The Power of Data and Analytics in Robotic Surgery Simulation

Jeff Berkley, PhD
CEO & Founder
Mimic Technologies, Inc

www.MimicSimulation.com info@MimicSimulation.com (800) 918-1670

Disclosure

Dr. Jeff Berkley is the CEO, Chairman and Founder of Mimic Technologies

Executive Summary

- The clinical battle in robotic is nearly won. The focus is now on cost and efficiency.
- Differences in surgical skill drive patient outcomes and costs. This is is true for robotic surgery as well.
- Identifying the surgeons who need the most help and putting a program in place to help remediate as well as support objective privileging and credentialing is key.
- Strong robotic training programs are focused on “proficiency” and leverage simulation and data to achieve consistency of performance.

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The Clinical Battle Over Robotics is Nearly Won

- Data is beginning to support that robotic surgery is equivalent or superior to open or laparoscopic surgery in the following areas:
  - Urology - Prostate, Kidney, Bladder *(20% of robotic procedures in the U.S. in 2015)*
  - Gynecology - Hysterectomy *(48% of robotic procedures in the U.S. in 2015)*
  - General Surgery - Developing for Hernia and Low Anterior Resection *(28% of robotic procedures in the U.S. in 2015)*
- Robotic surgery is continuing to capture more of the laparoscopic market, despite costs (currently 10% of laparoscopic procedures) with increases in robotic procedures world wide from **570,000 in 2014** to **652,000 in 2015**, according to the 2015 ISI Annual Report
- Capital equipment and instrument costs will decrease with new robotic surgery vendors entering the market and increased robot availability will increase procedure growth

The challenge?

- **More pressure on hospitals to monitor the training and skill levels of surgeons, especially as it relates to managing risks and lowering costs**
- **Increased training demand for credentialing and privileging programs**

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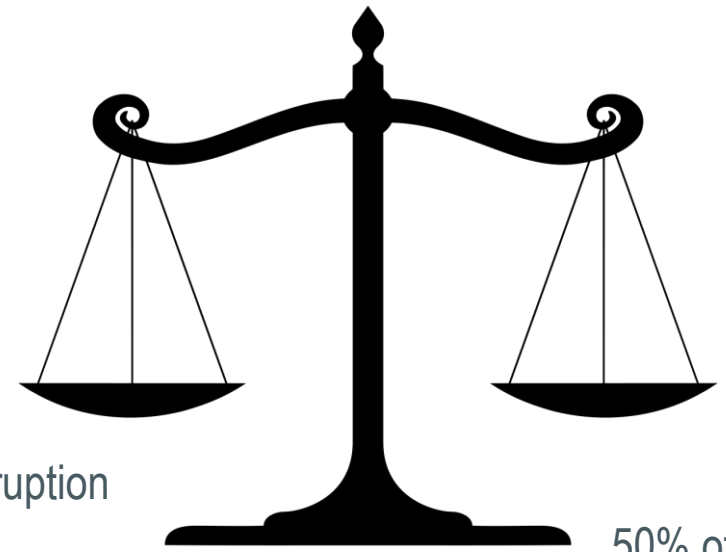
The Current Debate is About Cost



Surgeon Proficiency

50% of costs are related disruption in the OR:

- Consumables
- Setup times
- OR times
- Standardization of Procedures

➢ OR Operational Efficiency Costs

50% of costs are related to inadequate surgical skills and techniques:

- Surgeon console skills
- Clinical decision making
- First Assistant / OR Team skills

➢ OR Surgical Efficiency Costs
➢ Complication Rates
➢ Re-admissions

Surgical Skills and Complication Rates After Bariatric Surgery

Technical skill impacts clinical outcomes

Example:

In a study of bariatric surgeons, who were separated into quartiles based on technical skill assessment, poor performers generated:

- 2.5x more readmissions (6.7% vs 2.7%)
- 3x more complications (14.5% vs 5.2%)
- 5x more deaths than top performers (0.26% vs 0.05%)

This study was conducted with 20 Surgeons and 10,343 patients between August 2006 and August 2012

(Birkmeyer, et al, NEJM, October 2013)

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Examples from Robotic Surgery

