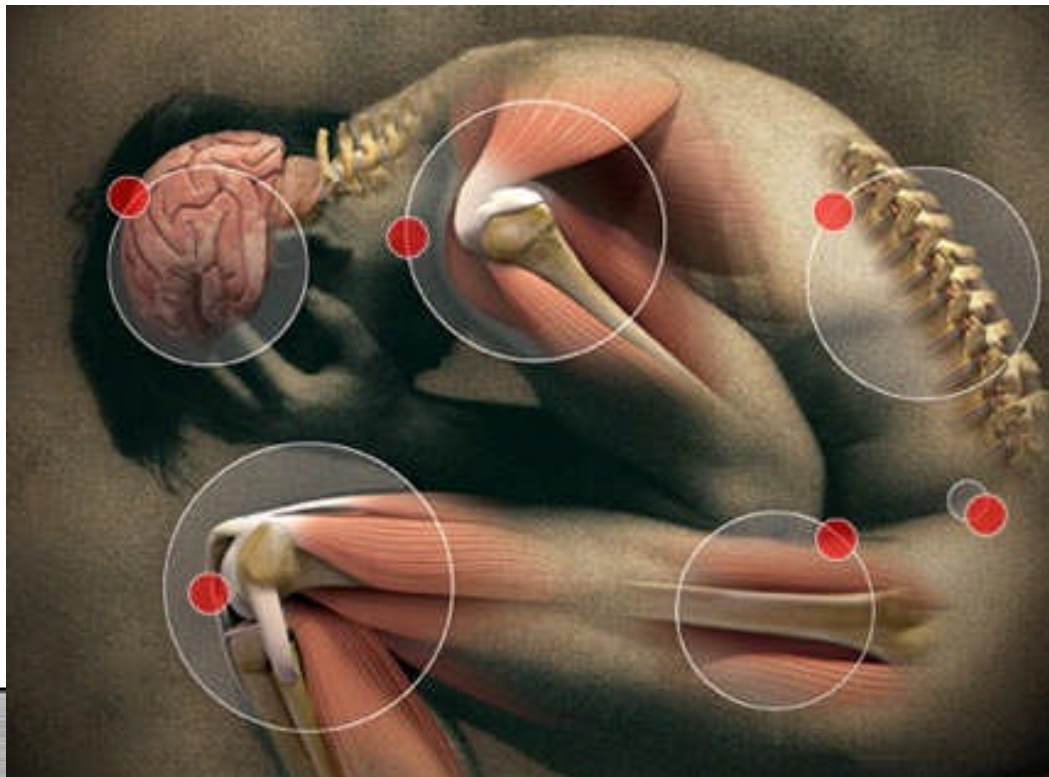
Creating Experts & Eliminating Errors

10,000 hours to become an expert - Gladwell
"There is no excuse for the surgeon to learn on the patient." – William Mayo, 1927

# Medical Education – Explosion of Information

- Medical procedures are becoming more numerous and more complex – medical knowledge has "hypertrophied" (Cooke, 2006)

- Training residents to a common level of knowledge and competence is already impossible (Satava, 2008)

"The Perfect Storm" (Murphy, 2007)

- <u>Risk</u> to patient health. (McDougall, 2007)

- <u>Ethics</u> of practicing on patients. (Satava, 2004; Murphy, 2007)

- <u>Cost</u> is a barrier to training. (Bridges, 1999)

- <u>Insurance</u> coverage of educational actions. (Satava, 2004)

- <u>Working hour</u> limits. (Satava, 2004)

- <u>Availability</u> of training opportunities. (Birden, 2007; Davis, 1999)

- <u>Access</u> to training. (Dunkin, 2007; Spitzer, 1997)

- <u>Complexity</u> of modern surgery. (McDougall, 2007)

- <u>Volume</u> of unique procedures. (Reznick & MacRae, 2006)

- <u>Proficiency-based</u> Medicine. (Murray, 2005)

- <u>Quality</u> of technology. (Murphy, 2007)

- <u>Expectations</u> around computer technologies. (Murphy, 2007)

- <u>Acceptance</u> of technology. (Ziv, 2003)

- Learning from <u>Mistakes</u>. (Ziv, 2005)

