THE UNIVERSITY OF ALABAMA AT BIRMINGHAM.
Department of Neurology

AUPN
Association of University Professors of Neurology

Spring Chairs Session
May 13th, 2022

Simulation-based Learning and Neurology Education

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Learning Objectives

1. Discuss and apply principles of adult and experiential learning theory to simulation -based learning (SBL)
2. Discuss and examine the impact of SBL on systems-based practice, patient safety and quality of care
3. Describe and appraise the current role of SBL in neurology education
4. Analyze the Cost-Benefit Structure and Feasibility of SBL as Replacement of Clinical Experience

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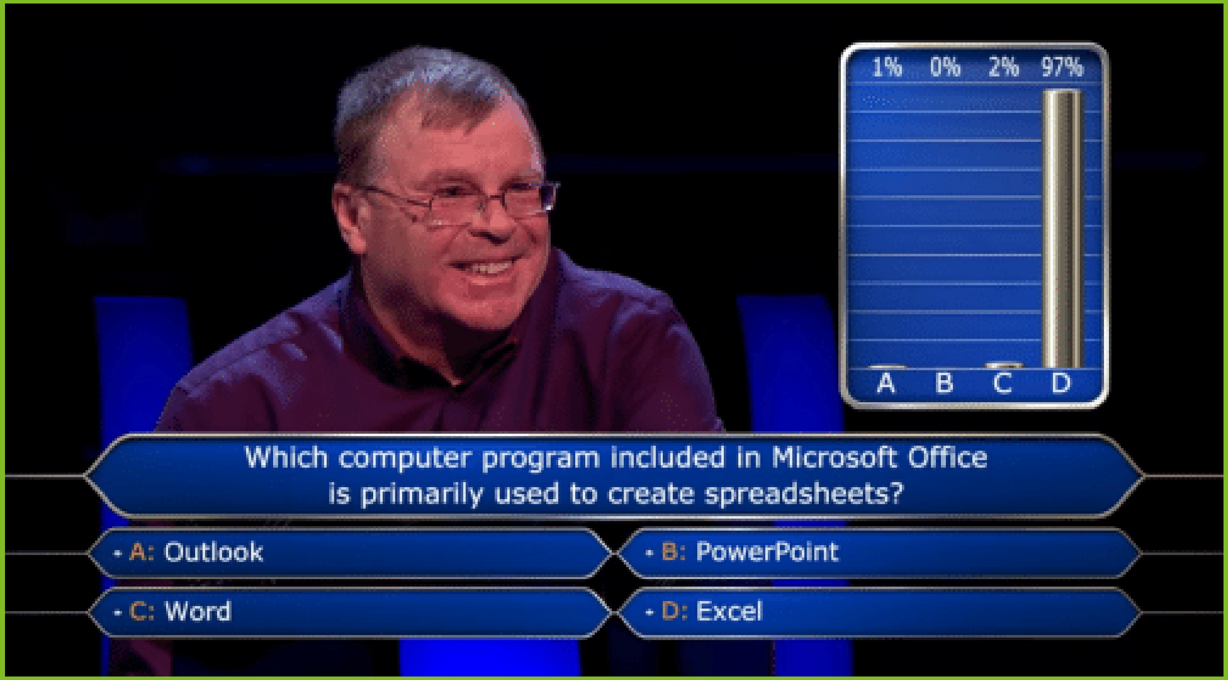

But first things first: Let’s ask the audience!

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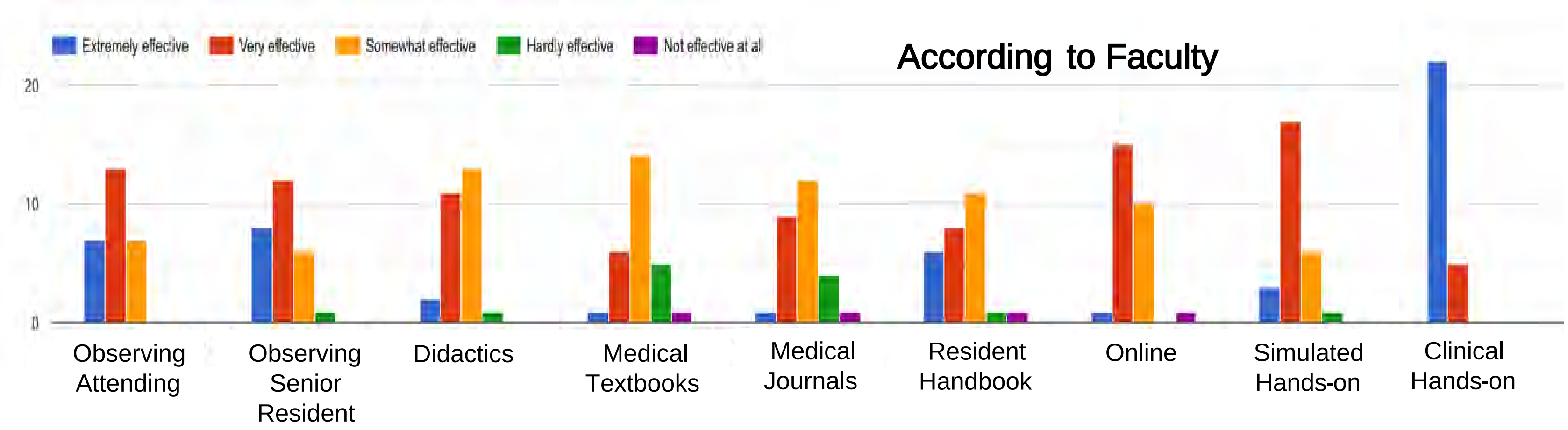
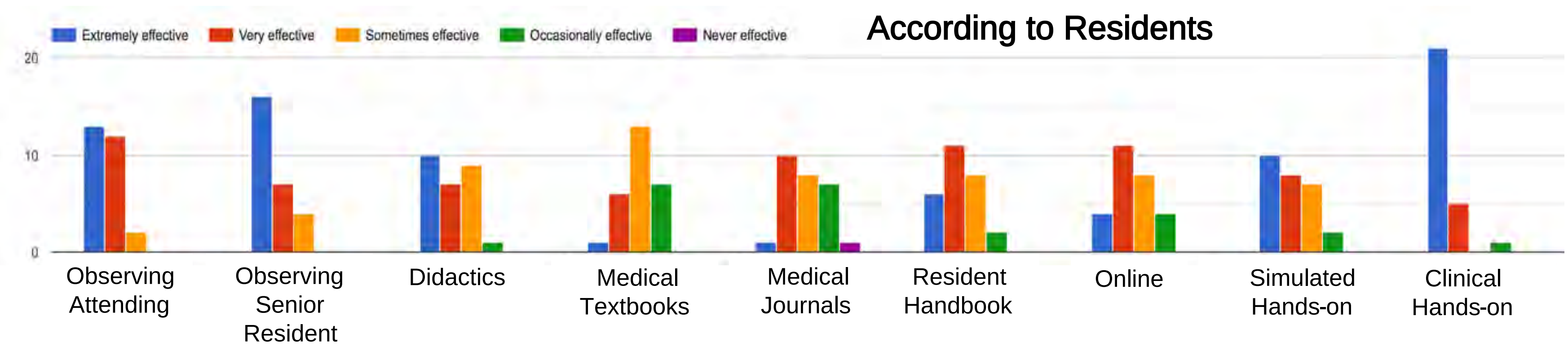
Question One

Effective Methods of Instruction (UAB)





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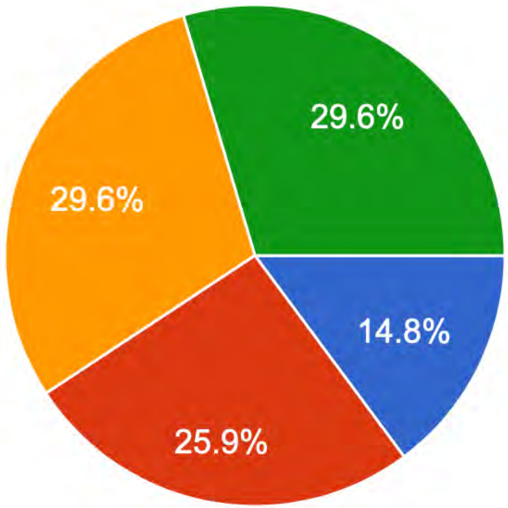
Question Two

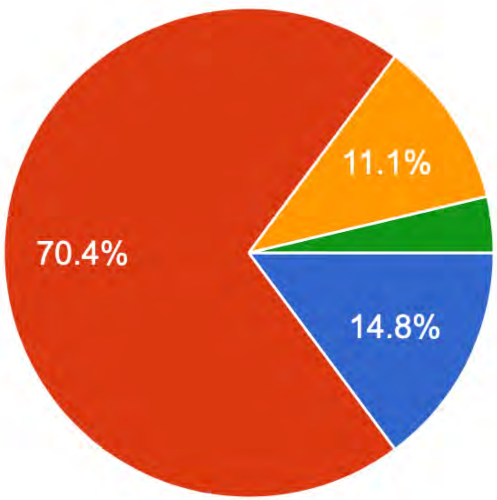
Experience with Simulation (UAB)

Residents

Simulation in Med School

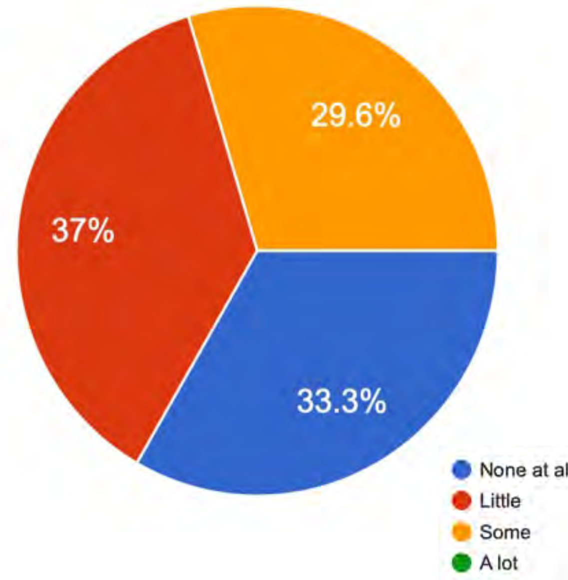


Simulation in Residency



Faculty

Simulation in Med School & Residency



Definition of Simulation in Healthcare

Instructional medium used for education, assessment, and research

Entails a wide range of experiences that have in common the **reproduction of certain characteristics of clinical reality**

Teaches **cognitive, psychomotor, and affective skills to individuals and teams**

Relies on experiential learning: must allow participants to affect the course of educational experience through verbal or physical interaction with the simulated components or patients

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Tell me and I will **forget**.
Show me and I may **remember**.
Involve me and I will **understand**.

