INCOSE Healthcare Working Group

5th Annual Systems Engineering in Healthcare Conference

May 1-2, 2019
Minneapolis, MN

How Using Simulation in Healthcare Can Reduce Cost & Improve Quality

by Chad Jackson, MS, RRT, FCCP
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VP of Market Growth and Innovation
American College of Chest Physicians

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Disclosure

- None
- While Chad is the creator of several commercial products sold by CHEST or through distributors, he receives no compensation for them.
- *Any mention of these educational products in this presentation is merely to engage learners on how they might use similar techniques described herein to achieve their own results in their organizations.*

Goals

Learning Objectives

1. Learners will contrast the different techniques used by CHEST to create various technologies and interventions to meet the needs of their learners.

2. Learners will recognize several different ways that CHEST has integrated low, medium and high fidelity, gamification and visualization technology into its practice to improve outcomes.

3. Learners will relate and identify opportunities to take ideas presented back to their own institutions.

Overview of discussion:

- Who is CHEST
- Simulation at CHEST
- Example Case Studies

Who is CHEST?

- The world's largest clinical pulmonary, critical care, and sleep medicine society.
- Mission: To champion the prevention, diagnosis, and treatment of chest diseases through education, communication, and research.
- Our journal CHEST is ranked 5th in 57 respiratory journals & 2nd in 27 critical care medicine journals.
- Website - www.chestnet.org

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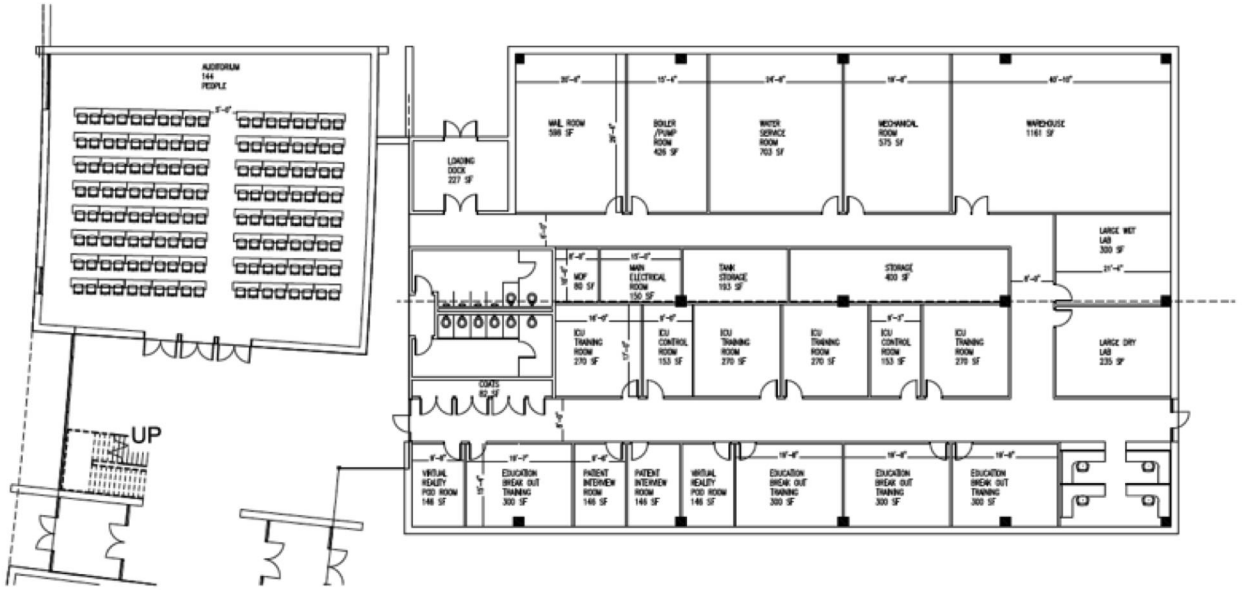
Study in Systems Engineering



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How do you use space?

