Training and Simulation in MIS

34TH ANNUAL
CONTROVERSIES, PROBLEMS
& TECHNIQUES IN SURGERY

Montefiore EINSTEIN

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Disclosures

- Bard/Davol – advisory board
- KCI/Acelity - research grant

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Medical School

PG training / Hands-on courses

All improvements are illusory and temporary if knowledge, experience and skills cannot be or are not transmitted to future generations of practitioners of the art and science of surgery. ?

Ambroise Paré – 1510-1590

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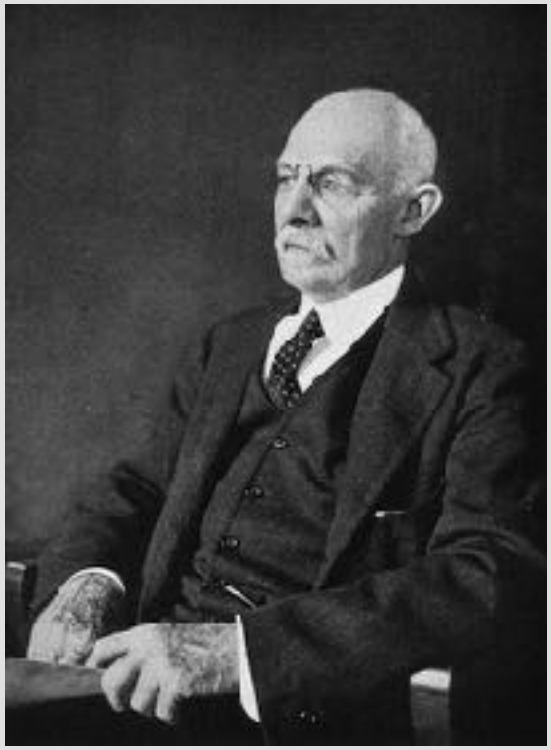
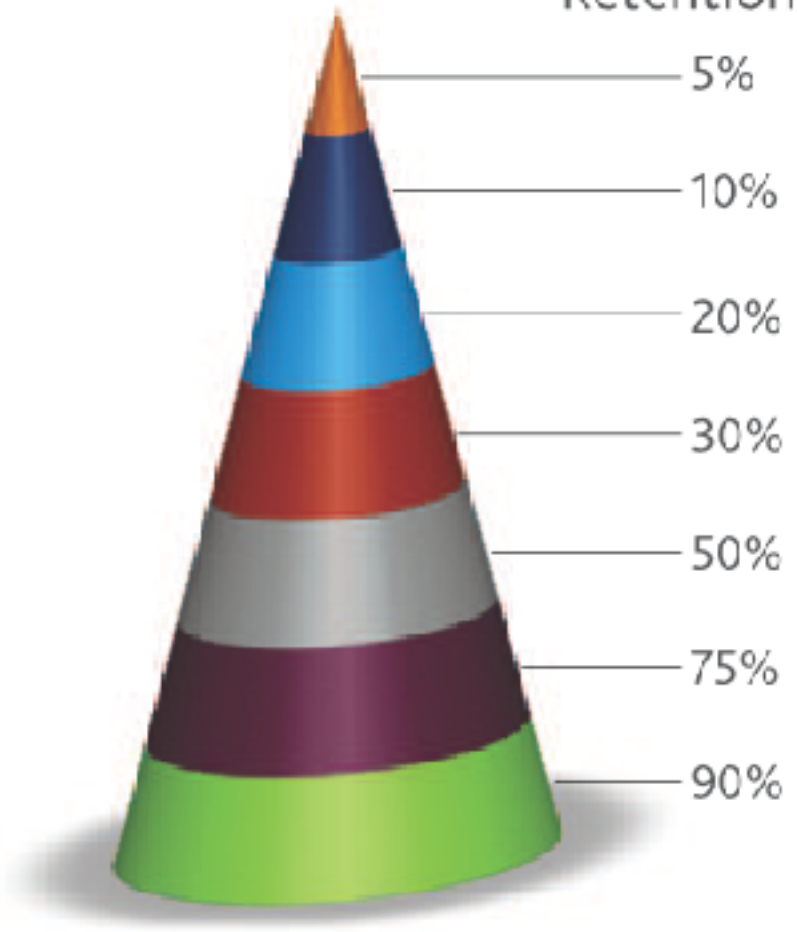
Apprentice Model

- Watch one
- Do one
- Teach one



William Stewart Halsted (1852 –1922)

