



**FLORIDA HOSPITAL**  
**NICHOLSON CENTER**

# Robotic Surgery and Surgical Simulation

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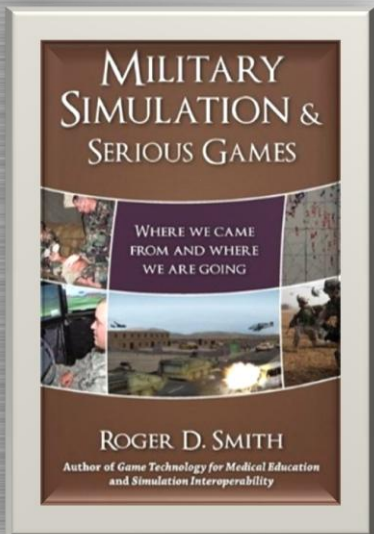


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- Leading research in exploration of telesurgery and applying simulation devices to surgical education
- CTO for U.S. Army Simulation, Training and Instrumentation (PEO STRI)
- CTO and Vice President at Titan Systems Inc.
- Research Scientist for Texas 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.

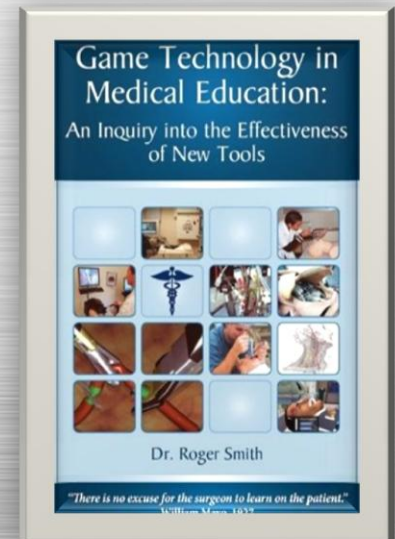


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- Technical, Social and Economic importance of simulation and gaming
- Focus on techniques, tools and technologies
- Historical summary and future possibilities
- Explores and contrasts Military and Commercial gaming evolutions

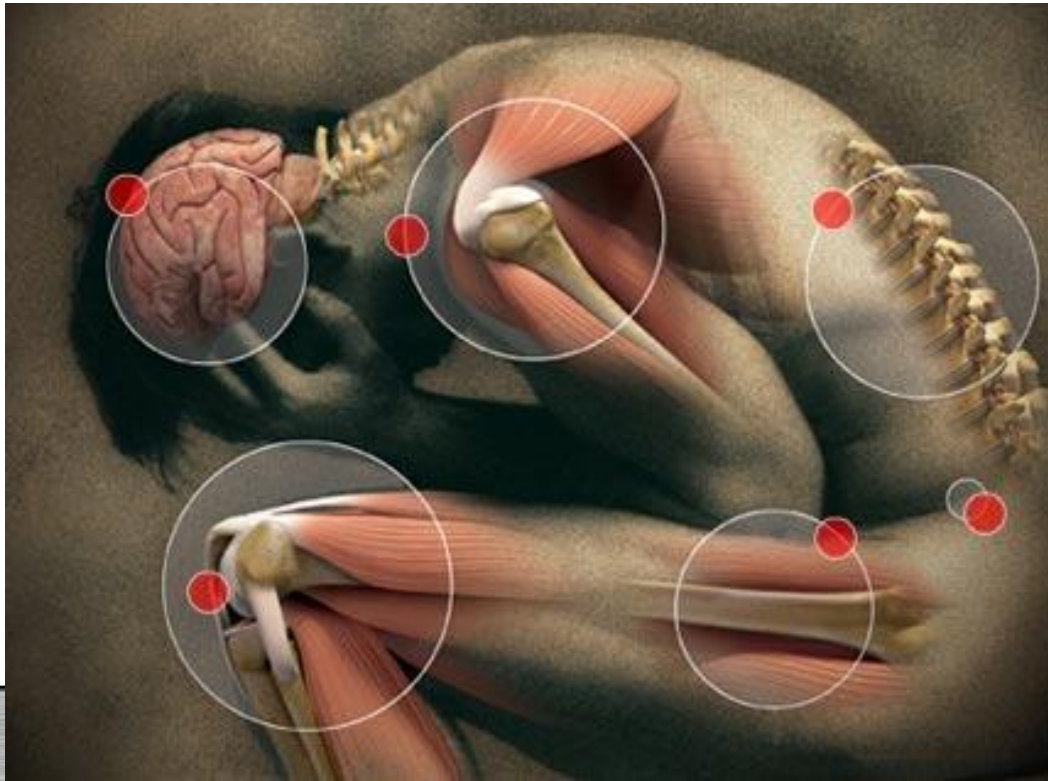
- The traditional Halstedian apprenticeship model of 'see one, do one, teach one' is no longer adequate to train surgeons, since good laparoscopic skills cannot be developed by merely watching an expert." - A. Pearson, M.D.
- "There is no excuse for the surgeon to learn on the patient." - William Mayo, 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