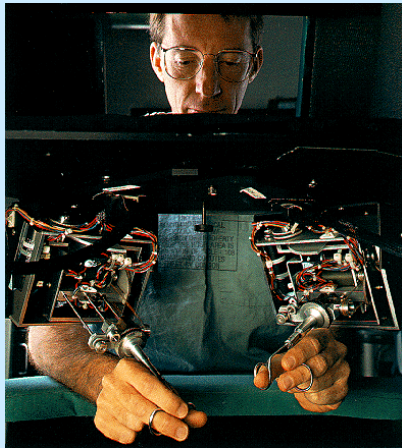# Intuitive Surgical's da Vinci Robot

Video at: http://www.youtube.com/watch?v=0NZLpWrJGgk
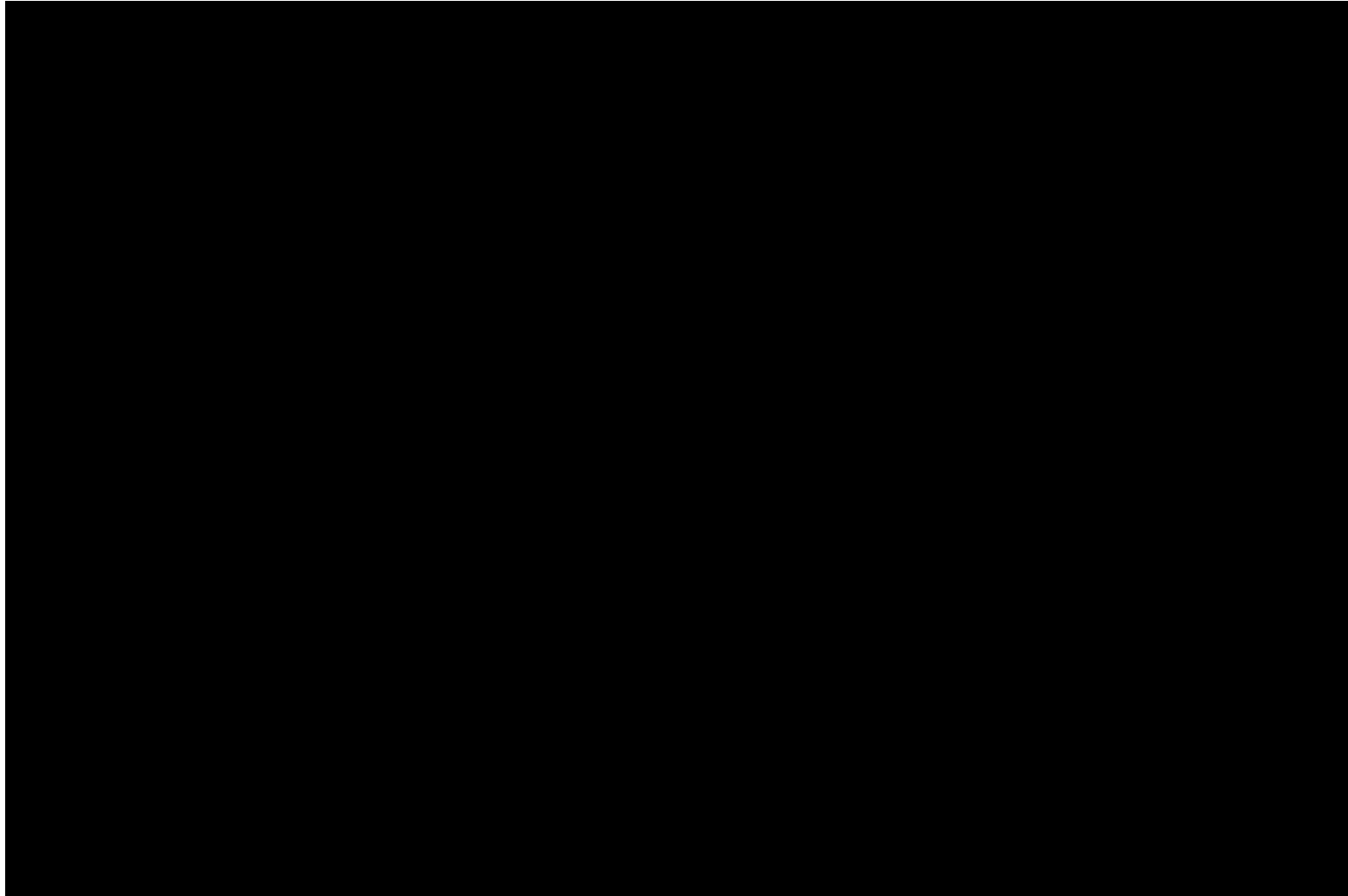
Robotic and Telesurgery Research using Simulation

Telesurgery

Comms Latency:
- Modify surgical procedures
- Safe Telesurgery at 500ms
- Match to City-Pairs