The Learning Pyramid*



*National Training Laboratories
Bethel, Maine

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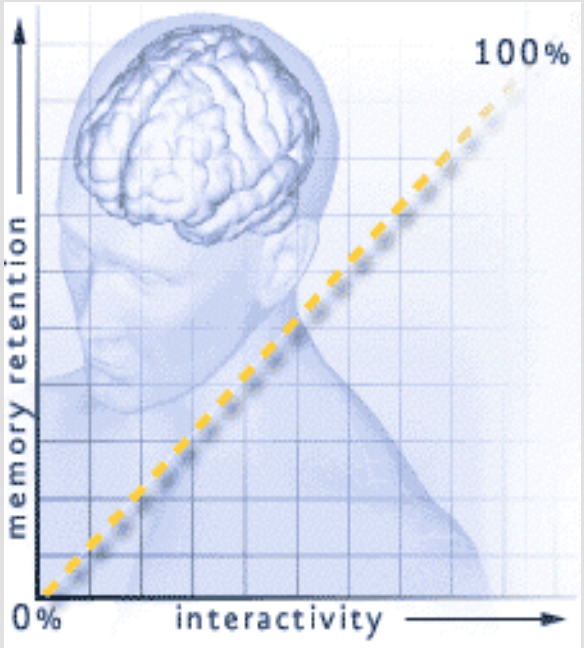
Human Learning: Level of Interactivity

	Retention	
Teach Others	**90%**	**Collaborative Simulations**
Learn By Doing	**75%**	**Simulations**
Discussion Groups	50%	Web Seminars, IM, chat
Demonstration	30%	Animation
Audio Visual	20%	PowerPoint Slides
Lecture	5%	Streaming media

Source: Andersen Consulting



- **Interaction** is associated with learning achievement and retention of knowledge
- Participants **learned faster** and had **better attitudes** when they used an interactive instructional environment

Najjar, L. J. (1998). Principles of educational multimedia user interface design. *Human Factors*, 40(2), 311-323.

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"The more I practice, the luckier I get."