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Marketing's idea of use of space

Reality

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Reality

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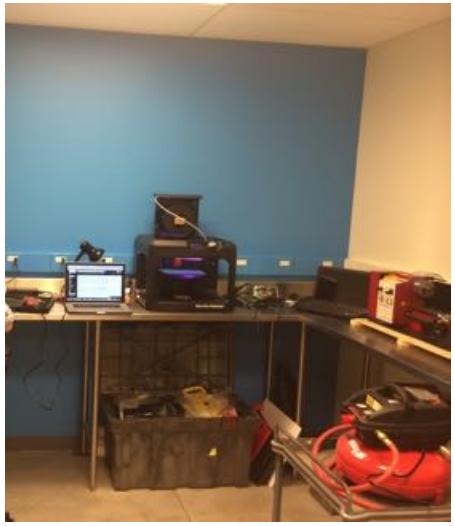
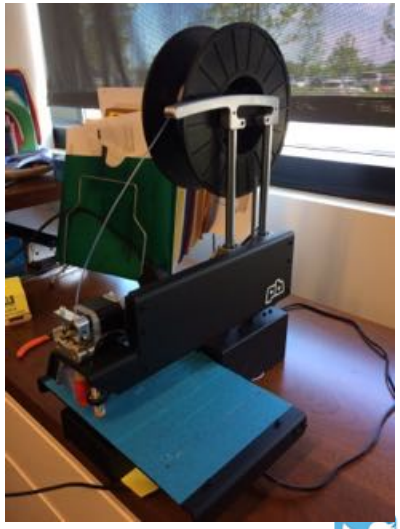
Marketing's Idea of use of space





Reality

Why Simulation for CHEST?

Educational philosophy based on our 2009 Effectiveness of CME Guideline

Goals of offerings based on this:

- Limit the didactics
- Create e-Learning opportunities for self study (flipped classroom)
- Build evidence-based medicine into everything
- Maximize hands-on opportunities for clinically relevant takeaways to impact physician practice and improve patient care
- Collect Data

From least effective educational offering to most effective:

- Level 1 – Didactics
- Level 2 – Self Study
- Level 3 – Evidenced based medicine
- Level 4 – Case-based education
- Level 5 – Simulation
- Level 6 – Performance/Quality Improvement/ Changing Practice

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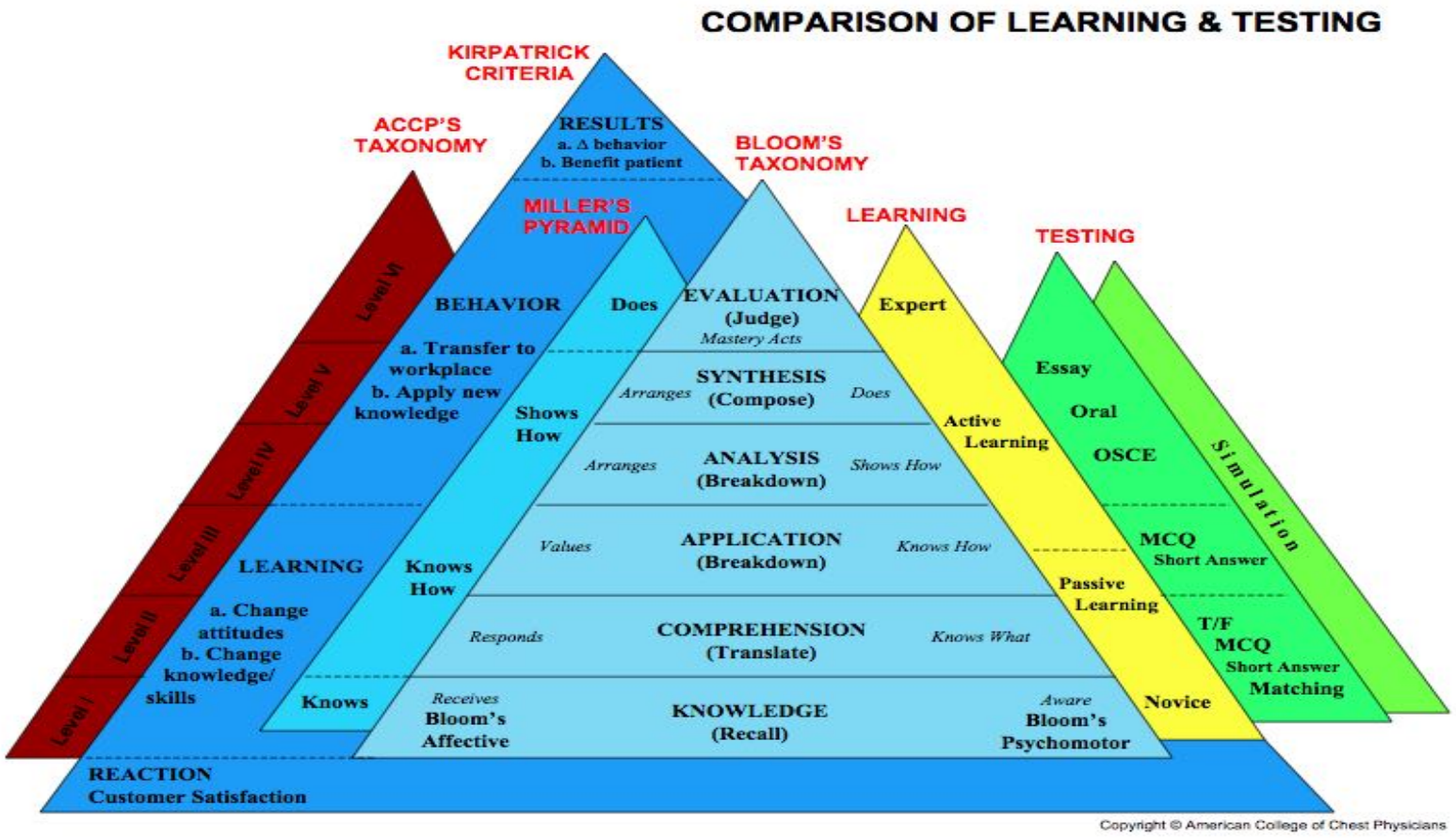