Automatic Surgery:
- Record Surgery in Simulator
- Execute with Unmanned Robot
- Identify Control Variables

Simulation

Surgical Rehearsal:
- Dynamic Organ Model in Sim
- Patient-specific Rehearsal
- Improve Surgeon Performance

Military-use Validation:
- Simulator of Robotic Surgery
- Retain Skills in Theater
- Define Deployable Package

Robotic Curriculum

Consensus Conferences:
- Define Certification Criteria
- Develop Curriculum
- Develop Training Tasks

Curriculum Validation:
- Validate the Program
- Identify Testing Measures
- Set Passing Criteria

- Stereo HD Video
- Team Audio

- Robot Commands
- Surgeon Audio

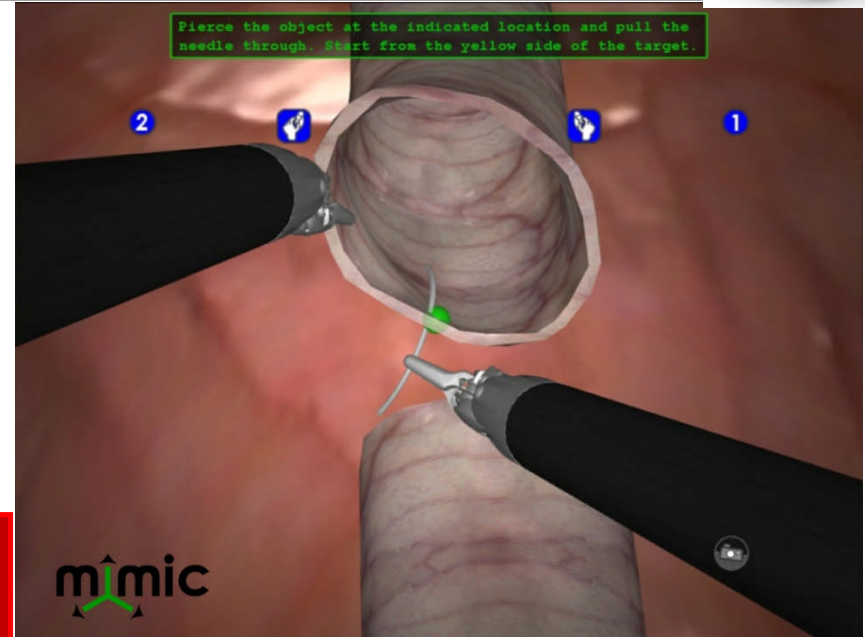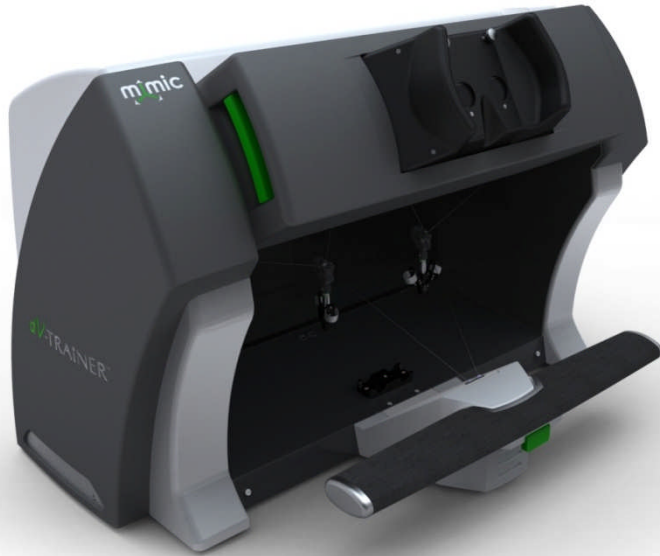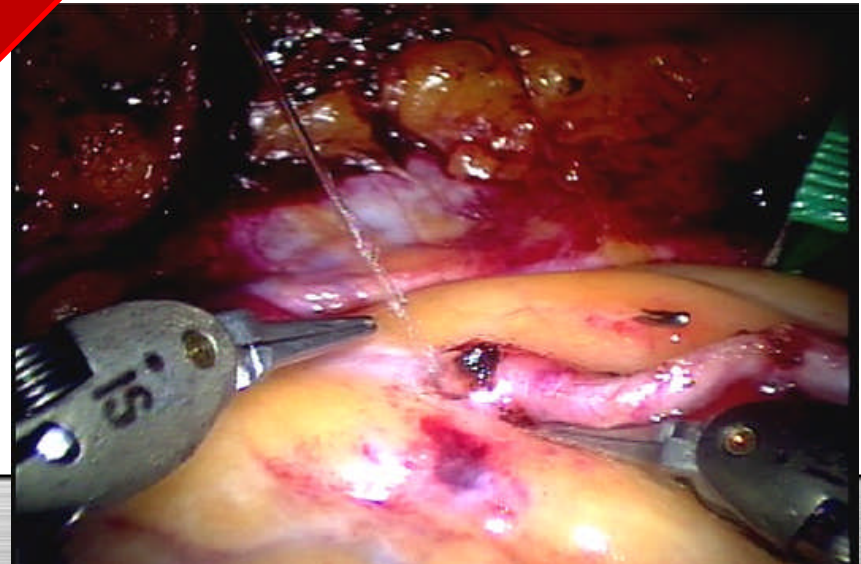Comm Latency = 1 + 2