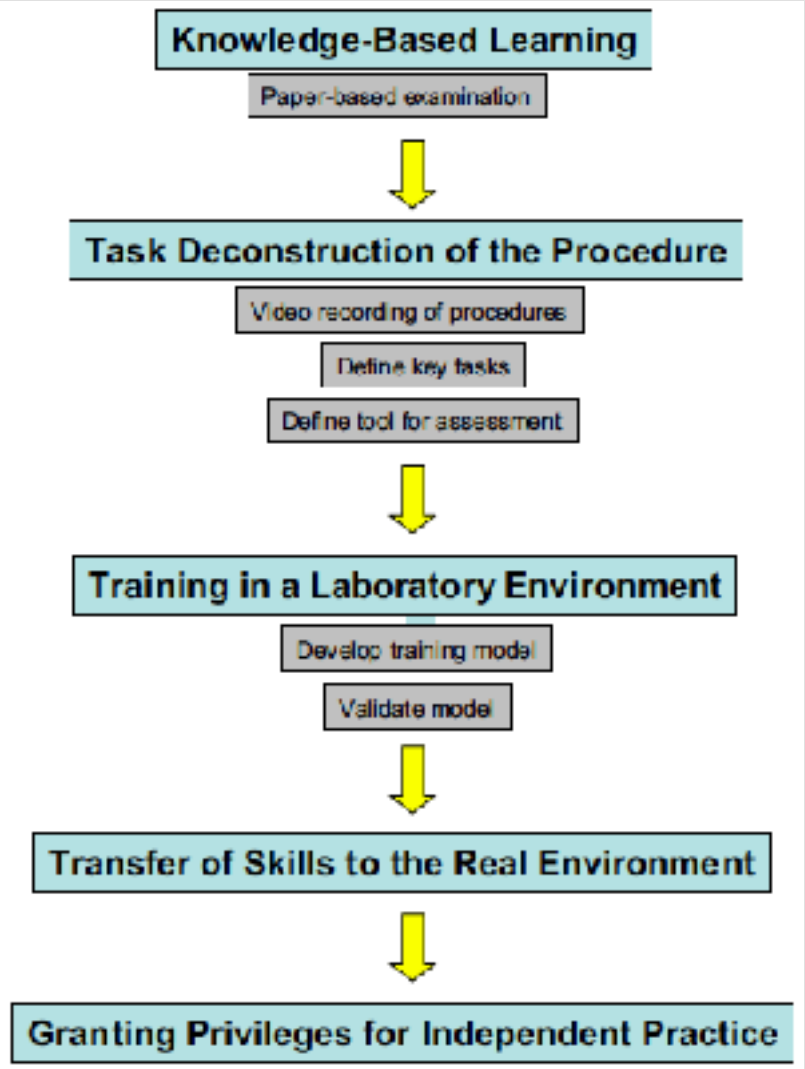
Gary Player 1936 -

Framework for Systematic Training and Assessment of Technical Skills

Aggarwal R. JACS 2007; 204 (4): 697-705

Rajesh Aggarwal, MA, MRCS, Teodor P Grantcharov, MD, PhD, Ara Darzi, KBE, MD, FACS, HonFREng, FMedSci

- Split procedures in tasks
- It is NOT necessary to perform the whole procedure each time, but its essential steps



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P ex TAPP

1. Trocar placement
2. Peritonial incision and flap creation
3. Direct sac reduction
4. Cord exploration
5. Final ANATOMY review
6. Mesh positioning & fixation
7. Peritonial closure

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Mental Training

Mental Training in Surgical Education

A Randomized Controlled Trial

Marc Immenroth, PhD, Thomas Bürger,‡ Jürgen Brenner, MD,‡ Manfred Nagelschmidt, PhD,§ Hans Eberspächer, PhD,† and Hans Troidl, MD§* (*Ann Surg* 2007;245: 385–391)

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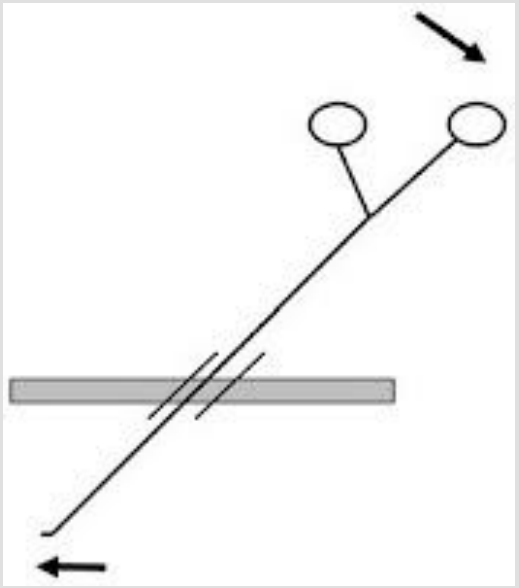
What differs in laparoscopy?



- Monocular vision: 2D
- Magnification
- Steady access by the trocars
- Less ROM
- Fulcrum effect
- Long instrument: amplifies tremor, less haptic feedback

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App 550 k/y, 45% MIS
Colon 350 k/ano, 19% MIS
Herniorraphy 700 k/ano, 13% MIS

Procedure	Chief Year	Total Residency
Cholecystectomy	25.0	103.1
Appendectomy	6.2	27.7
Inguinal hernia	5.3	14.4
Anti-Reflux	2.4	4.6
Bariatric (open + lap)	5.8	12.1
Colon resection	6.3	10.9

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MIS Training

- Suboptimal animal models
- Rare dry lab models
- Expensive cadaveric lab

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SIMULATION

Webster's Dictionary:

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Practice vs Simulation

Simulation's greatest strength is its ability to answer "what if" questions...

A Systematic Review of Skills Transfer After Surgical Simulation Training

(*Ann Surg* 2008;248: 166–179)

Lana P. Sturm, BSc (Hons), John A. Windsor, BSc, MBChB, MD, FRACS, FACS,† Peter H. Cosman, BA, MB, BS, FRACS,‡ Patrick Cregan, MBBS, FRACS,§ Peter J. Hewett, MBBS, FRACS,¶ and Guy J. Maddern, PhD, FRACS*‖***

- 1A, A
- 10 RCT

Conclusions: Skills acquired by simulation-based training seem to be transferable to the operative setting. The studies included in this review were of variable quality and did not use comparable simulation-based training methodologies, which limited the strength of the conclusions. More studies are required to strengthen the evidence base and to provide the evidence needed to determine the extent to which simulation should become a part of surgical training programs.


Atraumatic Grasper
Jaws opening 3 cm
Curved Scissors
40.0 W
Cut
Coag
120 mmHg
Insufflation pressure
Finish

Virtual reality training for surgical trainees in laparoscopic surgery

The Cochrane Collaboration

Working together to provide the best evidence for health care

Cochrane Database Syst Rev. 2009 Jan 21;(1):CD006575.