Confucius 450 BC

The Adult Learner according to Androgogy Knowles: "Art and Science of Adult Learning"

Self-Directed

Self-concept of being responsible for one's own life and decisions. Importance of Self-evaluation

Experienced

Have a greater volume and different quality of experiences than young learners, which can and should be used as resources for learning. Learn from each other not just the instructor

Purposeful

Willing to learn when they experience a need to know or do something in order to perform more effectively in some aspects of their lives. Fill knowledge gaps as needed.

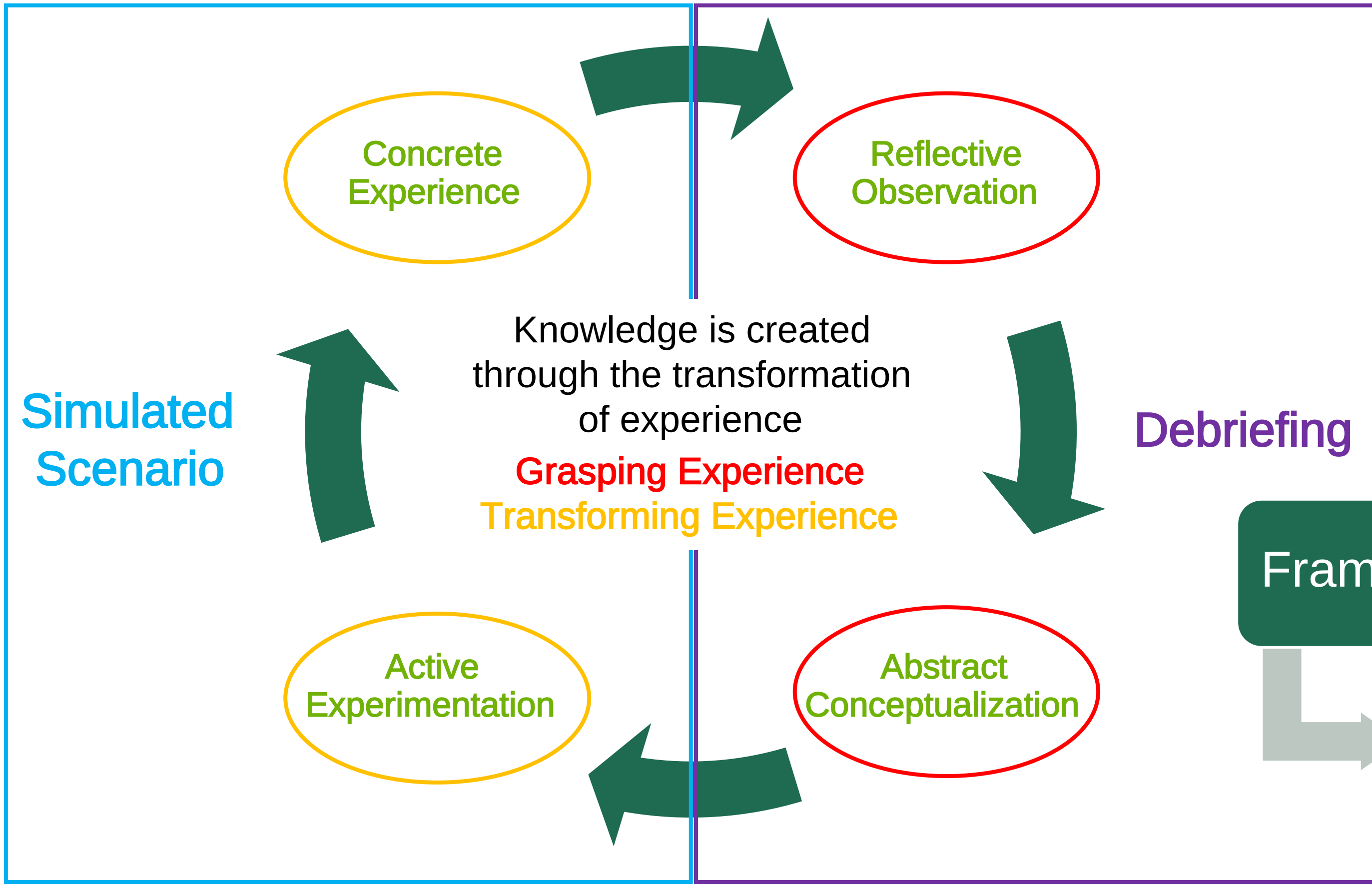
Problem Centered

Task- and problem-centered orientation to learning. They learn in order to be able to perform a task, solve a problem, or live in a more satisfying way

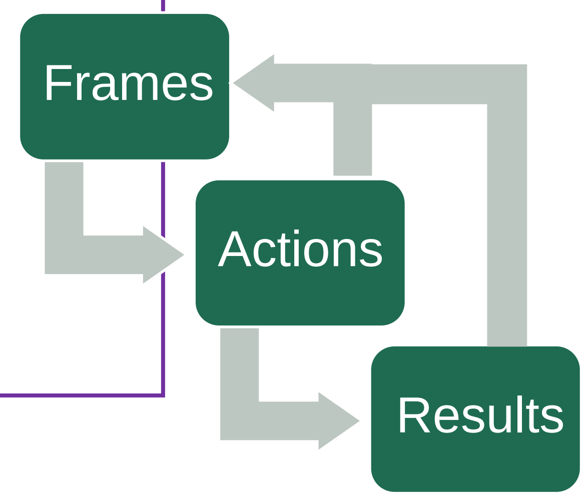
Self-Motivated

Increased self-esteem, recognition, better quality of life, greater self-confidence, and self-actualization are powerful motivators

Kolb's Experiential Learning Cycle



Simulation in Healthcare:
Safe and Protected Environment



Allen, Louise M., et al. *Medical Education* (2021).

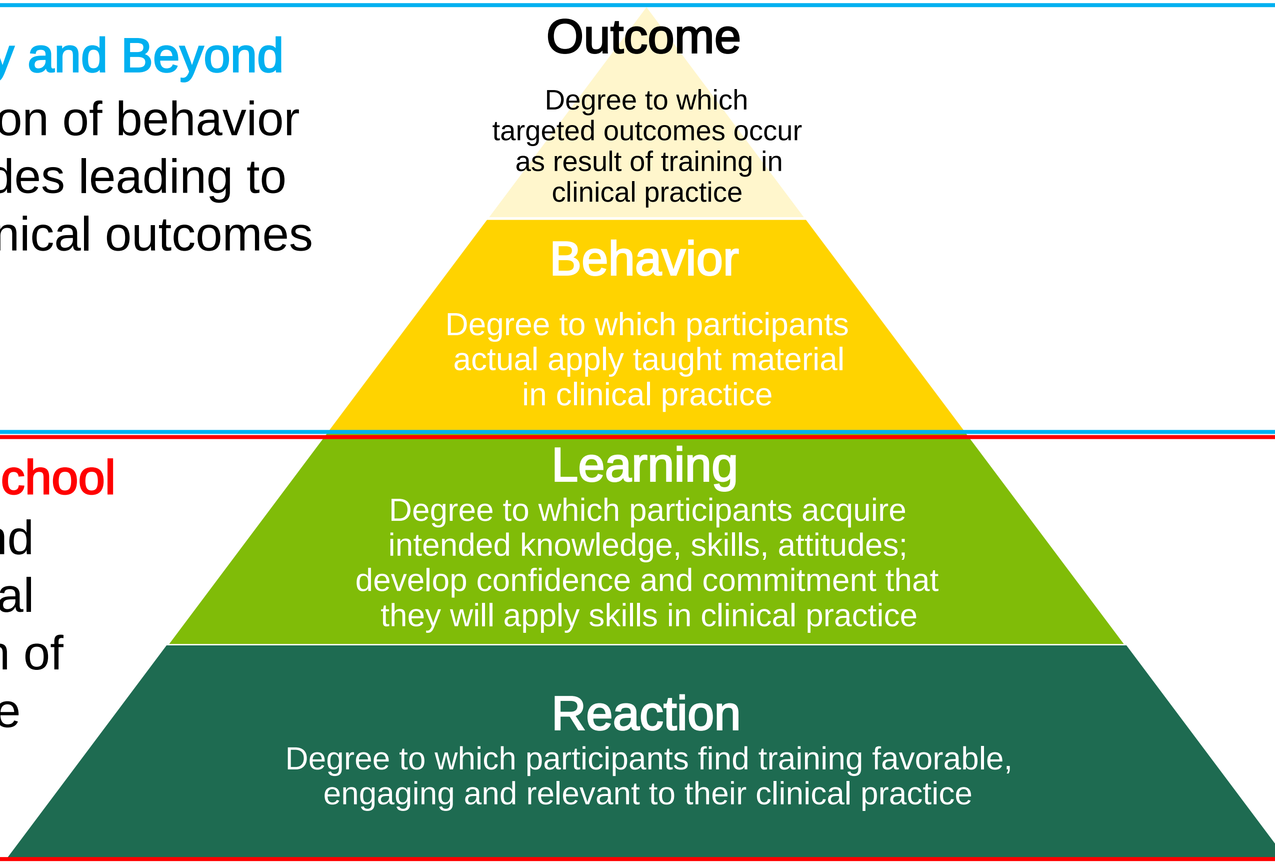
Kirkpatrick's Four -Level Training Evaluation Model

Residency and Beyond

Observation of behavior and attitudes leading to certain clinical outcomes

Medical School

Formal and longitudinal evaluation of knowledge + skills



Desai, Vinit, et al. *Handbook of Human Factors and Ergonomics in Health Care and Patient Safety* 2016. 202-213.