Data from 250 surgeons
200,000 robotic cases
36 institutions

Benign Hysterectomy Robotic Only	Avg Op time Hrs	Complications %	LOS Days	Re-Admissions %
Top 25% Volume	*1.5*	*1%*	*<1.0*	*<1.0%*
Bottom 25% Volume	*2.4*	*4%*	*1.8*	*3%*

55 Surgeons
5200 Cases

Cholecystectomy Robotic Only	Avg Op time Hrs	Complications % (major + minor)	LOS Days	Re-Admissions %
Top 25% Volume	*0.60*	*2%*	*<1.0*	*< 1.0%*
Bottom 25% Volume	*1.5*	*6%*	*1.5*	*6%*

Impact of about between $3,900 and $4,550 per case in increased cost for bottom performers tied to skill

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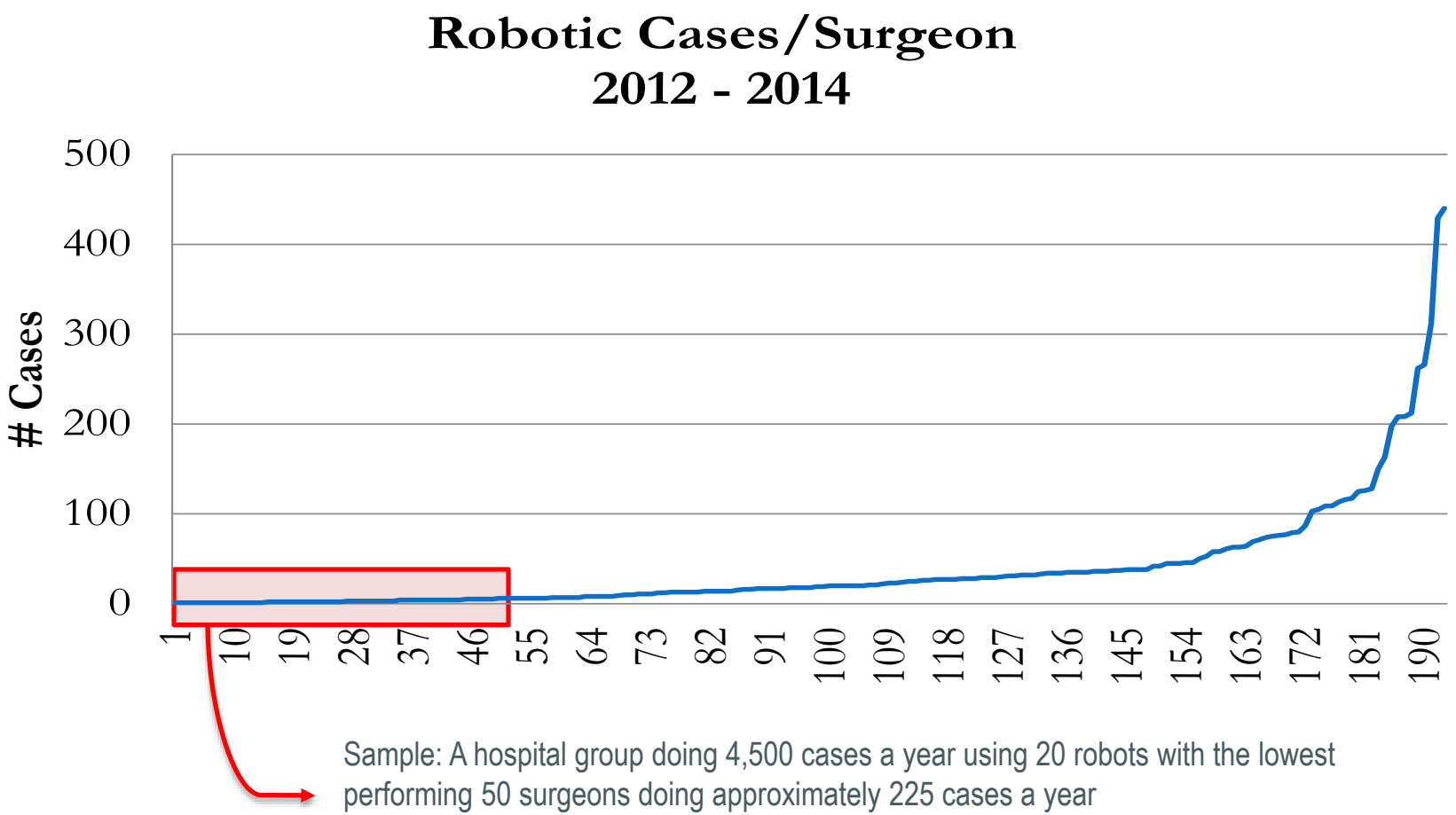
(data / study from CAVA Robotics, Dr. Rick Low et al, 2015)