Gurusamy KS, Aggarwal R, Palanivelu L, Davidson BR.

- 23 trials (612 participants)
- Improved performance in trainees: Shorter time, better accuracy, less errors

Virtual reality training can supplement standard laparoscopic surgical training of apprenticeship and is at least as effective as video trainer training in supplementing standard laparoscopic training. Further research of better methodological quality and more patient-relevant outcomes are needed.

Effect of virtual reality training on laparoscopic surgery: randomised controlled trial

BMJ 2009;338:b1802

Christian R Larsen, clinical research fellow,[1] Jette L Soerensen, assistant professor and consultant,[2] Teodor P Grantcharov, assistant professor and consultant,[3] Torur Dalsgaard, consultant,[4] Lars Schouenborg, consultant,[4] Christian Ottosen, consultant,[4] Torben V Schroeder, professor and consultant,[5] Bent S Ottesen, managing director and professor at the Juliane Marie Centre[6]

1B, A

Table 2 | Impact of virtual reality simulator training on surgical performance and operation time. Values are medians (ranges; interquartile ranges) unless stated otherwise

	Simulator trained group	Control group

Conclusion Skills in laparoscopic surgery can be increased in a clinically relevant manner using proficiency based virtual reality simulator training. The performance level of novices was increased to that of intermediately experienced laparoscopists and operation time was halved. Simulator training should be considered before trainees carry out laparoscopic procedures.

State of the Evidence on Simulation-Based Training for Laparoscopic Surgery

A Systematic Review

Zendejas B. Ann Surg 2013; 257 (4): 586-93

- 1A, A (42% RCT)
- 219 studies - 7138 trainees
- Comparison with NO training -> improvement at all levels
- Training boxes = VR for skills acquisition
- Instructor presence did NOT change results

Conclusions: Simulation-based laparoscopic surgery training of health professionals has large benefits when compared with no intervention and is moderately more effective than nonsimulation instruction.

Is the skillset obtained in surgical simulation transferable to the operating theatre?

The American Journal of Surgery (2014) 207, 146-157

Christina E. Buckley, M.B., B.Ch., B.A.O.*, Dara O. Kavanagh, M.Ch., F.R.C.S.I., Oscar Traynor, M.Ch., F.R.C.S.I., Paul C. Neary, M.D., F.R.C.S.I.

- 16 trials (309 participants)
- Operative time improved consistently in ALL trials
- Better objectives scores in 80-88% of the trainees

CONCLUSIONS: The current literature consistently demonstrates the positive impact of simulation on operative time and predefined performance scores. However, these reproducible measures alone are insufficient to demonstrate transferability of skills from the laboratory to the operating room. The authors advocate a multimodal assessment, including metrics, the Objective Structured Assessment of Technical Skills, and critical step completion. This may provide a more complete assessment of operative performance. Only then can it be concluded that simulation skills are transferable to the live operative setting.

Teaching and training in laparoscopic inguinal hernia repair (TAPP): impact of the learning curve on patient outcome

Ulf Bökeler · Jochen Schwarz · Reinhard Bittner · Steffi Zacheja · Constantin Smaxwil

Surg Endosc (2013) 27:2886–2893
DOI 10.1007/s00464-013-2849-z

3 groups:
254 by trainees / 3200 by experts / 254 pioneers (1993)

Characteristics	Trainee (04/2004–02/2007)	Expert (04/2004–02/2007)	Pioneer (04/1993–02/1994)
Morbidity (%)	3.2 %	2.2 %	14.4 %
Recurrence rate (%)	0.4 %	0.3 %	5.9 %
Operation time, min, mean	59	46	60

Characteristics	Trainee (04/2004–02/2007)	Expert (04/2004–02/2007)	Pioneer (04/1993–02/1994)
Intraoperative complications[a]	0 (0 %)	1 (0.03 %)	3 (1.2 %)
Orchitis	1 (0.4 %)	4 (0.1 %)	1 (0.4 %)
Chronic pain	1 (0.4 %)	17 (0.5 %)	0 (0 %)
Lesion nerves (Nervus cutaneus femoris lateralis)	1 (0.4 %)	5 (0.2 %)	4 (1.6 %)
Other	2 (0.8 %)	26 (0.8 %)	20 (7.9 %)
Total	8 (3.2 %)	70 (2.2 %)	37 (14.4 %)

Virtual Reality Robotic Surgery Warm-Up Improves Task Performance in a Dry Laboratory Environment: A Prospective Randomized Controlled Study