What do all these workplaces have in common?


Cockpit of Commercial Airplane

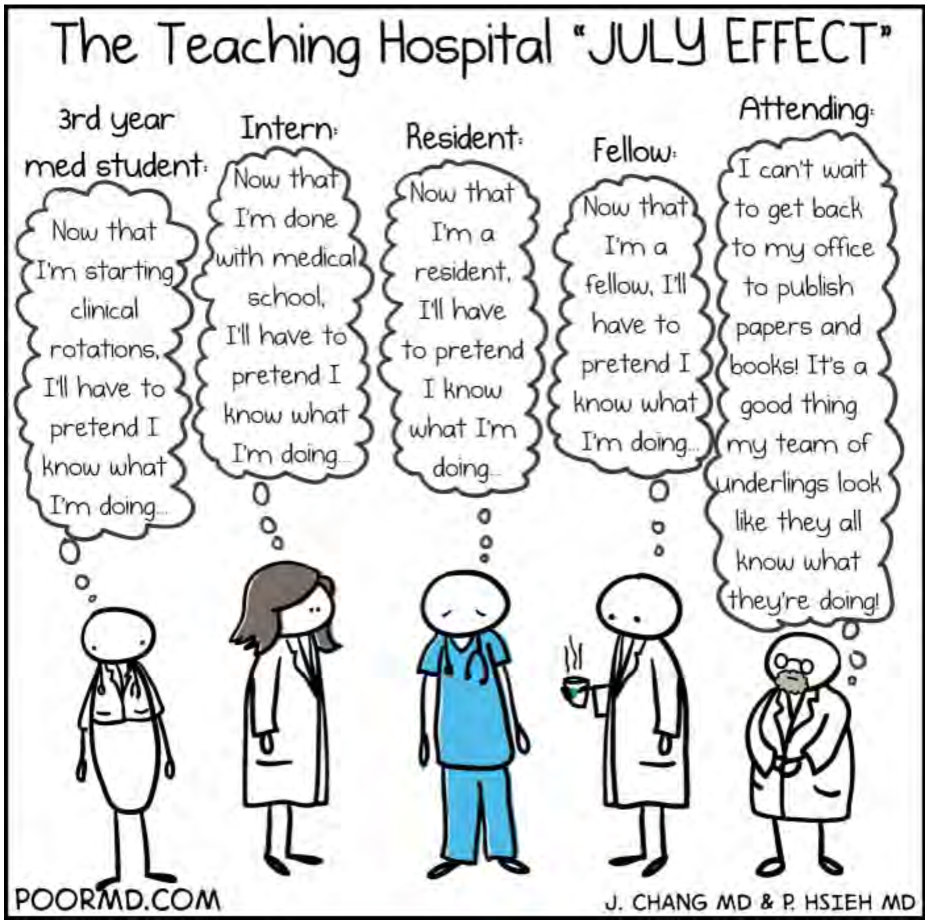

Deck of Aircraft Carrier

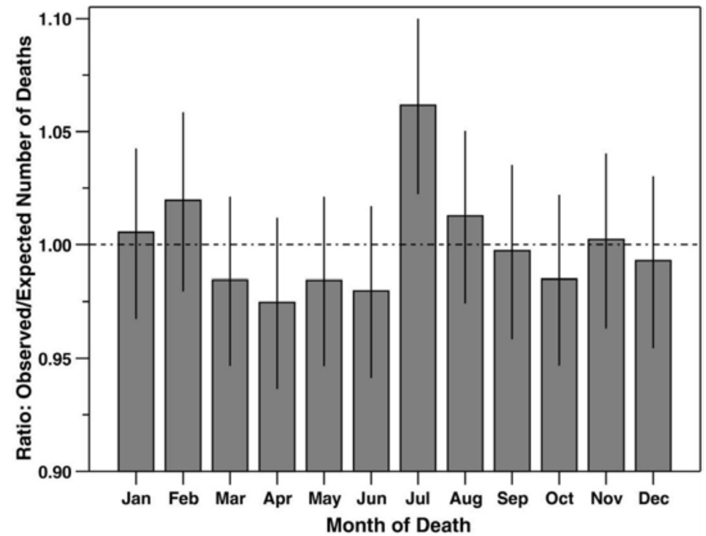

Control Room of Nuclear Power Plant

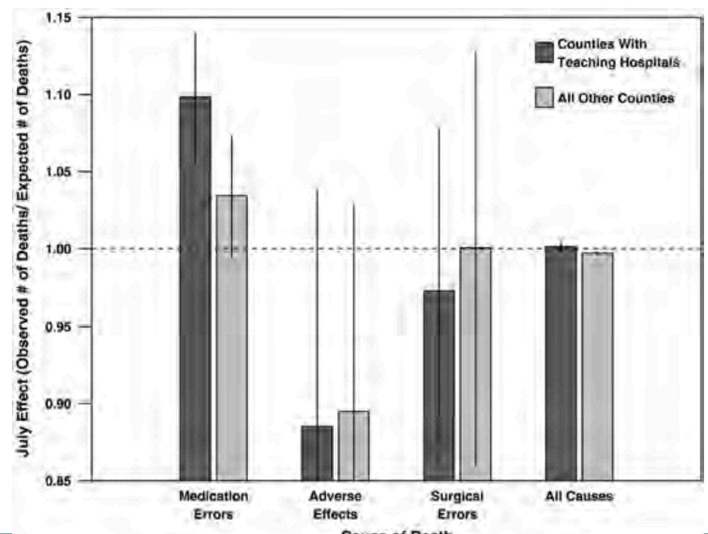

International Space Station

Phillips, David P. and Barker, Gwendolyn EC *Journal of general internal medicine* 25.8 (2010): 774779.

The Reality in Healthcare

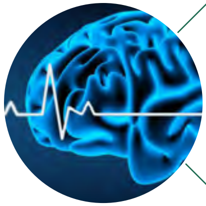






Anticipate Challenges

Please describe a clinical situation that you were exposed to as a resident, for which you felt underprepared and for which you wished you had had more hands-on clinical training beforehand.

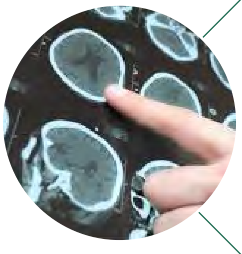


"My first brain death exam I felt underprepared, as I was the only one on call doing the exam and was not confident in my skills at that time."

"When my patients at the VA were angry about systemic mismanagement of their care and came to me to complain. […] it was very uncomfortable, and […] I felt we had done everything appropriately, which made it challenging."

"Ability to prioritize critical patients, not get caught in cross cover pages by ancillary staff for non-emergent things, concern for missing pages sent for urgent things on already admitted patients."

"My first tPA patient had a life-ending pontine hemorrhage, while I was on-call overnight alone with [the patient and] 12 of her family members. […] I had […] never given nor obviously seen a tPA complication before and was uncomfortable [determining] goals of care with so many family members, while my pager was demanding my time with a very busy call."



"I was on call and a patient presented as code stroke obtunded, I didn't have formal training on how to read CT angiograms and the attending didn't review the scans after they were obtained. There was a posterior circulation critical stenosis that I didn't identify on the scans. […] I wish they would have prepared us more from a neuroradiology perspective."

Aggarwal, Rajesh, et al. *BMJ Quality & Safety* 19.Suppl 2 (2010): i3443.
Schmidt, Eric, et al. *Annals of internal medicine* 158.5_Part_2 (2013): 426432.

Simulation Impact on Safety and Quality of Patient Care

CanMEDs Framework

The Competent Clinician according to the
Royal College of Physicians and Surgeons of Canada

COMPETENCY	DESCRIPTION
Medical Expert	Strong evidence base for the use of simulation to teach procedural skill, and emerging evidence that this protects patients from risk. Opportunities to routinely teach healthcare practitioners by simulation remain rare in many settings.
Communicator	Strong evidence of the use of simulation to teach and assess communication skills. While OSCEs are often used to assess communication skills, simulation is still underused to teach communication skills, with the exception of some medical schools.
Collaborator	Strong evidence base for the use of simulation to teach team working skills. Team working scenarios are expensive and time consuming to run, so are seldom used in practice.
Scholar	Simulation may be used to promote reflective practice, and encourage learning by observing and reflection. The evidence base for its use remains poor.
Professional	Simulation is increasingly seen as a means to assess professionalism. As simulation is grounded in scenarios, which are observed and discussed, rather than didactic classroom lessons, it provides a rich opportunity for teaching professionalism that is currently being missed.
Manager	Simulation has potential to be used to teach management and leadership skills which are important for patient safety, but the evidence base is weak.
Health Advocate	Simulation has potential to be used to train patient safety advocates, but its use in this area has not been developed.

