

# **Paradigm Shift in Surgical Training with Robotic Surgery and New Technology**

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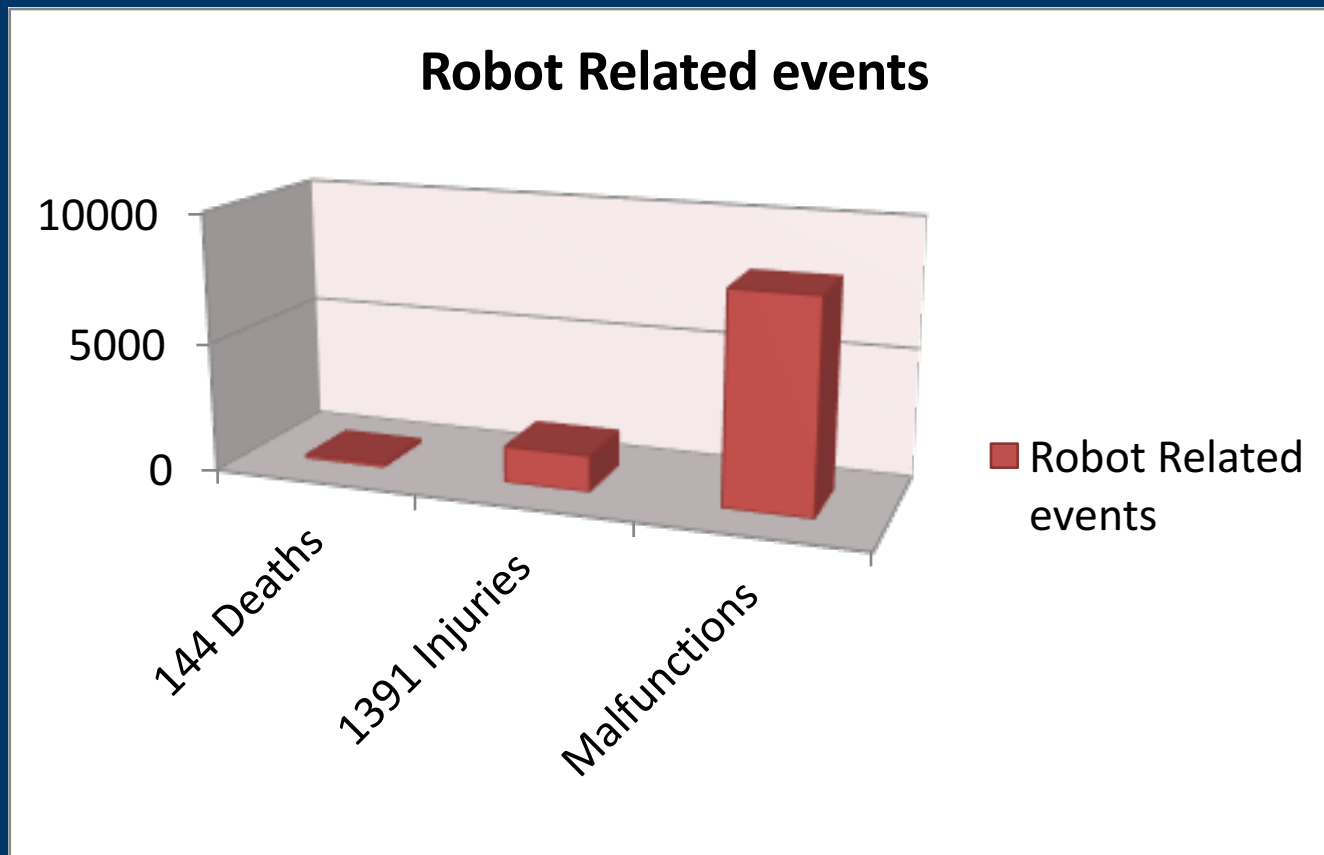
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**3,000 da Vinci units are in use worldwide, and about 100,000 physicians have been trained to use them since the first was introduced in 2000**

# Chronology of Robotic Surgery

- Surgical technologies need to mature
- Between 2000 and 2013: 1.7 millions procedures performed
- Robotic Related Adverse events in MAUDE database - FDA reports
- Manufacturer and User Facility Device Experience (“MAUDE”)