Thomas S Lendvay, MD, FACS, Timothy C Brand, MD, FACS, Lee White, BSc(Hons), PhC, Timothy Kowalewski, PhD, Saikiran Jonnadula, MD, Laina D Mercer, MS, Derek Khorsand, BSc(Hons), Justin Andros, BSc(Hons), Blake Hannaford, PhD, Richard M Satava, MD, FACS

(J Am Coll Surg 2013;216:1181–1192

We observed significant performance improvement and error reduction rates among surgeons of varying experience after VR warm-up for basic robotic surgery tasks. In addition, the VR warm-up reduced errors on a more complex task (robotic suturing), suggesting the generalizability of the warm-up.

Virtual reality laparoscopy: which potential trainee starts with a higher proficiency level?

Int J CARS (2011) 6:653–662

M. Paschold · M. Schröder · D. W. Kauff · T. Gorbauch · M. Herzer · H. Lang · W. Kneist

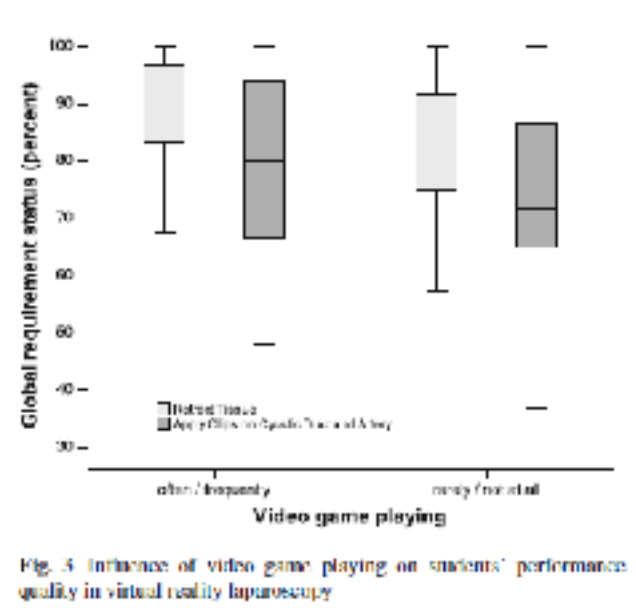
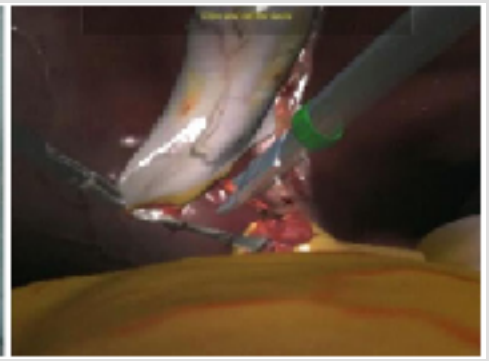


Fig. 5 Influence of video game playing on students' performance quality in virtual reality laparoscopy



Conclusion Frequency of video gaming is associated with quality of first-time VRL performance. Video game experience may be used as trainee selection criteria for tailored concepts of VRL training programs.

"Ah, Mr. Smith! We'll get started as soon as I finish my warmup."

World Journal of Surgery

Published Online: 8 March 2007
World J Surg (2007) 31: 764–772
DOI: 10.1007/s00268-006-0724-y

Augmented versus Virtual Reality Laparoscopic Simulation: What Is the Difference?

A Comparison of the ProMIS Augmented Reality Laparoscopic Simulator versus LapSim Virtual Reality Laparoscopic Simulator

Sanne M.B.I. Botden, MSc,[1] Sonja N. Buzink, MSc,[2] Marlies P. Schijven, MD, PhD,[3] Jack J. Jakimowicz, MD, PhD[1,4,5]