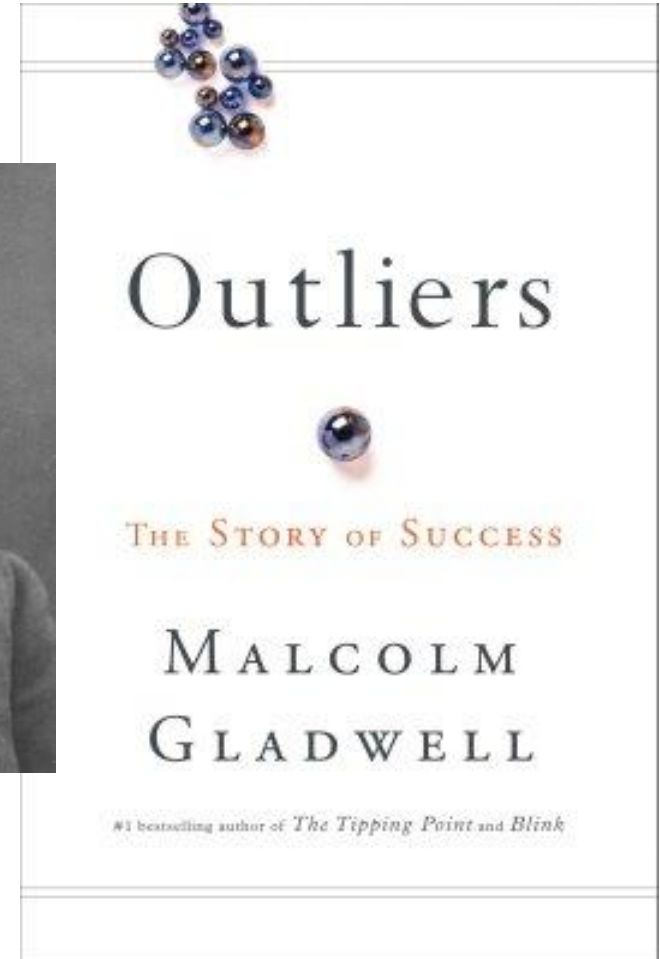
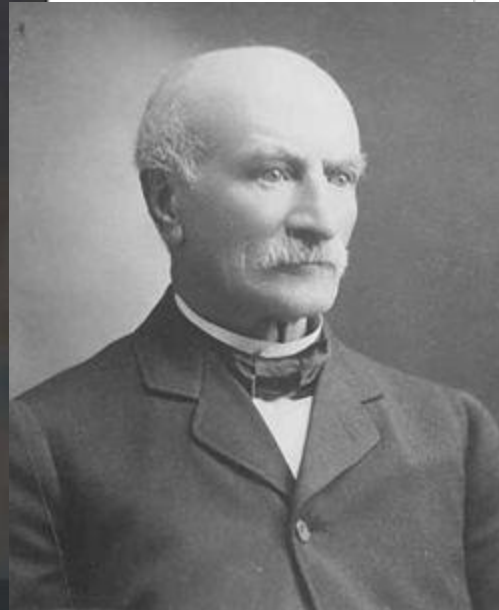
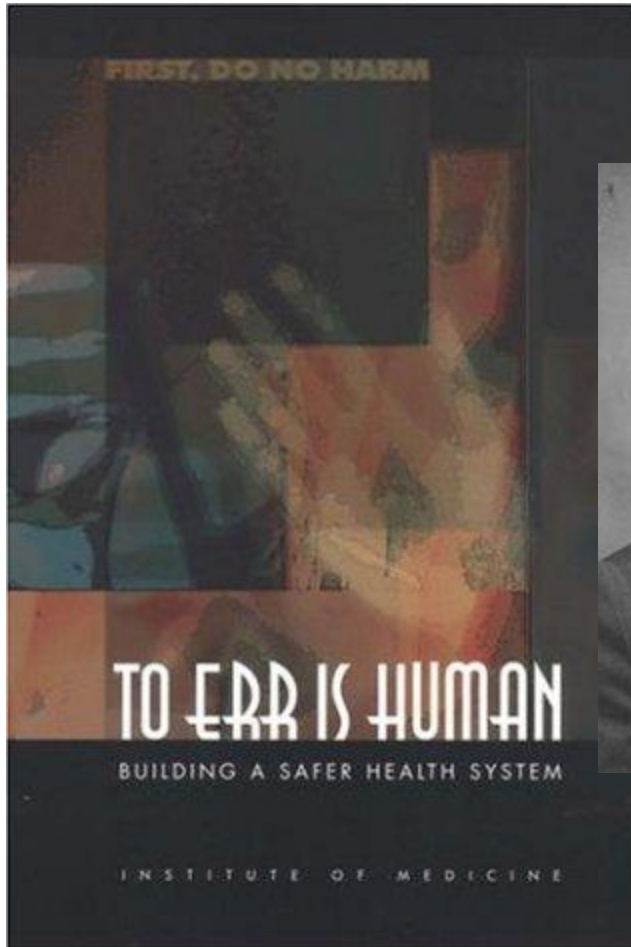