Simulation has no use in this role

Simulation has potential to be used in this area, but is either underused or its evidence base remains weak

Simulation is shown to work in this area, although evidence for its use in patient safety may still be under researched

Gardner, Aimee K., et al. *The Joint Commission Journal on Quality and Patient Safety* 43.9 (2017): 484-491.
Guise, Jeanne-Marie and Jeanette Mladenovic. *Seminars in perinatology*. Vol. 37. No. 3. WB Saunders, 2013.

Simulation Impact on Systems-Based Practice

Workplace Readiness

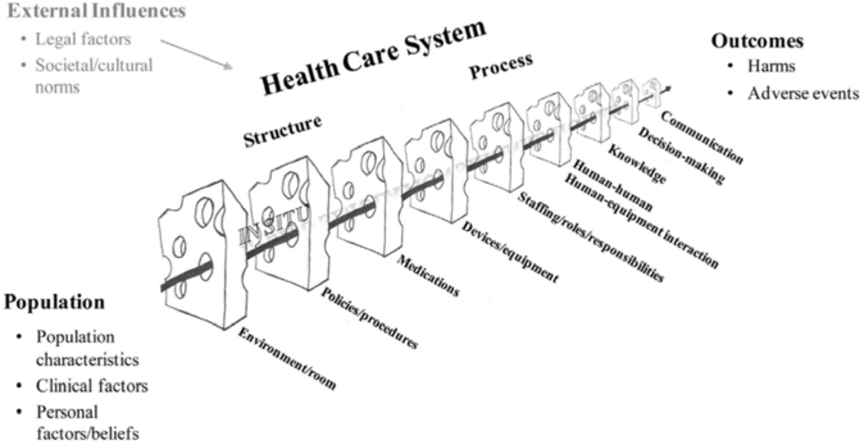
Vigilance and Escalation of Care

Prospective Root Cause Analysis

Evaluation of Electronic Medical Record

Longitudinal Patient Care Experience

Workload Assessment



Advantages of In-Situ Sim:

- Educational Fidelity
- Knowledge-Practice Gap
- Healthcare Team Efficiency
- System-based Issues

Challenges of In-Situ Sim:

- Patient Harm
- Scheduling Issues

Can Simulation replace Clinical Experience?

- **Study Details**:
  - 600 prelicensure nurses from associate and baccalaureate nursing programs
  - two (2) year duration
  - across seven (7) clinical courses
  - Ten (10) programs across the US were randomized into one of three study groups:
    1. Control group: traditional with <10% of clinical hours spent in sim
    2. Intervention group A: **25%** of clinical hours spent in sim
    3. Intervention group B: **50%** of clinical hours spent in sim
- **Methods**:
  - Medium or high-fidelity manikins, standardized patients, roleplaying, skill stations, and computer based critical thinking sims
  - Reliable and valid instruments measured students' clinical competency, nursing knowledge, and rated how learning objectives were met in clinical and simulated environments
- **Results**:
  - No statistical differences between groups in clinical competency as assessed by clinical preceptors and instructors, differences in comprehensive nursing knowledge assessments, and NCLEX pass rates
  - Study followed the groups for up to six (6) months into clinical practice via surveys sent to nurse managers assessing clinical competency and readiness for practice: no statistical differences between groups

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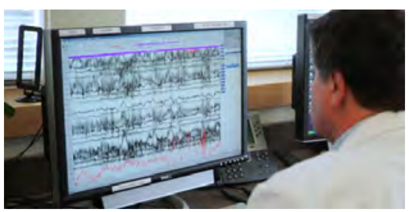
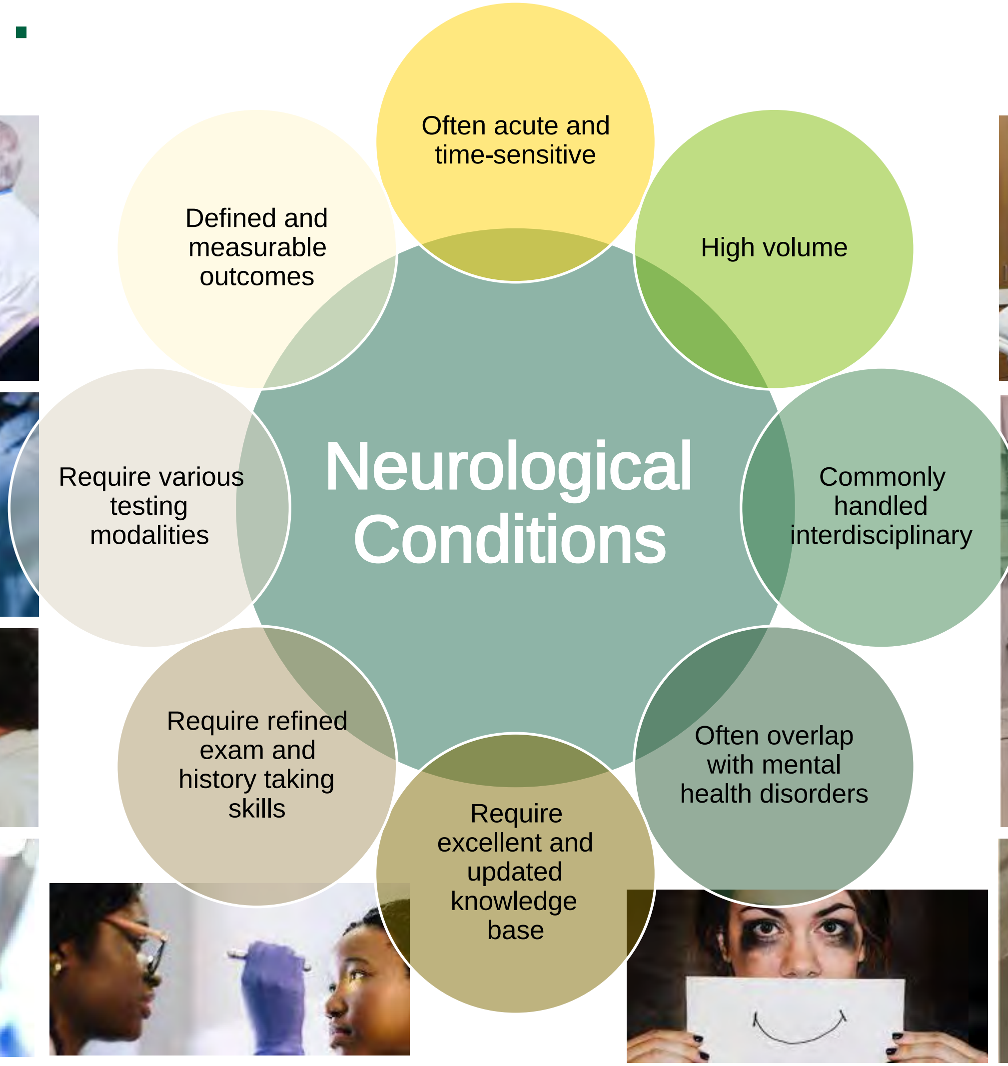
Hold on! Wasn't this talk supposed to be about Neurology Education?!

Micieli, Giuseppe, et al. *Neurological Sciences* 36.10 (2015): 1967-1971.

Why Neurology and SBL go so well together…









SBL improves Acute Stroke Care (ASC)

Intervention: In-situ Sim for established stroke team

Objective:

- Test/adjust and train staff on modified stroke protocol
- Evaluate reactions and changes in behavior and outcome as results of training

Results:

- 98% of participants rated experience as very useful and reported success in treating simulated patient
- DNT reduced from 27 min to 13 min
- No difference in treatment of stroke mimics or rates of fatal hemorrhage

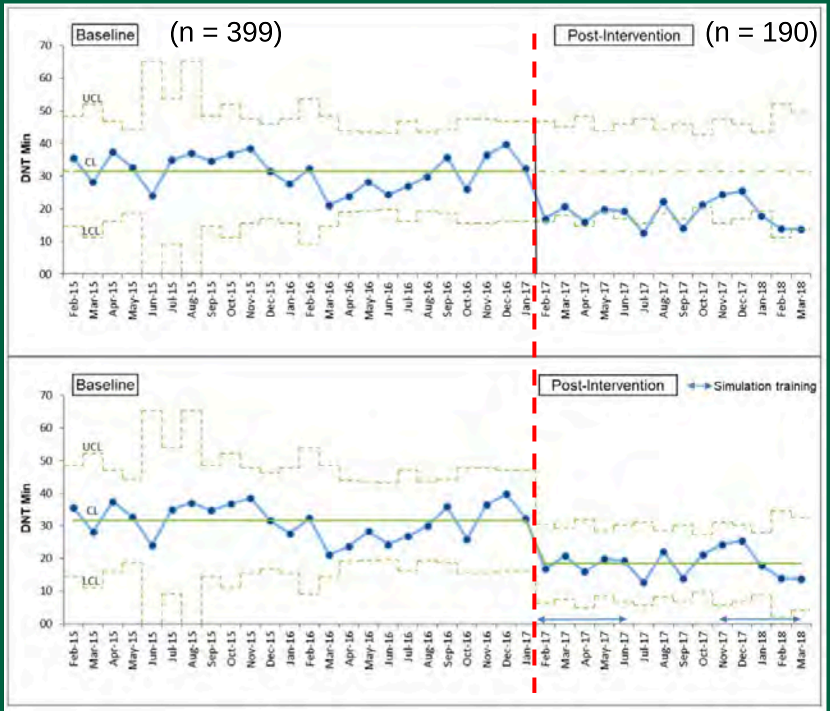


Table 3 Patient outcome measures with a signal of improvement on risk-adjusted CUSUM charts

	Preintervention	Postintervention	VLAD*	Adjusted OR (95% CI)	P value
Number of patients	319	141			
No symptoms 90 days (%)	105 (32.9)	54 (38.3)	2	1.27 (0.84 to 1.91)	0.263
'Worst' outcome 90 days (%)†	33 (12.2)	5 (3.5)	-8	3.75 (1.22 to 11.53)	0.021
Mortality 90 days (%)	29 (9.1)	5 (3.5)	-6	3.09 (1.00 to 9.51)	0.049

*Indicating estimated excess number of patients in an outcome category compared with baseline performance.
†mRS 5–6.
CUSUM, cumulative sum; VLAD, variable life adjusted display;mRS, modified Rankin scale.