Abstract

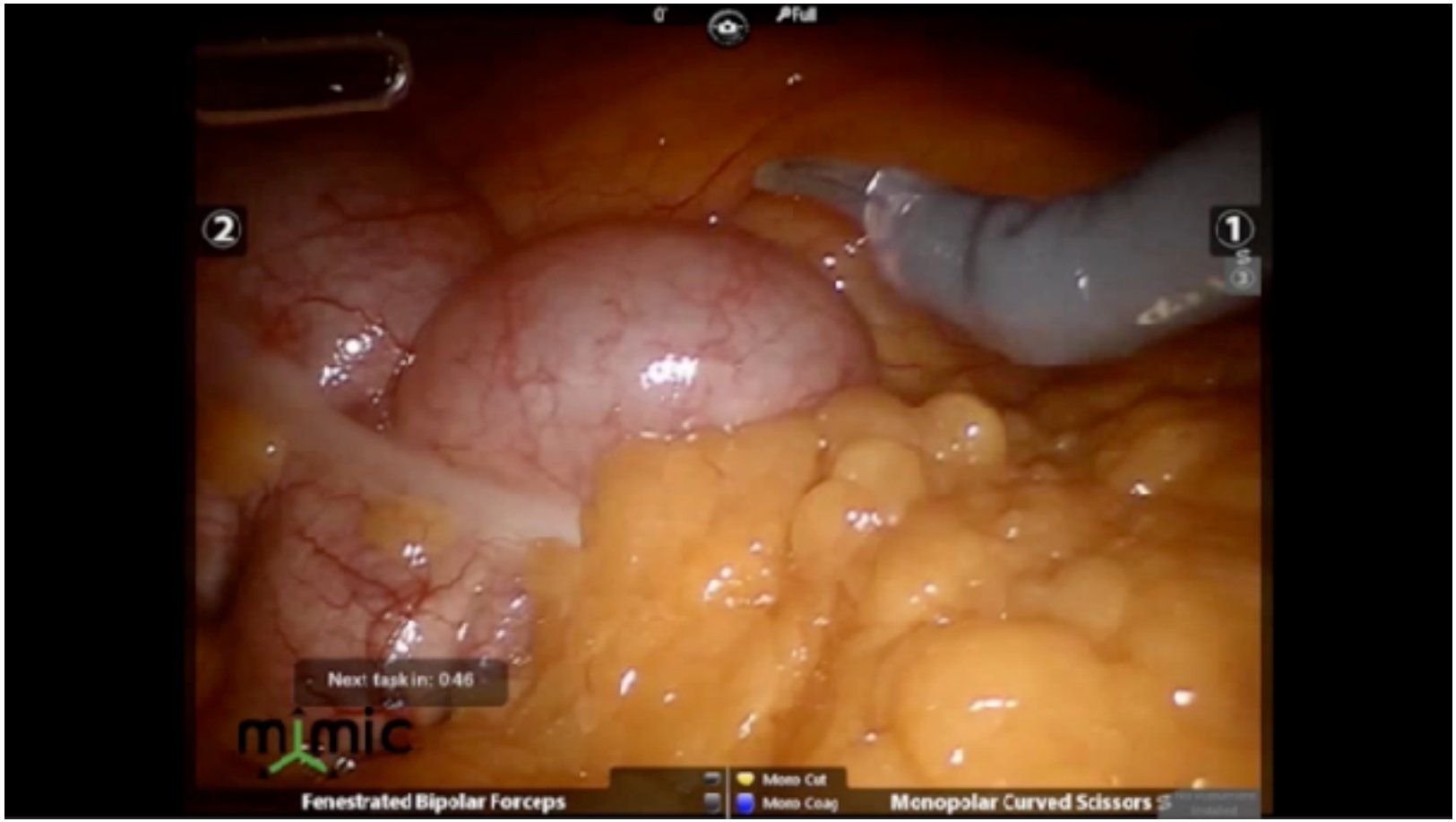
Background: Virtual reality (VR) is an emerging new modality for laparoscopic skills training; however, most simulators lack realistic haptic feedback. Augmented reality (AR) is a new laparoscopic simulation system offering a combination of physical objects and VR simulation. Laparoscopic instruments are used within an hybrid mannequin on tissue or objects while using video tracking. This study was designed to assess the difference in realism, haptic feedback, and didactic value between AR and VR laparoscopic simulation.

Methods: The ProMIS AR and LapSim VR simulators were used in this study. The participants performed a basic skills task and a suturing task on both simulators, after which they filled out a questionnaire about their demographics and their opinion of both simulators scored on a 5-point Likert scale. The participants were allotted to 3 groups depending on their experience: experts, intermediates and novices. Significant differences were calculated with the paired *t*-test.