Presented as the J. Maxwell Chamberlain Memorial Paper for adult cardiac surgery at the 50th Annual Meeting of the Society of Thoracic Surgeons in January 2015

# Examples of Growth in Robotic surgery

- **2013 JAMA study reported that robotic hysterectomy increased almost 1,000% between 2007 and 2010 — from 0.5% to 9.5% of all hysterectomies**

Rush to Robotic Surgery Outpaces Medical Evidence, Critics Say

MANAGED CARE [May 2014](#)

# Safety and Sustainability

- Source of compromise for surgeons or residents in training
- Depends of how many procedures are performed by a particular surgeon
- Surgical specialties, for **which robots are extensively used**, such as gynecology and urology, had **lower number** of injuries, deaths, and conversions per procedure than more complex surgeries, such as cardiothoracic and head and neck (106.3 vs. 232.9, Risk Ratio = 2.2, 95% CI, 1.9-2.6)
- Outcomes in Robotic assisted Surgery seem to correlate with individual surgeon experience. For example, in cancer surgery, surgeons with more experience are more likely to have clean margins.
- Not only is there potential for human error in operating the robotic technology, but an added risk of mechanical failure is also introduced
- Trainees in surgery still expected to build embodied competence through “live” experience
- Intense Focus on simulators: “The aviation model”

Adverse Events in Robotic Surgery: A Retrospective Study of 14 Years of FDA Data

# Safety and Sustainability

- In Securities and Exchange Commission filings, Intuitive Surgical acknowledges that it is defending “about 50” individual product liability lawsuits
- Another scrutiny in 2014 when Makary published a study in the Journal for Healthcare Quality stating that hospitals underreported complications
- What are the consequences on Robotic surgery training?

Rush to Robotic Surgery Outpaces Medical Evidence, Critics Say

MANAGED CARE [May 2014](#)

# Economics and Sustainability

- The break-even number for cost equivalence between open and Robotic prostatectomies is 270 cases/year
- In Average, the typical robotic operation costs about \$2,000 more than its traditional counterpart
- In gynecologic surgery, the story is different: 2 extra hospital days stay compared to laparoscopy were added to cost of surgery

Rush to Robotic Surgery Outpaces Medical Evidence, Critics Say  
MANAGED CARE [May 2014](#)

# Robotic Surgical Education

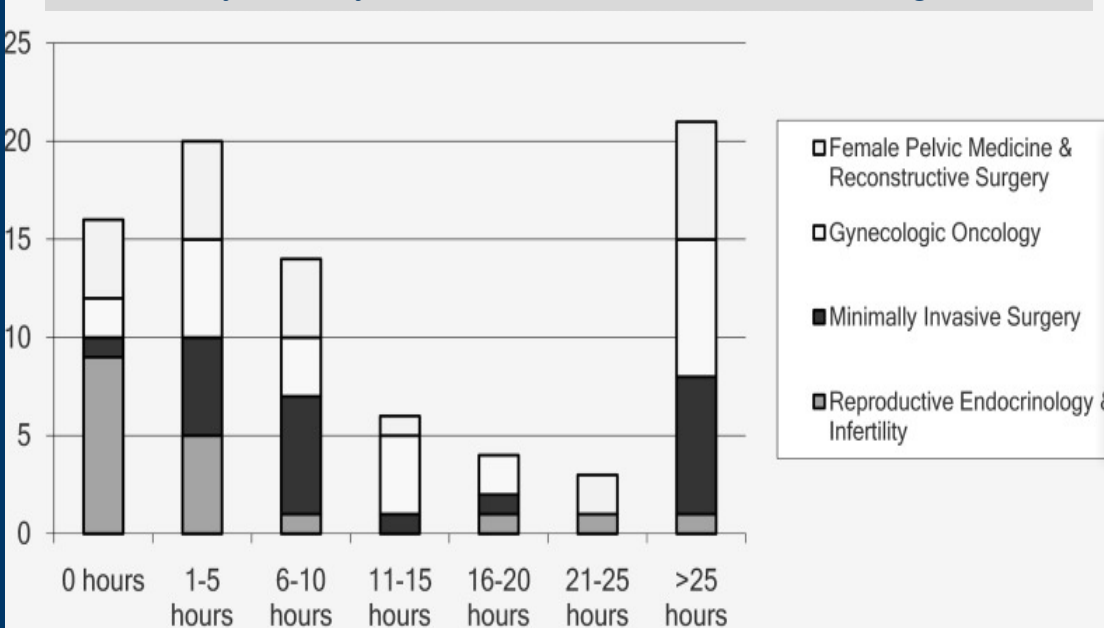
- In 2002 a survey showed that only 23% of surgery program directors had plans to incorporate robotics into their programs
- Varying reports of exactly how many cases are required to master the robotic learning curve, and the number varies by surgical procedure.
- For RALP, the range reported between as low as 40 to as many as 250
- For hysterectomies, a range of 20-50