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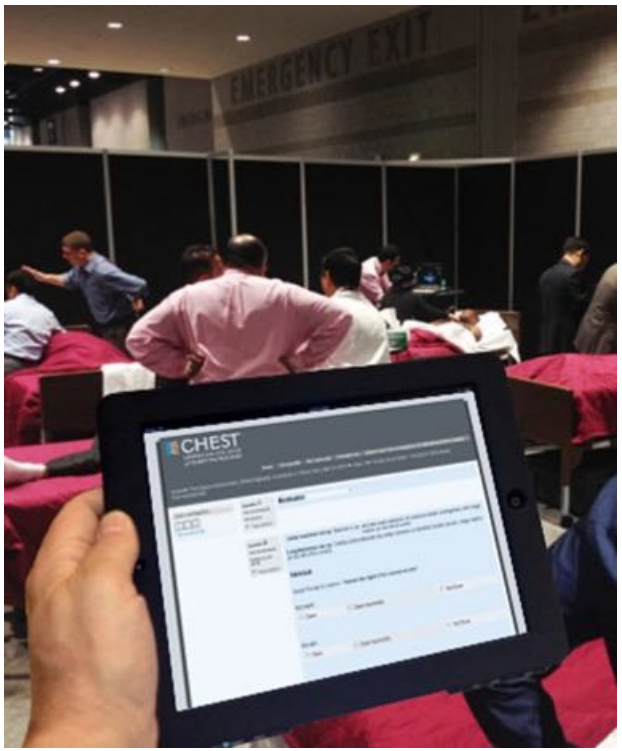
Group Dynamics in Simulation

Gathering data while training

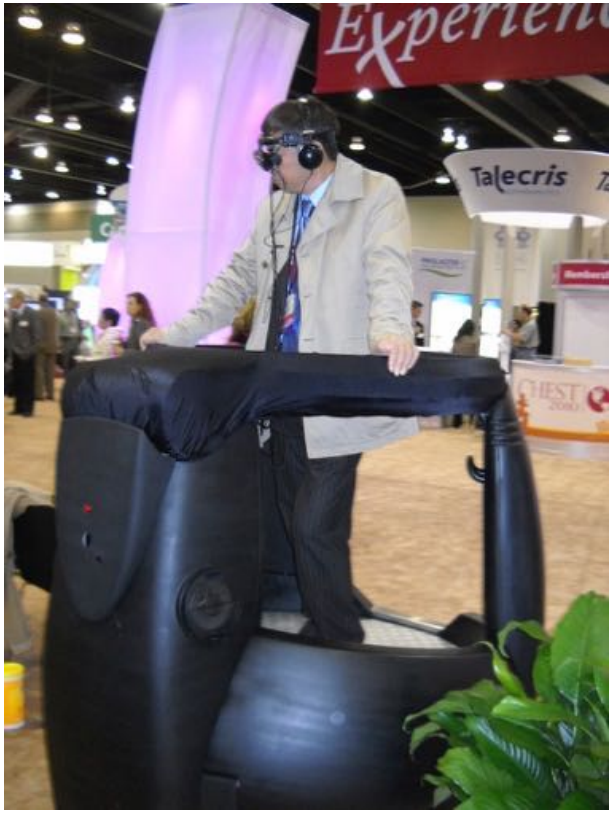
- With the addition of the LMS (2012), CHEST began robust data collection on all learners.
- Data typically collected on learners:
  - Demographics
  - Practice survey/confidence survey
  - Pre-knowledge exam
  - Pre Skills-based checklists
  - Post Skills-based checklists
  - Post knowledge exam
  - Commit to change/post confidence
  - Spaced Learning follow up