Results: There was general consensus in all groups that the ProMIS AR laparoscopic simulator is more realistic than the LapSim VR laparoscopic simulator in both the basic skills task (mean 4.22 resp. 2.18, $P < 0.000$) as well as the suturing task (mean 4.15 resp. 1.85, $P < 0.000$). The ProMIS is regarded as having better haptic feedback (mean 3.92 resp. 1.92, $P < 0.000$) and as being more

Physical Reality (Box trainer)	Augmented Reality	Virtual Reality
Advantages • Realistic haptic feedback • Cost-effective	**Advantages** • Realistic haptic feedback • Objective assessment of performance • Interactivity	**Advantages** • Objective assessment of performance • Interactivity
Disadvantages • Subjective assessment • Lack of interactivity	**Disadvantages** • Lack of assessment protocol	**Disadvantages** • Lack of realistic haptic feedback • Lack of assessment protocol

Procedure-Specific Curriculum Augmented reality



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Simulation

- COMPLEMENTS, not substitutes formal surgical training
- CURRICULUM needed, not only the machine
- Proficiency based in competency, not in training time/ exercise numbers or repetitions

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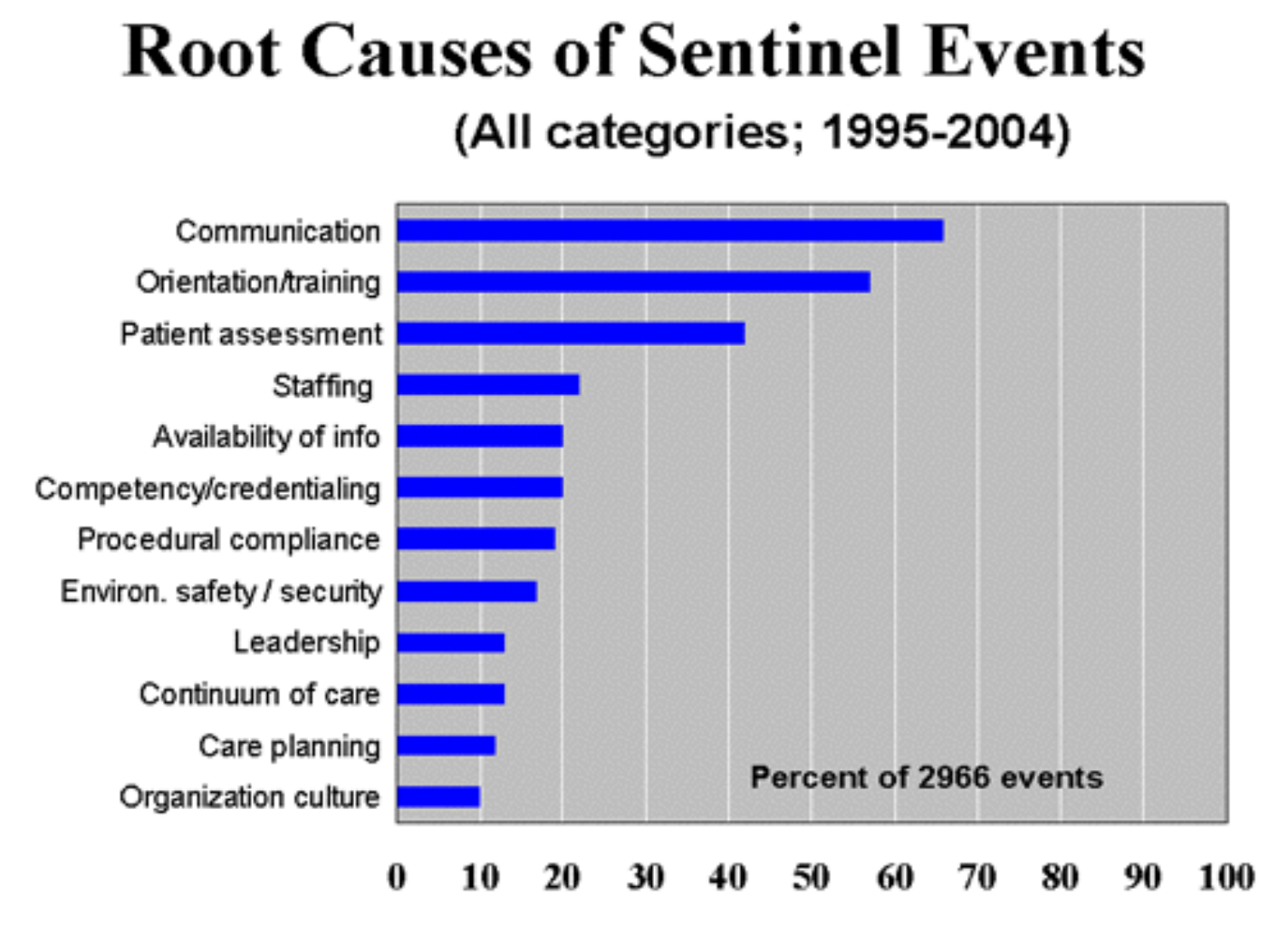
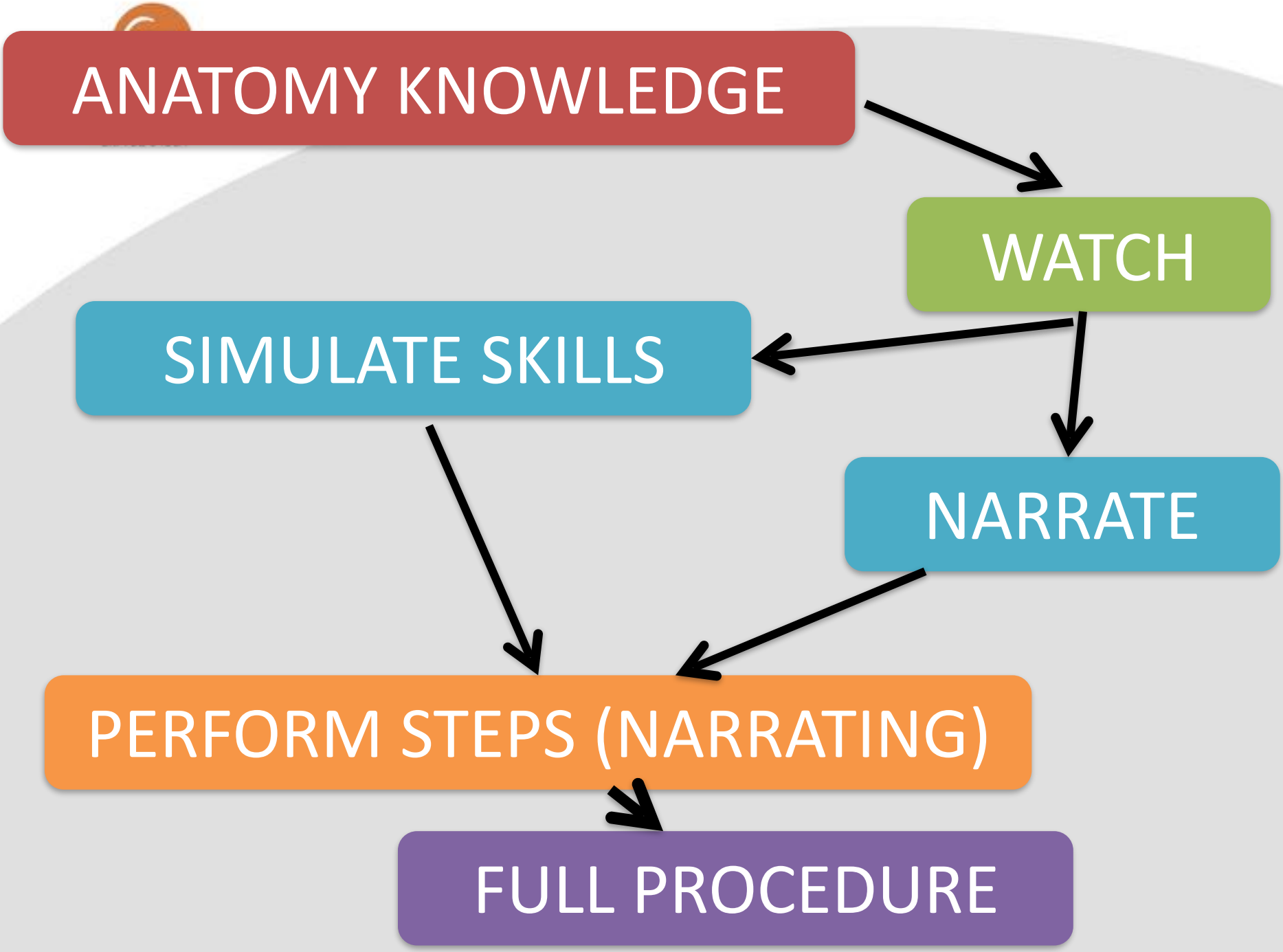
TEAM training



Available at www.jcaho.org


ANATOMY KNOWLEDGE
WATCH
SIMULATE SKILLS
NARRATE
PERFORM STEPS (NARRATING)
FULL PROCEDURE

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"I can't understand why people are pained/frightened by the NEW ideas. I am frighthened by OLD ones "

John Milton Cage (1912-1992)