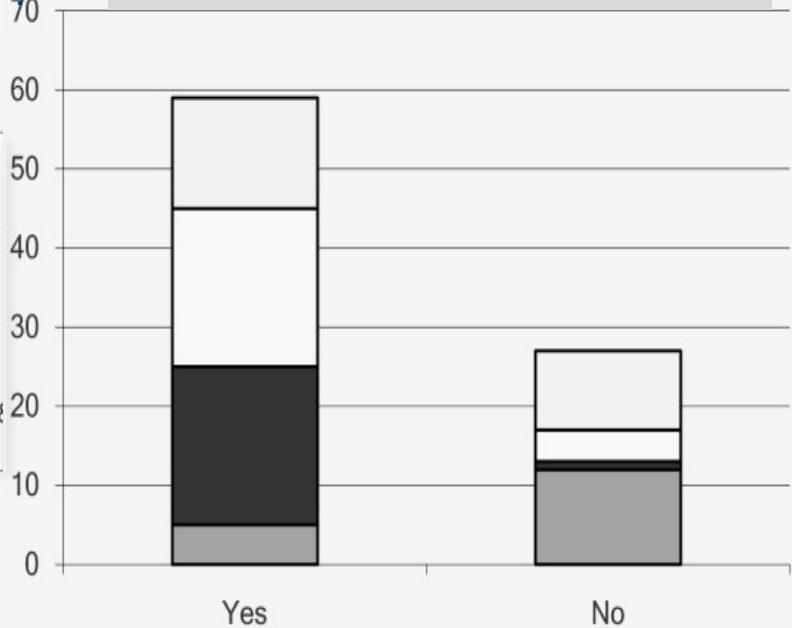
# What is the Current Situation of Robotic Surgery Training?

- Examples of Ob Gyn Fellowships:
- Robotic training built into the fellowship curricula of >80% of MIS and Gyn Onc
- 87% of Gyn Onc fellows will graduate with >50 robotic cases

How many hours/year are dedicated Robotic training education?



Is Robotic training built into curriculum?



# Development of Robotic Surgery Training

- **Complex technologic advancements in surgical robotics require well-designed training programs**
- **Remote, accurate telemanipulation of intracavitary instruments by general and cardiac surgeons is now possible with Robots**
- **Moreover, efficient robotic surgical procedures must be developed methodically and safely implemented clinically e.g. developed at East Carolina University (ECU) with objective-based curriculum levels for Thoracic Teams and surgeons**

[Robotic Surgical Training in an Academic Institution](#)

Ann Surg. 2001 Oct; 234(4): 475–486

# Robotic Surgery Training and Outcomes

*10 years study on 388 patients at Temple University*

- Training chief residents and fellows to perform RARP may be associated with increased operative times, *but does not compromise short-term functional and oncological outcomes*
- There was a difference in mean operative time attending only 89.3 min, attending and fellow 125.4 min, and attending and chief resident 126.9 min.

Can robot-assisted radical prostatectomy be taught to chief residents and fellows without affecting operative outcomes?

Prostate Int. 2015 Jun;3(2):47-50

# Robotic Surgery Training Models

- A pilot study at University of Southern California showed that:
  - Structured learning can be implemented in an academic robotic program with high levels of trainee and evaluator participation, encouraging both quantitative and verbal feedback.
  - A proficiency assessment tool developed for step-specific proficiency has construct and concurrent validity i.e. average *Proficiency Score* increased with PGY year for basic and intermediate steps

Structured learning for robotic surgery utilizing a proficiency score: a pilot study