# Errors Eliminate Profits

- **Minor Complication**
  - Revisit eliminates all profit from the original surgery
- **Major Complication**
  - Revisit costs 3X the profit 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)

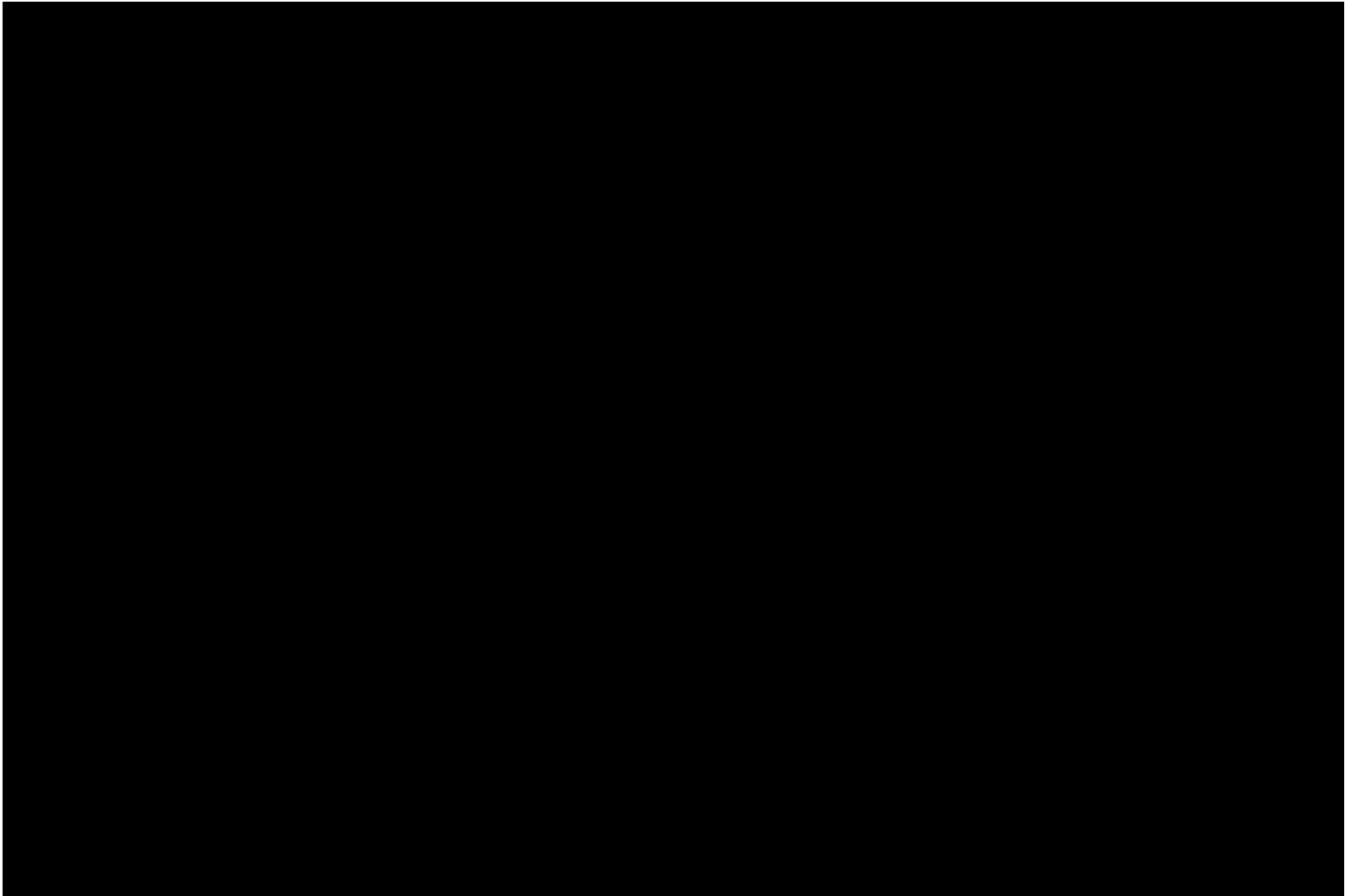




# “The Perfect Storm” (Murphy, 2007)

- Risk to patient health. (McDougall, 2007)
- Ethics of practicing on patients. (Satava, 2004; Murphy, 2007)
- Cost is a barrier to training. (Bridges, 1999)
- Insurance coverage of educational actions. (Satava, 2004)
- Working hour limits. (Satava, 2004)
- Availability of training opportunities. (Birden, 2007; Davis, 1999)
- Access to training. (Dunkin, 2007; Spitzer, 1997)
- Complexity of modern surgery. (McDougall, 2007)
- Volume of unique procedures. (Reznick & MacRae, 2006)
- Proficiency-based Medicine. (Murray, 2005)
- Quality of technology. (Murphy, 2007)
- Expectations around computer technologies. (Murphy, 2007)
- Acceptance of technology. (Ziv, 2003)
- Learning from Mistakes. (Ziv, 2005)