Cost Model Based on Hysterectomy

Activity	Cost	Top 25%	Cost per case	Bottom 25%	Cost per case	Delta per case
OR Times	$50 per minute	90 mins	$4,500	140 mins	$7,000	$2,500
Complications	$20,000 per complication	1%	$200	4%	$800	$600
LOS	$500 per day	1 day	$500	1.8 days	$900	$400
Re-Admissions	$20,000 per re-admission	1%	$200	3%	$600	$400
Total			$5,400		$9,300	$3,900

Delta = $3,900 per case

Procedural Volumes Across a Surgeon Population



Potential savings from training bottom performing 50 surgeons and teams: $926,200 per year

(data / study from Loftus Health Healthcare Consulting, 2015)

Focus on Performance to Improve Outcomes

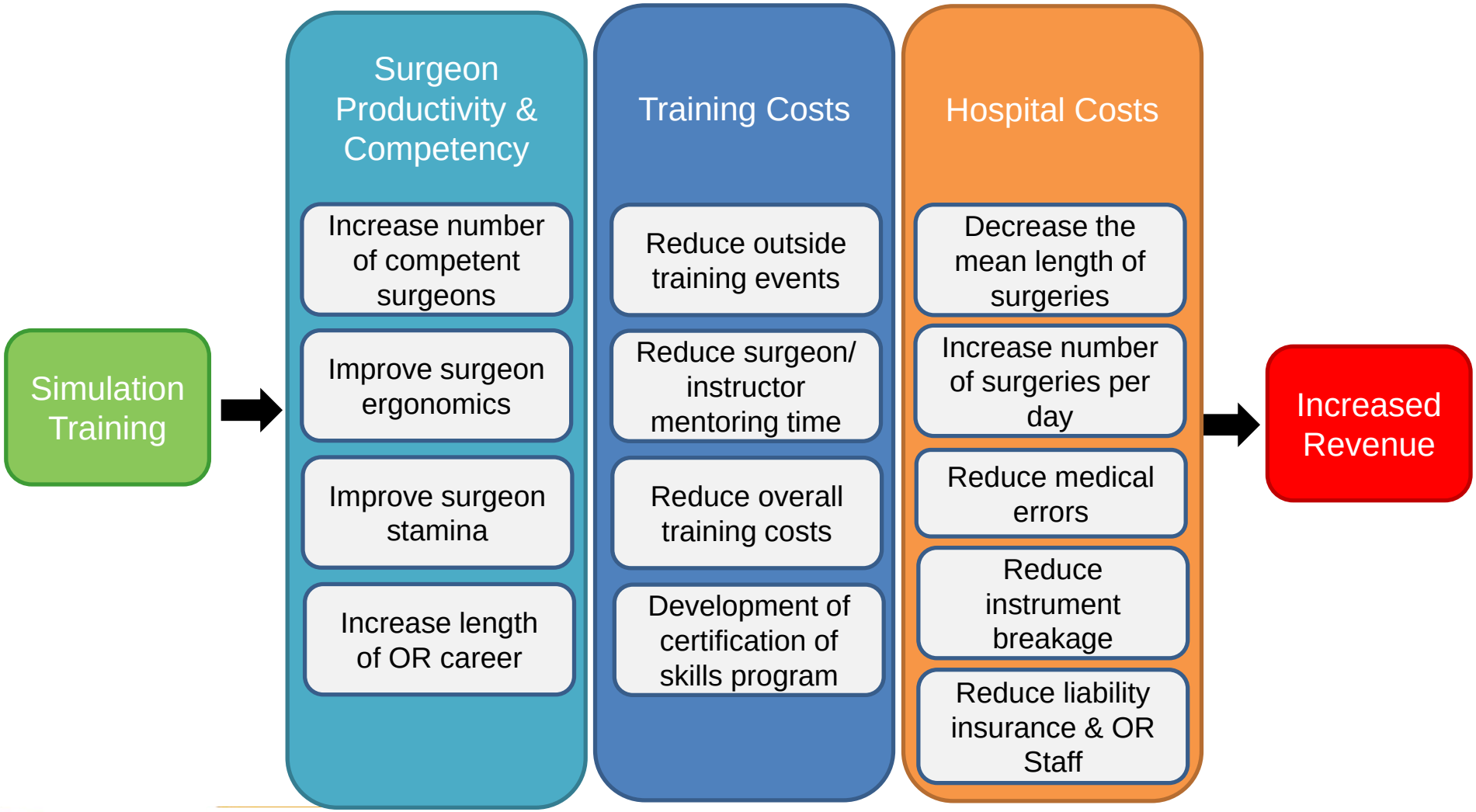
Improvements to existing operations realized through the inclusion of robotic surgery simulation training:

Increasing +	Decreasing -
Surgeon Productivity	Training Costs
Surgeon Stamina	OR Costs
Surgeon Competence	Medical Errors
Surgeon Certification	Instrument Breakage
Surgeon Career Length	Insurance Costs
OR Utilization	

Figure 1. Summary of Simulation Effects on Surgical Practice

Smith, et al, Robotic Simulators: A Case for the Return on Investment

Financial Impact of Robotic Surgery Simulation Training



Effects of Simulation-based Training on Robotic Surgery Business

Smith, et al, Robotic Simulators: A Case for the Return on Investment

What Have We Learned in 10 Years?

- Simulation can help accelerate the learning curve for surgeons without impacting patient safety
- Simulation can help distinguish the innate skill levels of individuals
- Having a structured curriculum is vital to success
- User performance benchmarking through simulation can be used as part of a hospital or institution's risk management strategy

Culligan Study – Morristown Protocol

	Expert Surgeons	Study Group	Control
Number	5	14	4
Demographics	N/A	Same (49.1)	Same (53.5)
Average simulation hours	Some	20 (9.7 to 38.2)	0
Number of cases	Average 142 per year	0	Enough to be granted privileges
Mean Hyst operative times	20.2 Minutes	21.7 Minutes	30.9 Minutes
EBL	25ml	25.4ml	31.25ml
Goals score	50	34.7	31.1

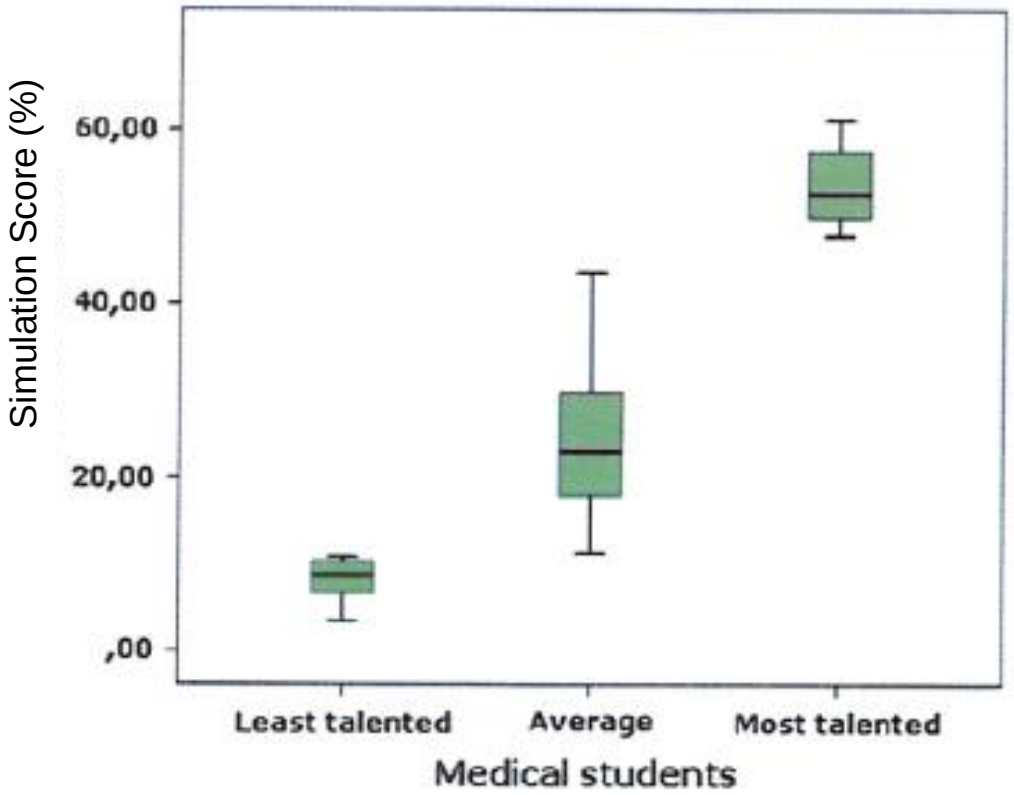
"Completing this protocol of robotic simulator skills translated to expert-level surgical times during live human surgery. As such, we have established predictive validity of this protocol."