World J Urol. 2016 Apr 22

# The Reality of Robotic Training for Residents is Different

- **Assessment of robotic simulation by trainees in residency programs of the Southeastern Section of the American Urologic Association by Mayo Clinic**
  - 53.1% reported never having had robotic console time
  - 65.6% had access to the Mimic dV-Trainer or simulation trainer
  - 34% had no simulation exposure
- **For 84.4% the simulator replicated real-life robotic console surgery and 90.6% felt the simulator was helpful or would be helpful for training in their program**
- **Most difficult task to perform: vesico-urethral anastomosis.**

Assessment of robotic simulation by trainees in residency programs of the Southeastern Section of the American Urologic Association

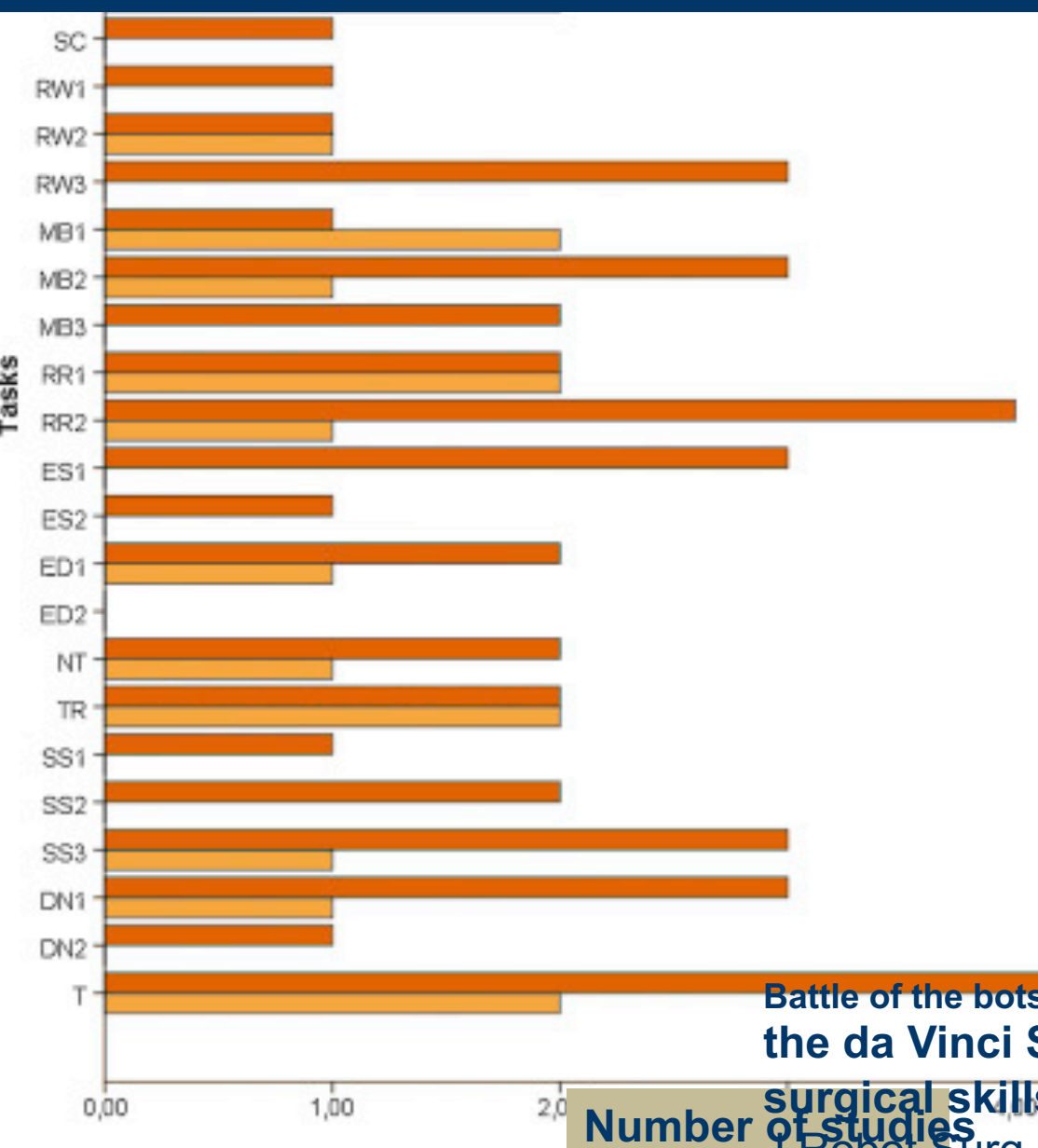
J Surg Educ. 2013 Sep-Oct;70(5):571-7.