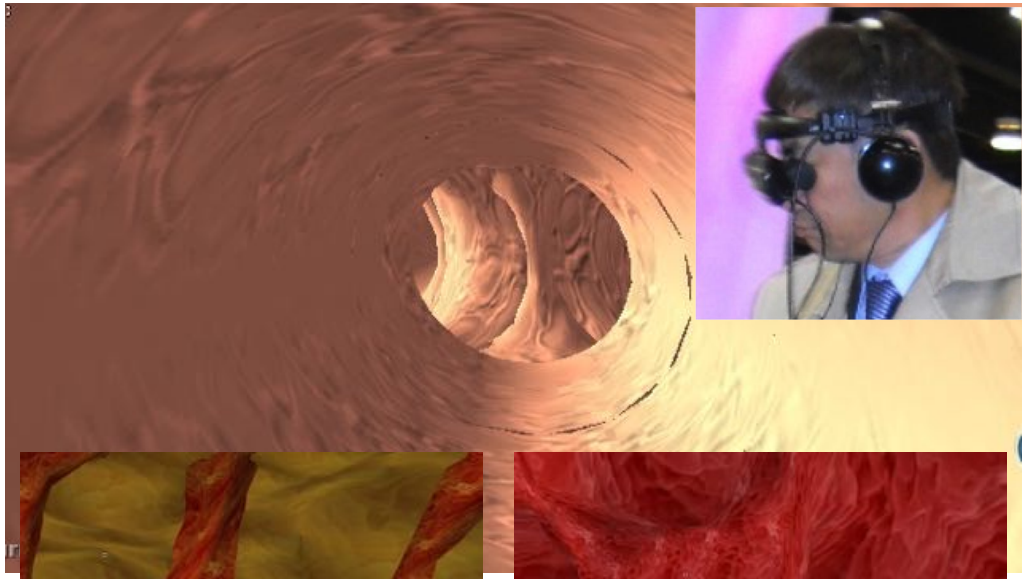


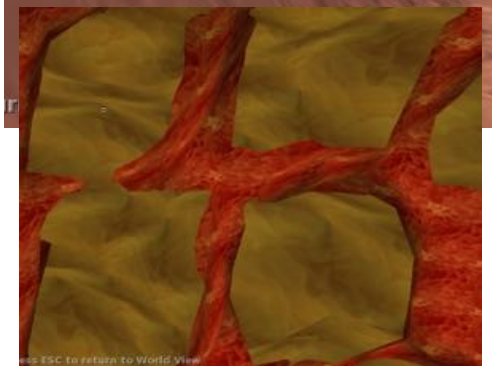
Case Study Number One

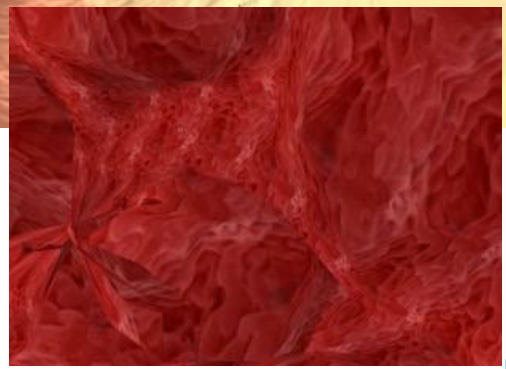
- Virtual Reality for CHEST Annual Meeting
- Budget: $25K
- Goal: Help physicians understand the esoteric differences between COPD and more serious emphysema.
- Technical requirements: Must be able to navigate in world, need head tracking to follow line of sight, need free use of their hands to manipulate things in world.
- Easy? Difficult?