(Culligan, et al, FPMRS, Jan/Feb 2014)

Surgical Aptitude Can Be Predicted Through Simulation

- Study completed using 26 simulation exercises
- Statistically differentiated
  - Best 7% of Medical Students
  - Worst 12% of Medical Students

(Moglia, et al, JSE, Jan 2014)
N = 121



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EAU Validated Curriculum (including Simulation Training)

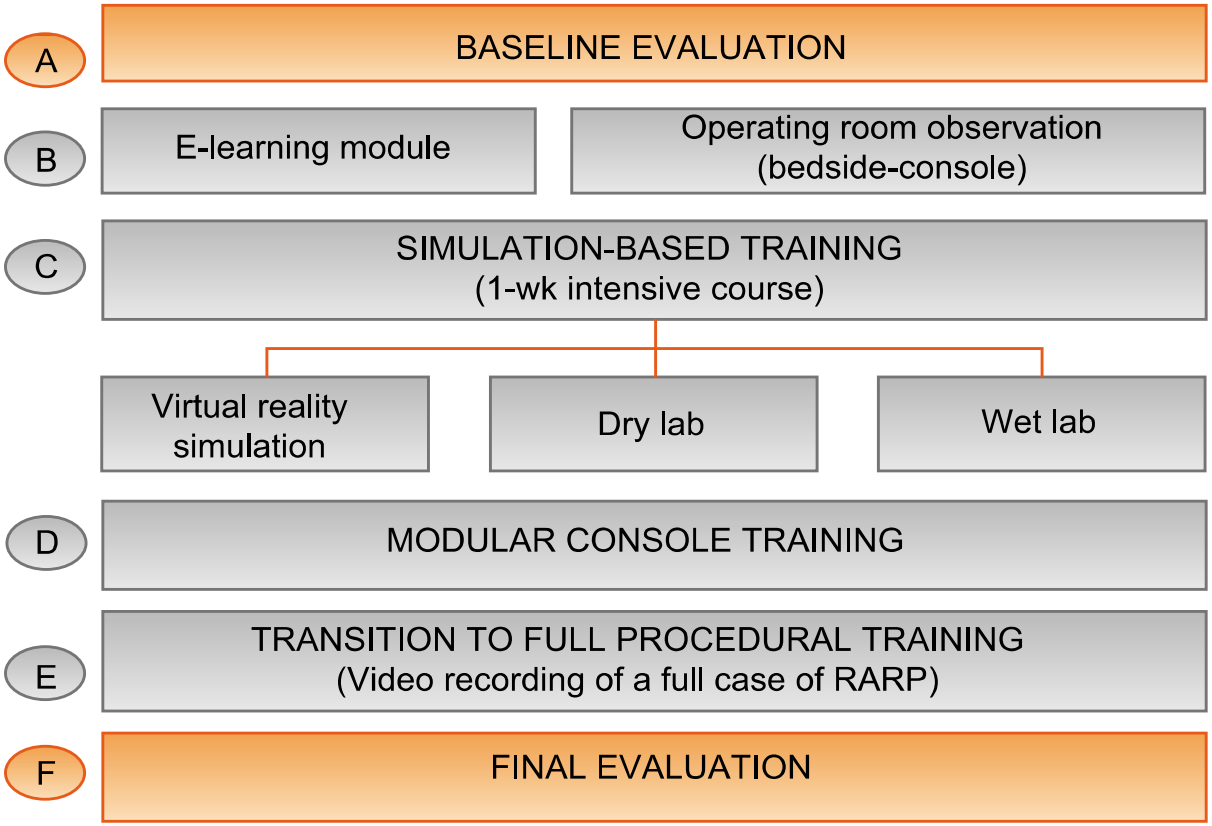

Fig. 1 – Structure of the European Association of Urology Robotic Training Curriculum.