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Mikhaeil-Demo, Yara, et al. *Journal of graduate medical education* 13.2 (2021): 223–230.

Sim-based Assessment of SE Care

Intervention:

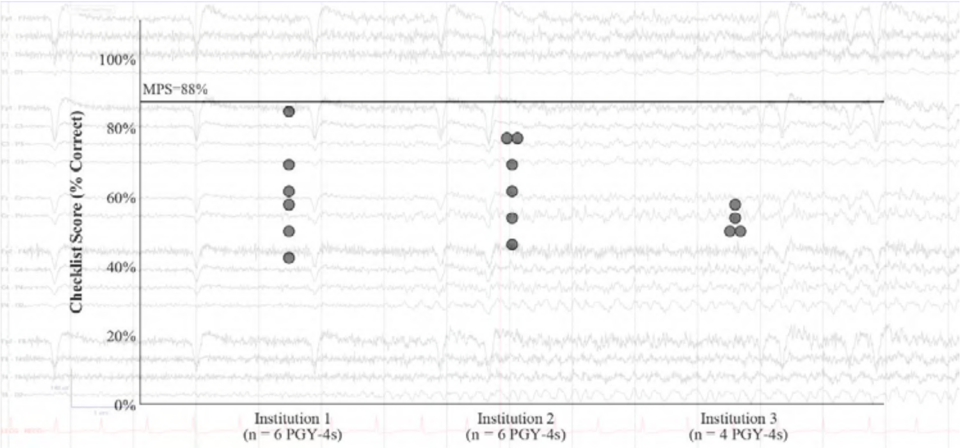
- Cohort study of 16 graduating neuro-residents from 3 programs
- No prior sim-experience or dedicated pre-learning
- Scenario: HFS of patient w/ 2 GTCSz's w/o returning back to baseline

Outcomes:

- Objective assessment of performance via a standardized and validated 26-item checklist
- Compare to self-reported experience and confidence in identifying and managing SE
- Compare to end-of-residency level of milestone for epilepsy and management/treatment patient care

Results:

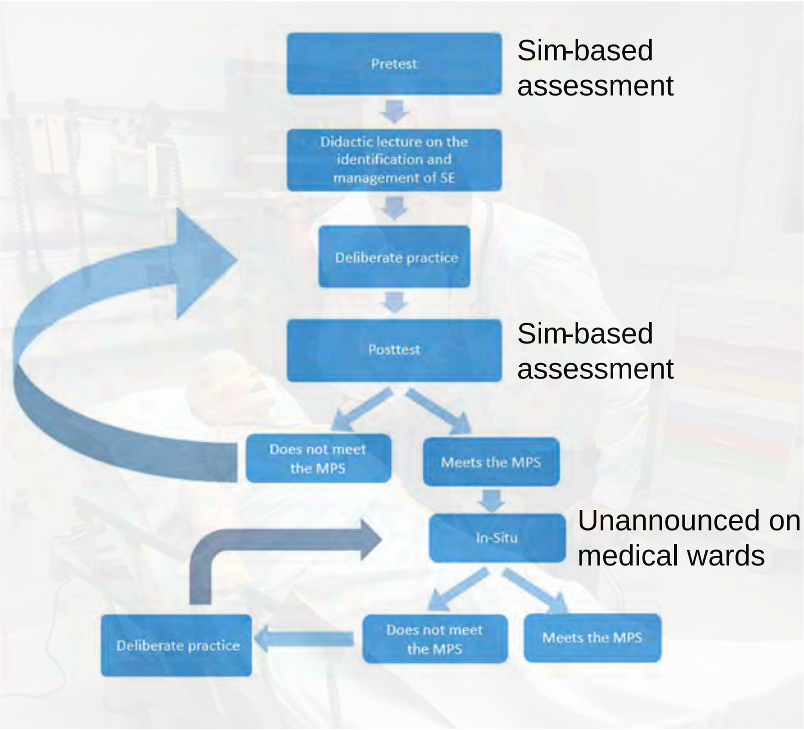
- majority experienced ≤ 8 clinical episodes where they identified and managed CSE or NCSE; one resident experienced no clinical episodes
- Only 69% identified possible NCSE; <50% ordered 2nd line agent and relevant lab work



Milestone	Milestone Level				P Value
	3.5	4	4.5	5	
Epilepsy					
N (%)	1 (6)	6 (38)	7 (44)	2 (13)	
Average checklist score (SD)	61.5% (N/A)	60.1% (14%)	57.1% (13%)	69.2% (0%)	.71
Management/treatment-patient care					
N (%)	0	6 (38)	6 (38)	4 (25)	
Average checklist score (SD)	...	63.5% (10%)	59.6% (14%)	55.5% (14%)	.63

DP SBL improving SE Management Skills

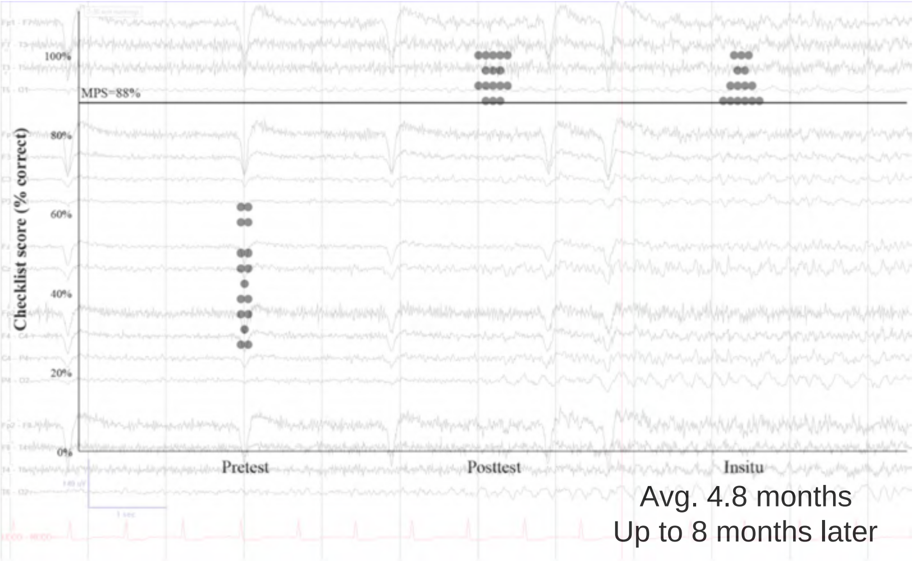
Intervention:



Outcome: Objective assessment of performance via a standardized and validated 26-item checklist

Results:

- 56% achieved mastery at initial posttest after one DP session
- Avg. time from pretest/DP to final posttest was 71 days
- 93% achieved mastery at initial insitu sim
- Avg. time from meeting MPS at posttest to in-situ test was 146 days



Barsuk, Jeffrey H., et al. *Neurology* 79.2 (2012): 132-137.

SBL and Lumbar Puncture Skills in Adults

Intervention :

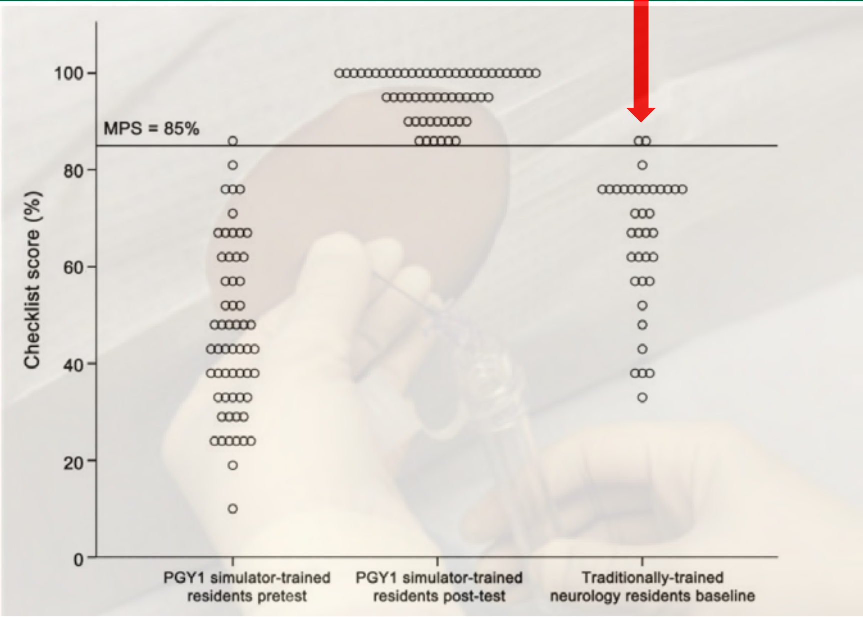
- 58 PGY-1 IM residents training with LP sim task trainer
- Pretest followed by 3-hour session featuring DP and feedback
- Immediate Posttest: meet/exceed MPS on CSE using checklist
- Residents who failed MPS had more DP until they did (mastery learning)
- Comparison group: 36 traditionally trained PGY2-4 neuro-residents from 3 academic centers

Results:

- Sim-trained PGY-1s: Significant score increase from mean of 46.3% to 95.7% (all met MPS)
- Traditionally trained Neurons w/ mean of 65.4%