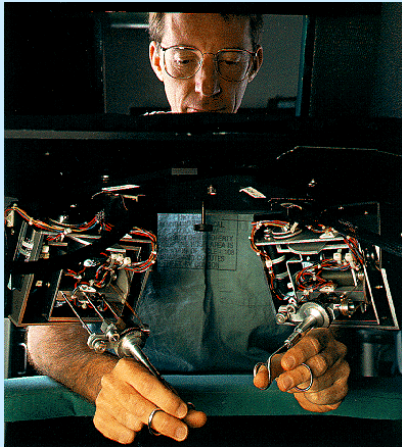
# Intuitive Surgical's da Vinci Robot





# 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:

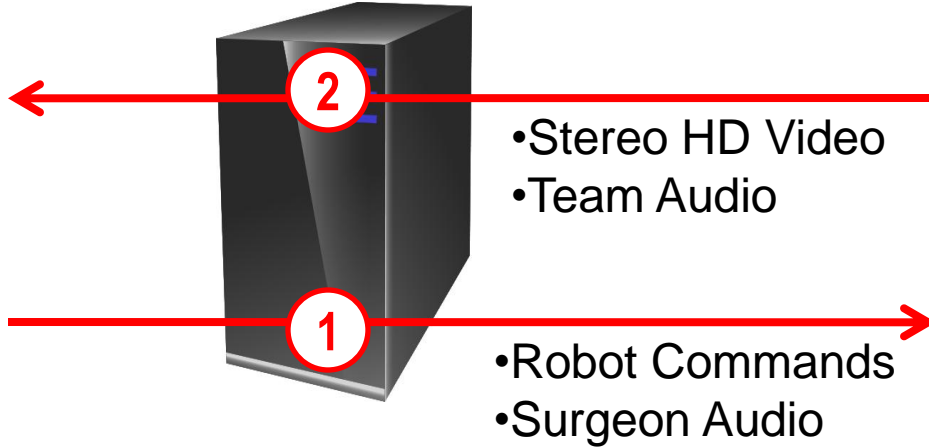
- Define Certification Criteria
- Develop Curriculum
- Develop Training Tasks

### Curriculum Validation:

- Validate the Program