Target time = 12 Weeks

1 week intensive simulation training activity

(Volpe, et al, EAU, Oct 2014)

Continuous Improvement

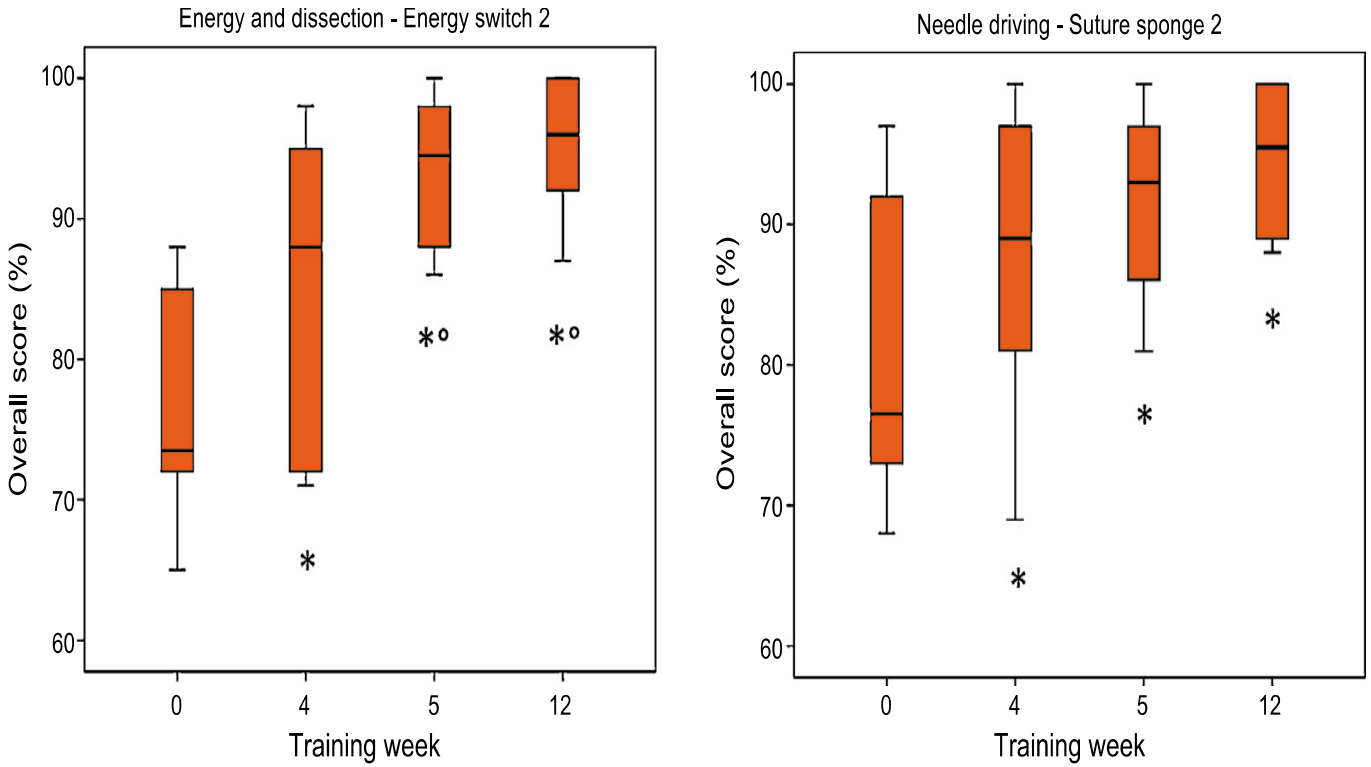

Fig. 2 – Progressive improvement in overall scores for different tasks on the da Vinci surgical simulator before, during (weeks 4 and 5), and after completion of the curriculum. * Significant difference compared to overall score before the curriculum ($p < 0.05$).° Significant difference compared to overall score in week 4 ($p < 0.05$).