Table 1 Baseline demographics of simulator-trained and traditionally trained residents

	PGY1 simulator-trained residents (n = 58)	PGY2-4 traditionally trained neurology residents (n = 36)	p Value
Mean ± SD age, y	26.9 ± 1.9	30.4 ± 3.9	<0.001
% Male	43.1	58.3	0.15
No. of LPs performed in actual clinical care, mean ± SD	1.0 ± 1.7	25.4 ± 23.9	<0.001
Self-confidence regarding ability to perform LP (scale 0 = not confident, 100 = very confident), mean ± SD	42.6 ± 27.7	74.0 ± 16.5	<0.001



SBL to assist Formative Assessment and Feedback of Communication Skills

Intervention:

- 9 Sim-based OSCEs with SPs portraying pediatric patients and/or patients (20 min encounter and 20 min feedback from SP-perspective)
- Variable complexity/difficulty
- 16 individual trainees (4 adult neuro, 2 CNP fellows, 10 peds neuro) over 3 years
- Each resident went through 3 OSCEs per session
- Faculty, SP and Trainee filled out Gap-Kalamazoo Communication Skills Assessment Form

Results:

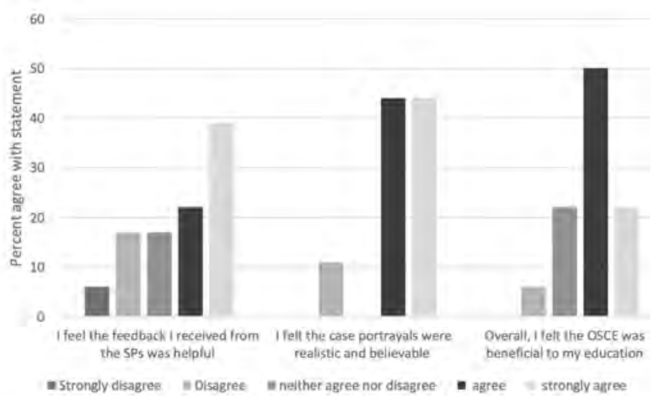


TABLE 6.
Rating Averages for Each of the Nine Items on the Modified Gap-Kalamazoo Communication Skills Assessment Form

Dimension	Trainee			SP			Faculty		
	OSCE 1	OSCE 2	OSCE 3	OSCE 1	OSCE 2	OSCE 3	OSCE 1	OSCE 2	OSCE 3
Builds a relationship	87	**82**	80	81	78	87	86	82	**90**
Opens the discussion	82	74	80	86	80	87	81	85	77
Gathers information	69	66	76	80	69	83	83	77	82
Understands patient's perspective	*64*	59	*58*	*76*	*64*	*77*	*71*	*73*	*73*
Shares information	77	70	78	83	78	88	85	82	83
Reaches agreement	68	*46*	75	79	79	86	77	82	82
Provides closure	74	69	77	85	68	87	78	81	78
Demonstrates empathy	79	71	76	87	86	89	**88**	**87**	84
Communicates accurate information	72	71	72	**92**	**87**	**93**	84	85	86

Abbreviations:
OSCE = objective structured clinical examination
SP = standardized patient
Ratings with the highest average scores for each OSCE event are represented by bold font. The dimensions with the lowest average score among trainees are represented by italic font.

MedEdPORTAL® The AAMC Journal of Teaching and Learning Resources

Asche, Carl V., et al. *Academic Emergency Medicine* 25.2 (2018): 230-237.
Aggarwal, Rajesh, et al. *BMJ Quality & Safety* 19.Suppl 2 (2010): i34-43.
Brazil, Victoria, et al. (2019): 862-865.

Cost-Benefit Analysis of Simulation

Traditional Clinical Training	Simulation Based Education
Realism/complexity of teaching scenarios	Improves systems-based care/Identifies latent health threats
Integrated in everyday workflow	Formal training in teamwork and communication
No sim equipment or staff needed	Procedural efficiency and competence
Need for clinical care (Provider opportunity cost)	Reduction medical errors/Improved patient satisfaction

Zhang, Lihan, et al. *British journal of neurosurgery* 30.5 (2016): 577-581.
Harrop, James, et al. *Neurosurgery* 73.suppl_1 (2013): S25-S29.
Spiotta, Alejandro M., et al. *Journal of neurointerventional surgery* 8.4 (2016): 429-433.

Pioneer Role of Neurosurgery (NSG)

Congress of Neurological Surgeons Sim-Based Educational Curriculum (2011/2012)

Educational objectives in all 6 ACGME CC using well-established physical models, virtual reality, web-based and hybrid sims

Assigned 3 specific case-based sims of a vascular, spine and cranial procedure with a 2h block each:

Written pretest on arrival (5 min)
Didactics on the basics of pertinent anatomy (10 min)
Case presentation (5 min)
Simulator demonstration (5 min)
Practical pretest (5 min)
Hands on training—interaction with faculty (45 min)
Written posttest (5 min)
Posttest evaluation (10 min)

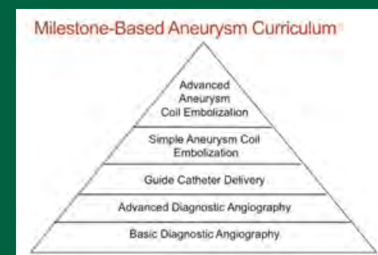
OSCE-based skills assessments and written posttest to check knowledge gain

Published online to provide consistent access and expand with chance of multicenter validation studies

NSG Residency Curriculum at UT Texas (2012/2013)

Variety of sim techniques: 79 physical models, 57 cadaveric, 44 haptic and computerized sims

Residents completing 30 sims per year appropriate for their training level



Improved skills across all levels of post-graduate training

Initial cost was $4.2 million, $476,000 in annual expenses, and $12,500 per resident per year

Summary

Let’s change this together!

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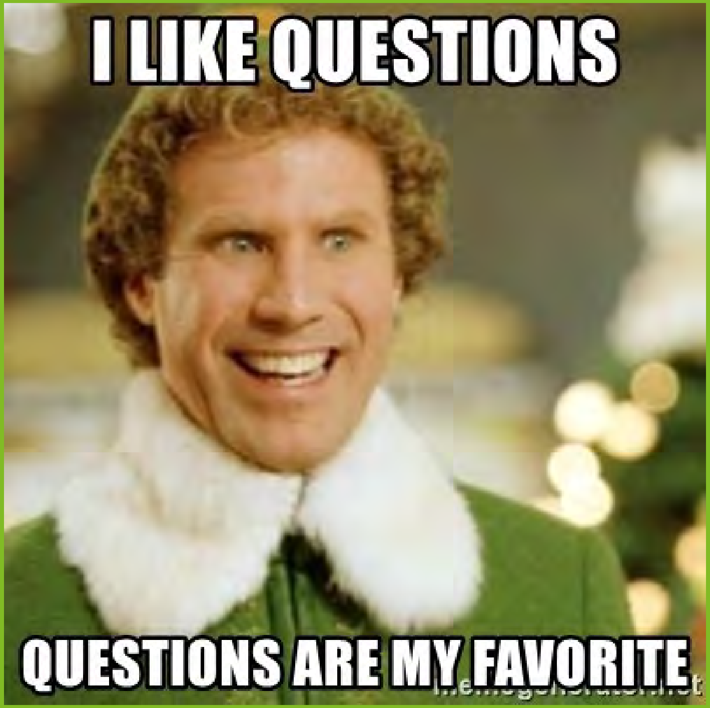
Thank You!



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Innovative Digital Technology for Trainee Education

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Disclosures

- Scientific Advisory Board, AstraZeneca

Introduction

- In the field of educational technology, there is a wide variety of technologies and approaches to provide better support for teaching and learning processes

- Simulation training offers a realistic teaching environment

- Widjicks et al. A Future for Simulation in Acute Neurology. Semin Neurol 2018; 38(04): 465-470

Introduction

The benefits of innovative digital technologies such as augmented reality (AR) and virtual reality (VR) are significant

However, this relationship needs to work seamlessly in the structural environments of traditional practice-based medical education

We also need well-designed, tested teaching scenarios and need more validation of this approach

A recent systematic review concluded that although simulation-based training in health education is gaining momentum, limited research has been conducted to measure the impact of these on students' learning outcomes

- Bracq M-S, Michinov E, Jannin P, et al. Virtual reality simulation in nontechnical skills training for healthcare professionals: a systematic review. Simulation in Healthcare 2019;14(3):188–194.

Educational Goals

- Simulation-based medical curriculum can provide comprehensive and realistic training and safer patient care

- It promotes experiential and reflective learning

- Although it uses technology, this is a **learning process** to help the trainee gain clinical experience and understand clinical manifestations of diseases in specific patients

- Salman H. Most significant barriers and proposed solutions for medical schools to facilitate simulation-based undergraduate curriculum in OBGYNArch Gynecol Obste 2021
- Al-Elq A. Simulation-based medical teaching and learning. *J Fam Community Med.* 2010;

Pandemic Impact on Clinical Training

- Profound impacts on medical education globally

Table 1. Recommendations for Medical Education During the COVID-19 Pandemic

- Maintain social distancing (>6 feet between people)
- Limit the number of people present in work spaces
- Educate trainees to monitor signs and symptoms of COVID-19 infection and quarantine at home if symptoms develop
- Consider limiting or disallowing personal and business travel
- Alter service structures to allow residents to work from home
- Teach all didactics virtually (remotely)

Abbreviation: COVID-19 = coronavirus disease 2019.