12
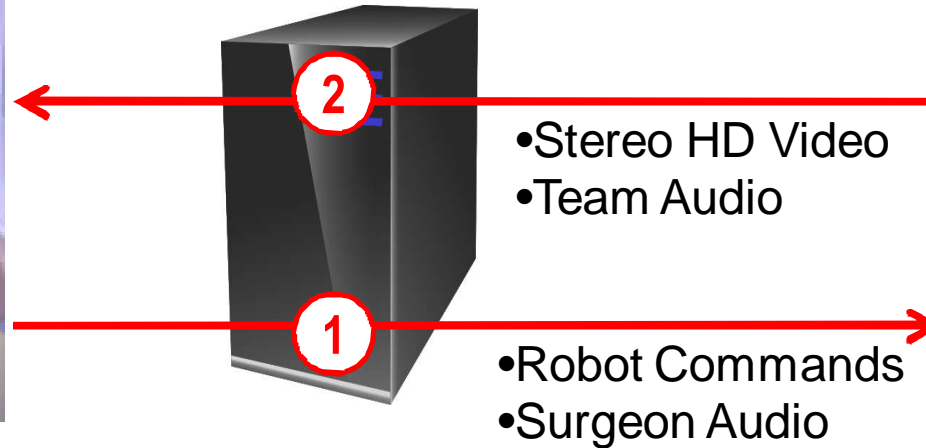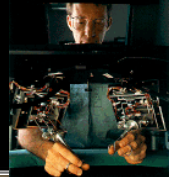
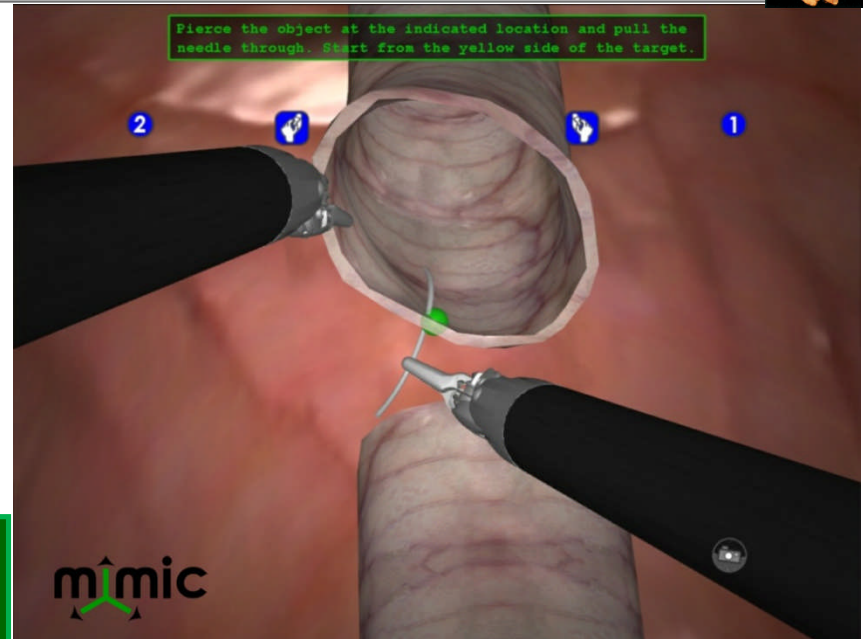**da Vinci Skills Simulator**