- Identify Testing Measures
- Set Passing Criteria



# Telesurgery: Communication Latency



$$\text{Comm Latency} = 1 + 2$$



# Telesurgery: Simulated Latency



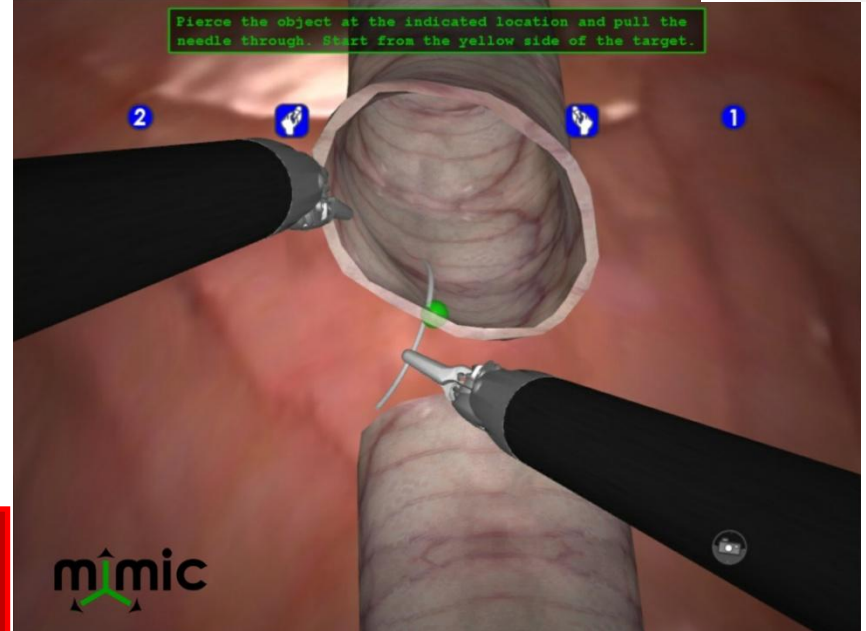
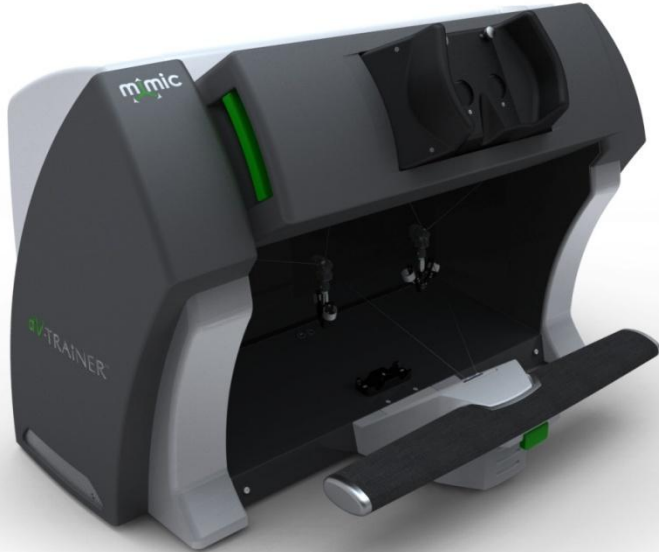
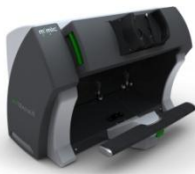
da Vinci Skills Simulator