Results of the European Association of Urology Robotic Training Curriculum

(Volpe, et al, EAU, Oct 2014)

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Simulation as Part of a Risk Management Strategy

Example:

- A Hospital Group with five hospitals, four robots (1-S & 3-Si), 49 accredited surgeons
- Implemented annual privileging curriculum based on five simulation exercises (one exercise per skill)
- Removed robotic surgery privileges from four surgeons due to inability to pass required curricula:
  - Too much tremor
  - Eyesight deterioration / lack of depth perception

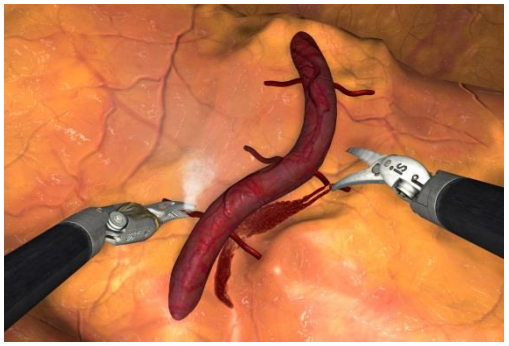
The Importance of Proficiency

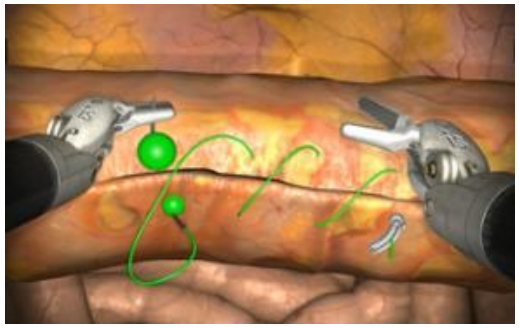
- To become a good surgeon trainees need to become proficient at:
  - Technical Skills
  - Clinical Decision Making
  - Teamwork

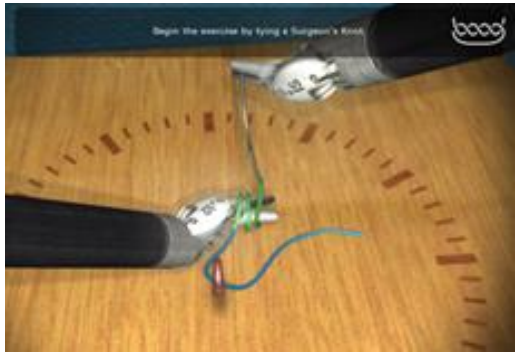
- Proficiency can be measured through simulation by the implementation of:
  - Structured curriculum
  - Agreed expert level performance benchmarks
  - Specified numbers of required passes
    - Ex. two consecutive, five non-consecutive

What Does an Excellent Training Program Look Like?

- Individuals are uniquely identified and training results and data are recorded
- Proficiency levels are discussed and agreed upon
- Curriculum has been developed, assigned to users and measured regularly
- Simulation platforms are easily accessible
- Simulation time is transferable to the real tool
- Teams can train together
- Cognitive and psychomotor skills can be validated







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How Can We Achieve Maximum Results?

- Data is key in monitoring and tracking surgeon training progress
  - Objectively determines true proficiency
  - Helps to identify trends and weak areas
  - Allows for comparison between users and institutions

Conclusion – Discussion Points

- Do you know how your robotic surgical program is doing?
- Do you track the differences in outcomes and costs of the surgeon population?
- Do you know what % of surgeries are performed by your top and bottom 25%?
- Are you focusing on the amount of training completed or reaching proficiency with a data feedback loop?
- Is objective data a key component of your privileging and credentialing program?

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Questions