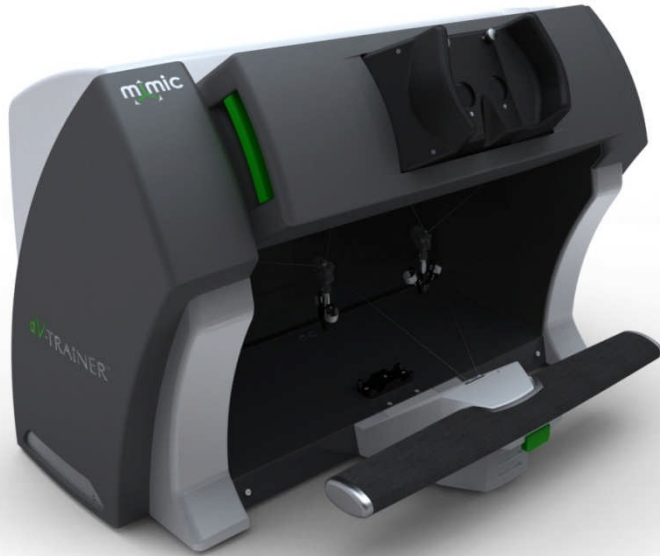**Mimic dV-Trainer**
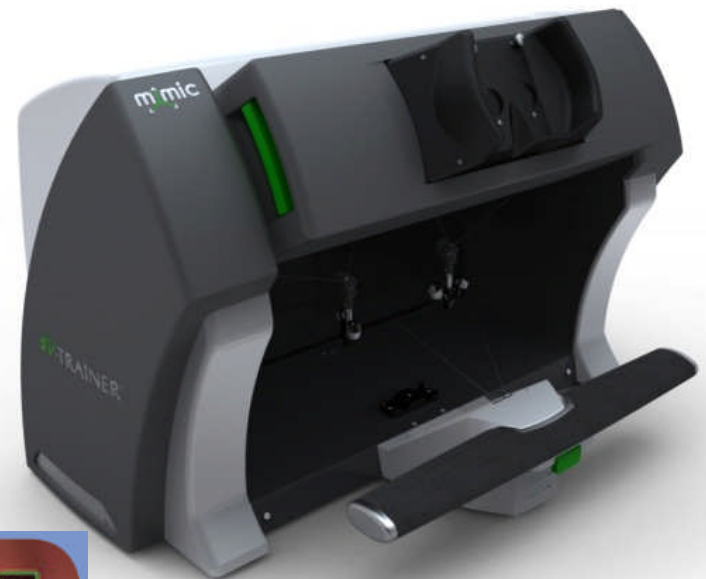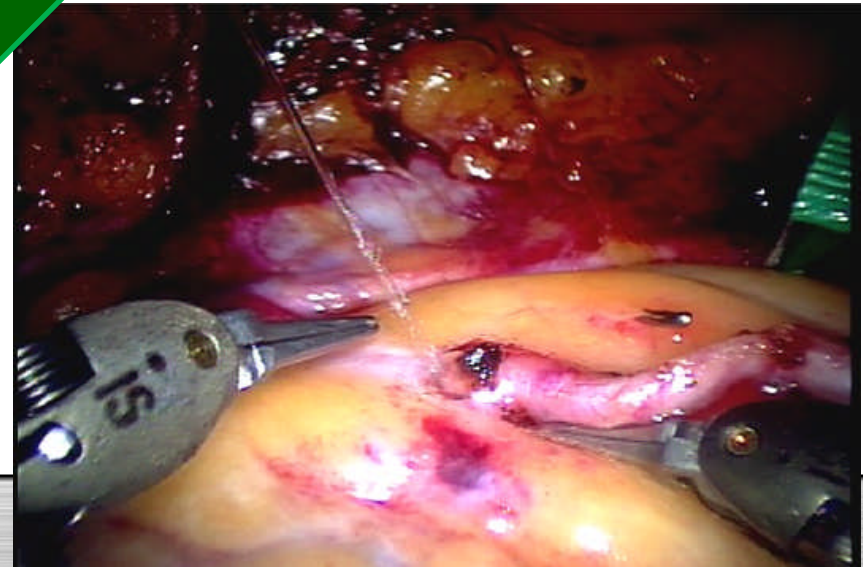
Simulation: Surgical Rehearsal
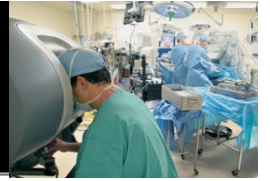

Skill
Trans

Telesurgery: Automatic Surgery

Data Trans

Industry Perspective

- **Simulation as a Research Lab**

  - Simulated environments are a viable and affordable research environment within which to conduct experiments.

- **Simulation for Rehearsal**

  - Simulation is a tool for real-time preparation for surgery.

- **Simulation for Education**

  - Redesign GME surgical courses to include simulators along with classroom and laboratory components.