Mimic dV-Trainer





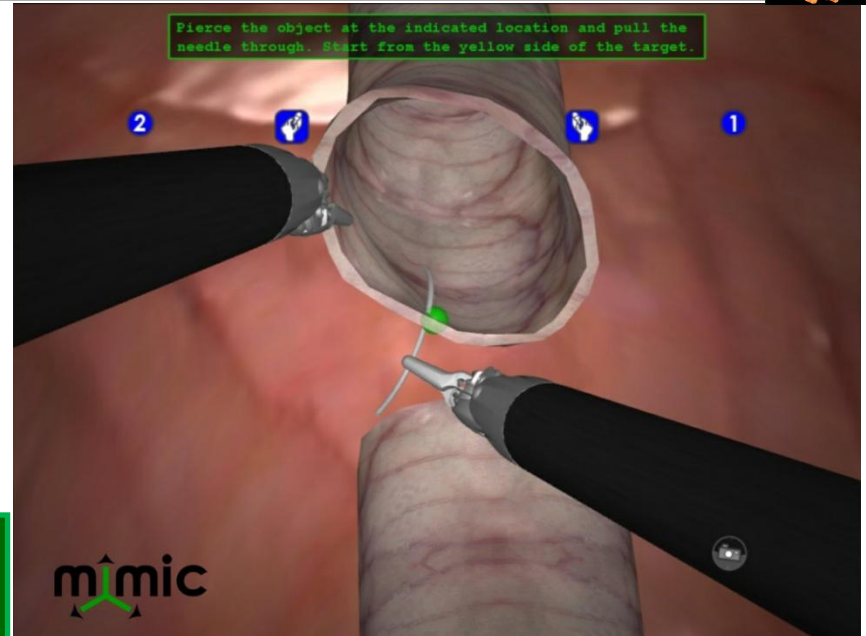
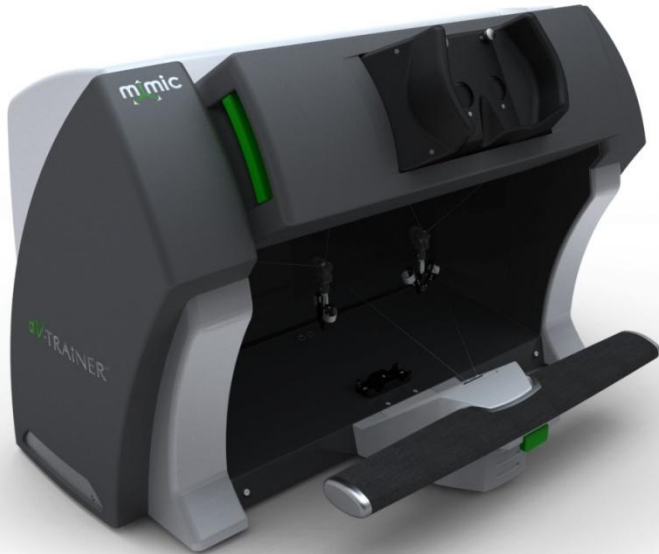
# Simulation: Surgical Rehearsal



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.