# The Role of Simulators

- **Systematic review-June 2016, in European Urology, on 36 studies of randomized controlled trials, observational and validity study cohorts**
- **Overall there is no evidence on the transfer of skills gained using virtual simulators to the operating room**
- **Need for multicenter RCTs studies to have verified conclusions**

**A Systematic Review of Virtual Reality Simulators for Robot-assisted Surgery** Eur Urol. 2016 Jun;69(6):1065-80

# Core exercises available for the dV-Trainer and da Vinci Skills Simulator (dVSS) evaluated by numerous validity studies



PP = pick and place; PB1 = peg board 1; PB2 = peg board 2;  
 CT1 = camera targeting 1; CT2 = camera targeting 2;  
 SC = scaling; RW1 = ring walk 1; RW2 = ring walk 2; RW3 = ring walk 3;  
 MB1 = match board 1; MB2 = match board 2; MB3 = match board 3;  
 RR1 = ring and rail 1; RR2 = ring and rail 2; ES1 = energy switching 1;  
 ES2 = energy switching 2; ED1 = energy dissection 1; ED2 = energy dissection 2;  
 NT = needle targeting; TR = thread the rings; SP1 = suture sponge 1;  
 SP2 = suture sponge 2; **SP3 = suture sponge 3; DN1 = dots and needles 1; DN2 = dots and needles 2; T = tubes**

Battle of the bots: a comparison of the standard the da Vinci Surgical Skills Simulator

Number of studies surgical skills acquisition  
 Robot Surg 2016 Aug 29

# Barriers to Efficiency in Robotic Surgery : The Resident Effect v/s New Technology Effect

- Surgery flow disruptions encountered in resident training are more frequent but may not significantly increase operative duration.
- Equipment related flow disruptions or external factors, may be more impactful.
- Limiting these specific barriers should be the focus of performance improvement efforts without compromising resident training in a recent study in the Journal of Surgical Research in 2016

Incorporating resident/fellow training into a robotic surgery program  
J Surg Oncol. 2015 Dec;112(7):689



# Maintaining Open Surgical Skills

- Obviously, open surgical skills still remain vital
- As pointed out by Hoag and colleagues, open skills are needed for cases not amendable to MIS or in situations where conversion to open is required
- With the establishment of MIS as standard of care for many urologic surgeries, the *decrease in open operative experience is concerning*
- Organ procurement provides excellent exposure to anatomy throughout the pelvis, abdomen and retroperitoneum

[Can Urol Assoc J. 2014 Jan-Feb;8\(1-2\):39.](#)

[Maintaining open surgical skills in current day urology residency.](#)

[McGregor TB<sup>1</sup>](#)

# Means of Increasing Open Surgical Experience During Urology Residency Training

- 17.25 organ procurements can be performed by urology resident trainees over their 5-year residency in American / Canadian programs
- 3.45 procurements per urology resident/per year
- Current average participation rate 0.95 procurements / 5 years of training in a Royal college of surgeons survey for Canadian residents
- Organ procurement may be a viable option to enrich open surgical experience among Canadian trained urology residents

**Organ procurement surgery as a means of increasing open surgical experience during urology residency training**

[Can Urol Assoc J.](#) 2014 Jan-Feb; 8(1-2): 36–38.

# Residency Training Program Paradigms for Teaching Robotic Surgical Skills to Urology Residents

- Robotic-assisted surgery may become an integral component of residency training programs in the future
- An important aspect is compensation for the cost involved in robotic training establishment without compromising the quality of education provided
- Potential solutions to aid our current lack of open surgical experience for urology residents
- Will we need to implement open surgical fellowships? One would never have imagined we'd have to ask this question!

[Curr Urol Rep.](#) 2010 Mar;11(2)

Residency training program paradigms for teaching robotic surgical skills to urology residents

# Next Wave of Development in Surgical Technology

- **Google's joint venture on robotic surgery with Johnson & Johnson – would extend minimally invasive surgery : “The Verb Robot”**
- **IBM Watson – early diagnosis of cancer**

**Beyond safety: Is robotic surgery sustainable?**

Robohub July 2015