- Changes in health care delivery and uncertainty regarding how the delivery of clinical training will evolve in this type of environment

The use of digital technologies for educational purposes, are likely to be the most significant aspects of the transformative and post-COVID medical education

- Gill et al. Challenges to medical education at a time of physical distancing. Lancet June 2021
- Gaur U, Majumder MAA, Sa B, Sarkar S, Williams A, Singh K. Challenges and opportunities of preclinical medical education: COVID-19 crisis and beyond. *SN Compr Clin Med.* 2020;

Simulation Models

- VR and AR are two contemporary simulation models which create a promising opportunity for the education of medical professionals

- Evaluating a patient using an audiovisual paradigm in real time is an important clinical tool

- However, the definitions are used interchangeably and this can be challenging

Figure 3. The AR app 'HoloHuman' showing a virtual cadaver placed on a real examination table. The moderator (shown) is able to interact with the model and user interface through the use of a HoloLens headset. Structures, organs and systems can be examines individually or in combination and are fully supported by visual narrative and digital dissection tools (image courtesy of 3D4 Medical from Elsevier, 2020; https://3d4medical.com/apps/holohuman)

- Dhar et al. Augmented reality in medical education. Medical Education Online. Vol 26, 2021 Issue 1

Reality Types

- **VR** involves an artificial environment which is experienced through multisensory stimuli provided by a computer

- **AR** an enhanced version of reality created by the use of technology to overlay digital information on an image of something being viewed through a device (such as a smartphone camera)

- **Mixed reality (MR)** is considered a combination of virtual and augmented reality

- Dorsey, E.R., et al., Teleneurology and mobile technologies: the future of neurological care. Nat Rev Neurol, 2018. 14(5): p. 285-297
- O'Carroll, C.B., et al., Robotic telepresence versus standardly supervised stroke alert team assessments. Telemed J E Health, 2015. 21(3): p. 151-6
- Hilty, D.M., et al., Virtual reality, telemedicine, web and data processing innovations in medical and psychiatric education and clinical care. Acad Psychiatry, 2006. 30(6): p. 528-33..

How are they different?

VIRTUAL REALITY	AUGMENTED REALITY
• Creates immersive computer generated environments which replace real world	• Closer to real world experience, maintain sense of presence with graphics, smells, sounds
• User is immersed in artificial world and cut off from real world	• User interacts with the real world and can see both the real world and virtual world

High Fidelity VR Modeling

- Recreates a scenario to replace actual patient encounters with a supervised clinical practice closely mimicking realistic situations in a completely immersive approach
- Trainees learn tasks in a setting practiced in surroundings where exploration and troubleshooting are safe
- A study conducted in the Medical School of the University of South Carolina used a Cardiopulmonary Patient Simulator called Harvey and found that students who were trained for cardiac examination skills using the simulator performed better (on examinations including the USMLE and MCAT) than those trained on standardized manikins or patient models

- May result in trainees who are well trained for a particular task on the job in a set context, but who lack competencies needed to adapt to ever changing situations in the real working environment

- Kern DH. Simulation-based teaching to improve cardiovascular exam skills performance among third-year medical students. Teach Learn Med. 2011;23(1):15–20

VR Sim Lab

- Sophisticated neurological simulations cover not just basic procedures such as lumbar punctures but also complex emergency care
- Can duplicate multiple medical settings
- Headsets allow learners to interact with a patient controlled by a computer operator
- Ensure our trainees are exposed to uncommon but necessary situations, can develop scenarios such as a brain death evaluation

- Kurzweil et al. Education Research: Teaching and assessing communication and professionalism in neurology residency with simulationNeurology Jan 2020

Simulation of Neurological Disease

- Is often difficult, as neurological signs can be challenging for actors to portray and manikins typically are not designed to depict neurological findings
- We can change the way the manikin appears to breathe or the blood pressure, but it is virtually impossible for it to simulate a stroke
- Neurocritical care subspecialties are particularly challenging

- In a study published in the February 2017 issue of Neurocritical Care, Mayo Clinic researchers found that a neurological simulation course administered to critical care fellowship trainees improved the trainees' skill and confidence

•Braksick SA, et al. Neurology education for critical care fellows using high-fidelity simulation. Neurocritical Care. 2017;26:96
•Wijdicks EFM, et al. A future for simulation in acute neurology. Seminars in Neurology. 2018;38:465
•The OculAR SIM AR program Image courtesy of Apperition (www.appearition.com/deakin-university/), and Peter Bright,School of Medicine, Deakin University

Acute Neurology

- Encompasses diseases with high levels of morbidity and mortality

- Discussing goals of care and ethical conflicts with acutely distraught patients and families in the setting of acute neurologic illness where some time pressure may exist requires practice

- Debriefing with video playback documents the learner’s body language, use of medical jargon, and handling of ethical dilemmas

How is this different from traditional methods?

- Simulation can induce a stress response that very effectively mimics what learners will eventually feel when faced with a real emergency

- It also involves focused thinking, interpretation of the clinical history, examination and neuroimaging to manage a patient

Stanford University introduced the Neurosurgical Simulation and Virtual Reality Center in 2016

Provides medical graduates to explore the structure of the brain and train them to operate

The system has been designed from MRI and CT scans of real patients, offering trainees with an opportunity they would only otherwise get while in the surgery room

Real-time experience of the surgical room and how to work under stress and pressure, while being efficient and skilled

Abhinav leads a training session for residents in the new neurosurgical anatomy laboratory. *Paul Sakuma*

- Lanese N New neuroanatomy lab bridges virtual reality, operating room. 2018. Available at: https://med.stanford.edu/news/all-news/2018/03/new-neuroanatomy-lab-bridges-virtual-reality-operating-room.html.

Creating a scenario

- Includes a synopsis, one page summary of the key highlights needed to run the scenario. Complete this with enough information so that someone can quickly review and understand how the scenario should run

- Each also includes a descriptive title, diagnosis, target audience, prerequisite knowledge and skills, setup, scenario, and debrief process

STROKE SIMULATION SCENARIOS

SCENARIO 1: Suspected Ischemic Stroke without Large Vessel Occlusion

PREHOSPITAL

ACTORS:

- Patient: 68 y/o female
- Husband: approximately same age
- 911 Call Taker
- Engine Company (3): Firefighter/EMT, Driver Engineer, Lieutenant
- ALS Ambulance crew (2): paramedics

SETTING:

- Residential home

A sixty-eight year-old female patient has a sudden onset of left-sided weakness and slurred speech.

This 68 y/o patient with a history of hypertension develops a sudden onset of slurred speech while watching television in her home. Her husband recognizes her abnormal speech, and asks her what is wrong. He then realizes that the left side of her mouth seems to be drooping slightly when she tries to speak. He reassures her, then immediately calls 911.

The EMD trained call taker establishes the scene location, level of consciousness, and the onset history, and then asks a series of more specific questions:

- **Does the person's speech sound normal?** *No.*
- **Does the person have weakness or paralysis on one side of the body?** *Not sure.*
- **Does the person have a facial droop?** *Yes.*
- **Does the person have a headache?** *No.*
- **Has the person ever had a stroke before?** *No.*

An emergent response for a possible stroke is initiated with both an engine company and Advance Life Support (ALS) being dispatched to the address. The husband is told to keep his wife calm, secure any pets, and to call back if there are any changes. Help will be there soon.

The fire department engine company arrives within five minutes of being dispatched. They establish scene safety, pull their equipment and approach the front door of the residential home. The husband, greets them at the door, "please hurry!" The crew enters into the living area and forms a general impression as they approach the patient. She is conscious with good color, and is watching them enter. They engage contact with the patient completing the initial assessment: establishing that she's alert with a patent airway, is breathing adequately, and has a strong regular pulse. Her skin is warm and dry. The engine company EMT notes that the patient has a slight left facial droop and begins the assessment.

American Heart Association | American Stroke Association | Together to End Stroke

- https://anesthesiology.duke.edu/?page_id=824799support.html
- https://www.sim.ucla.edu/

FIG. 2.1 Setup of simulation, showing interview of the simulated patient **(A)**, taking history of family **(B)** Control room **(C)**. Debriefing room allowing discussion of the scenario and also reviewing of taped interactions **(D)**.

FIG. 2.4 Examples of portrayals by actors (**A**, stroke with hemiplegia and neglect favoring one side; **B**, seizure with flexed arms and rolled-up eyes; **C**, myasthenia with ptosis, bifacial palsy, and shortness of breath).

Neurologic Signs Suitable for Portrayal by Actors
• Forced gaze deviation and apraxia of eyelid opening
• Facial twitching (cheek)
• Hemianopia
• Vertical eye movements only (locked-in syndrome)
• Neck stiffness
• Global aphasia (mute or only "no" or "good")
• Complete paralysis—arm[a]
• Complete paralysis—leg[a]
• Complete paraparesis[a]
• Sensory level (to be detected with pinprick)[a]
• Neglect and anosognosia
• Seizures (some types)
• Myoclonic twitches, asterixis (possibly)
• Accessory respiratory muscle activation and paradoxical breathing (neuromuscular respiratory failure)
• Posturing

- Elselvier Siumlation of Acute Neurology Chapter 2


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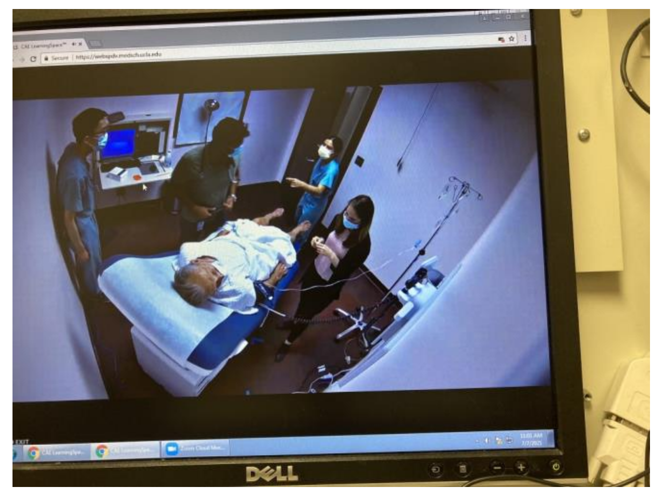
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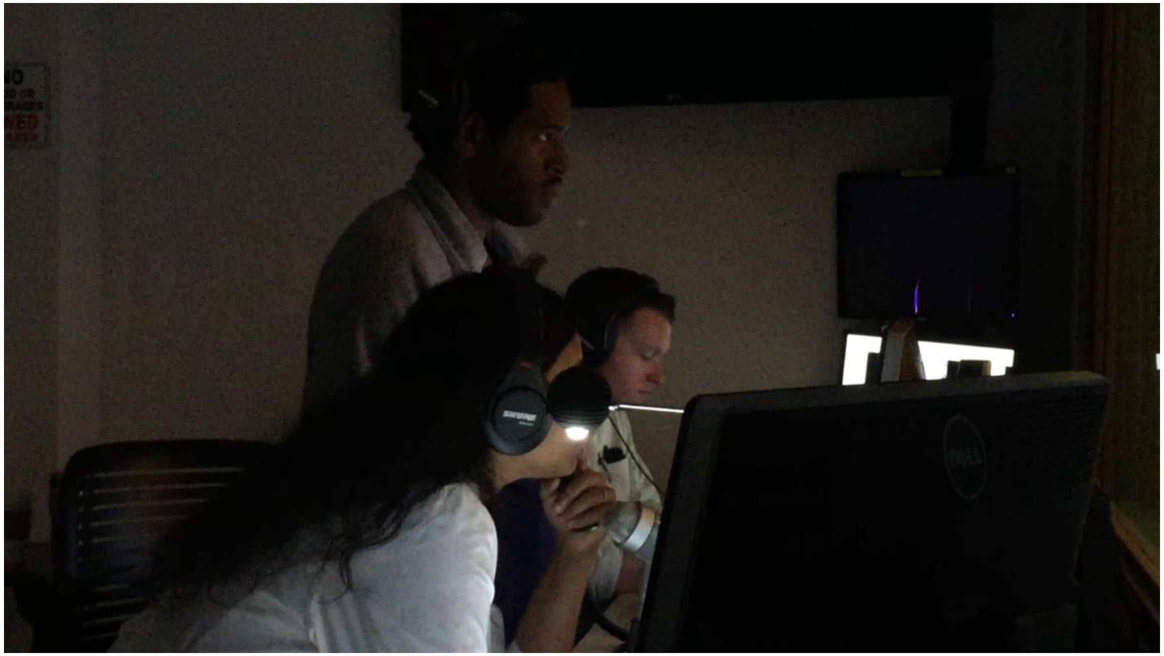


Limitations

- Simulation with standardized patients and high-fidelity simulation mannequins has been a core aspect of medical training and assessment
- However, even the most advanced actor-based and mannequin-based simulation labs are limited in their ability to visually represent certain neurological experiences such as a critically ill stroke code evaluation

AR Integration

- Creates a training environment offering flexibility and adaptation in training true-to-life working processes in the changing medical environment

- Greatly enhances resident education when utilized for centralized education and as a clinical supervision tool for trainees

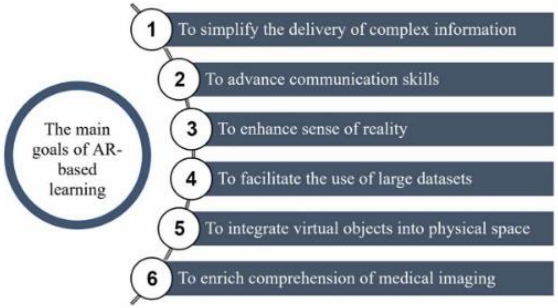


Figure 1. The main goals of augmented reality in medical education [16]

- Dhar et al. Augmented reality in medical education. Medical Education Online. Vol 26, 2021 Issue 1
- Salehahmadi F, Hajialiasgari F. Grand adventure of augmented reality in landscape of surgery. World J Plast Surg. 2019;8(2):135–145.

AR in Medical Education

Students who successfully complete learning activities enhanced by AR programs are more likely to achieve both enhanced theoretical knowledge and practical skills

AR-based learning boosts outcomes in several main aspects of training, including professional knowledge, cognitive and practical skills, social skills, innovation, competence, and creativity

- Eckert M, Volmerg JS, Friedrich CM, et al. Augmented reality in medicine: systematic and bibliographic review. JMIR Mhealth Uhealth. 2019;7(4).
- Klimova A, Bilyatdinova A, Karsafov A, et al. Existing teaching practices in augmented reality. Procedia Comput Sci. 2018;136:5–15.

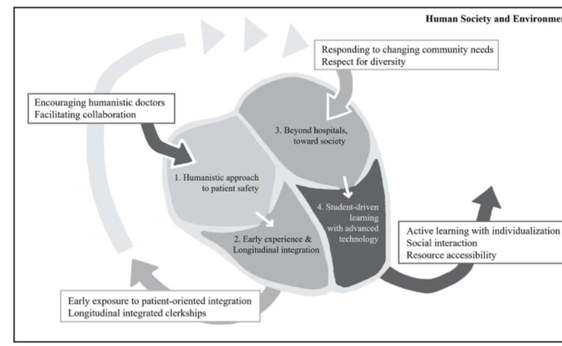
Advantages of AR

- Clinical experiences are more valuable

- Offers new forms of interactivity with content, improved visualizations of scientific phenomena and seamless integration into curricula

- Facilitates quality interprofessional education independent of geography

- Potential ability to accelerate learning curves and potentially contribute to the shortening of training timelines



- Han et al. **Medical education trends for future physicians in the era of advanced technology and artificial intelligence: an integrative review.** BMC Med Educ 2019 Dec 11;19(1):460.
- Avila-Gazon et al. Augmented Reality in Education: An Overview of Twenty-Five Years of Research. Contemporary Education al Technology 2021

Wearable Technology

- Wearable technology with smart glasses, connect clinicians to machines and software—hands-free

- Delivery of the entire patient interaction between medical professionals, between attendings and residents and between physicians and patients

- Can involve multiple users for a single encounter,

- This allows remote, collaborative learning in a real time clinical case – a paradigm that has never been possible before

Hands Free Technology

- Can also combine AR/VR platforms to allow for seamless communication, improved real-time capabilities and faster more informed decisions

- Multiple commercial platforms are available

- Smart glasses have been used for virtual ICU rounds in neurosurgical patients, stroke inpatient rounds and reported to be feasible, effective and widely

- Eckert, M., J.S. Volmerg, and C.M. Friedrich, Augmented Reality in Medicine: Systematic and Bibliographic Review. JMIR Mhealth Uhealth, 2019. 7(4): p. e10967
- Davids, J., et al., Simulation for skills training in neurosurgery: a systematic review, meta-analysis, and analysis of progressive scholarly acceptance. Neurosurg Rev, 2020.
- Johnson, T., et al., Virtual Reality Use for Symptom Management in Palliative Care: A Pilot Study to Assess User Perceptions. J Palliat Med, 2020. 23(9): p. 1233-1238.
- Noorian et al. Use of wearable technology. J Stroke and Cerebrovascular Diseases

How does it work?

- Uses commercially available hardware and intuitive software such as zoom, there are no high setup budgets allowing for much broader, flexible access

- From an institutional standpoint, AR allows simulation to be delivered at reduced cost with fewer resources

- Encourages learner engagement and may identify struggling residents who may benefit from further training

- Johnson L, Adams Becker S, Estrada V, et al. NMC horizon report: 2015 higher education edition. Austin, TX: The New Media Consortium. 2015. Retrieved from http://cdn.nmc.org/media/2015-nmc-horizon-report-HE-EN.pdf

UCLA Stroke Assessment Educational Platform

- Vascular neurology attendings assess general neurology and vascular neurology residents (PGY 2, 3 and 5)

- In situ assessment in the actual clinical environment in the ED

- Attendings provide real-time supervision, oversight and feedback of the clinical evaluation

- Trainees can walk through via real-life scenarios and feedback can be given instantly

Methods

Verbal consent to perform the encounter

The Vuzix 400M ARS uses an encrypted HIPAA protected protocol via zoom to transfer real time health information without the concerns of using third party cloud or space and violating patient safety

Bluetooth 4.0 connectivity allows them to pair with Android devices or connect wirelessly with our secure health system Wi-Fi

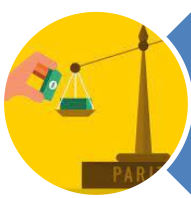
Streamlined the training process, basic how-to video to be used as a reference guide for the clinical team

Challenges and Future Directions

Cost of technology to implement simulation-based medical education

Faculty expertise and competencies in debriefing, simulator logistics and integration of simulation into the curriculum are critical components

In resource-poor settings and in low-income households in high-income countries this approach could prove to be a barrier for learners



Concerted efforts will be needed to ensure parity of learning opportunities for all trainees

- Comprehensive simulation in healthcare: operations, technology, and innovative practice” written by Scott B. Crawford, MD, FACEP, CHSOS, a practical guide to help practitioners prepare for a wide range of simulations in healthcare.

Summary

- As we move forward, we must be able to adapt and allow our traditional methods to include alternatives which rely on digital resources such as simulation technology

- The goal of simulation should not be to replace clinical training altogether, but to supplement and enhance education in a clinical setting

- Although AR and VR share many technical aspects, AR differs from VR as it is not within a fully artificial environment

- The educational experience with AR allows for seamless interaction between real and virtual environments