VR for Experience CHEST 2009!









Case Study Number Two

- Virtual Reality combined with Artificial Intelligence
- Budget: $102K
- Goal: Help physicians understand how to apply the CHEST VTE Guidelines in simulated medical practice situations.
- Technical requirements: Must be able to navigate in virtual world, need head tracking to follow line of sight, need free use of their hands to manipulate things in world, need to get data into LMS, and needed natural language conversation with the patient and physician.
- Easy? Difficult?

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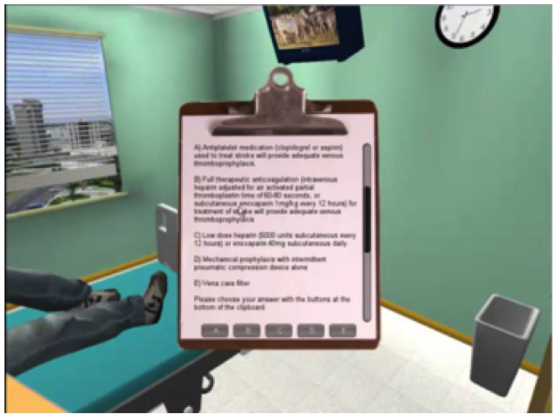
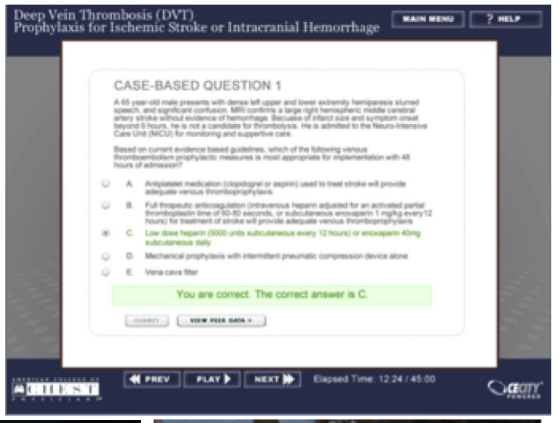




Technical Goals of the AI/VR Program

1) a web interface that allows subject experts to build and maintain the questions and case datasets without having to understand or interact with the underlying code,

2) a case repository that contains the content, or knowledge, that the virtual patient needs to perform its task, decoupled from AIML or any specific conversational engine.

3) an AIML generator which is a Java application that converts XML case files to AIML for the conversational agent. This content AIML is combined with common AIML files which handle generic conversation-related behaviors and avatar control.

4) an AIML sever which is an open source program – (Program D) with an HTTP server component. SL scripts access this service via typical HTTP request functions, and

5) scripts for avatars (Second Life) which provide an interface between SL users and AIML server, avatar animation and other interaction with avatars and in world objects.

Case Study Number Three

- Providing a safe simulated environment for physicians to practice EBUS-TBNA bronchoscopy
- Budget: $450K
- Goal: Help physicians practice the 15 steps of EBUS-TBNA safely, without damaging expensive clinical equipment
- Technical requirements: Must be able to navigate to any of the 16 main lung nodules. Must be able to sample the nodules with any of the tools including ultrasound, white scope and CT images.
- Easy? Difficult?

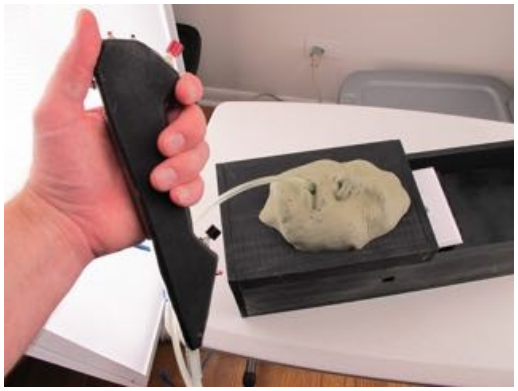
Clinical equipment vs. Virtual Simulators

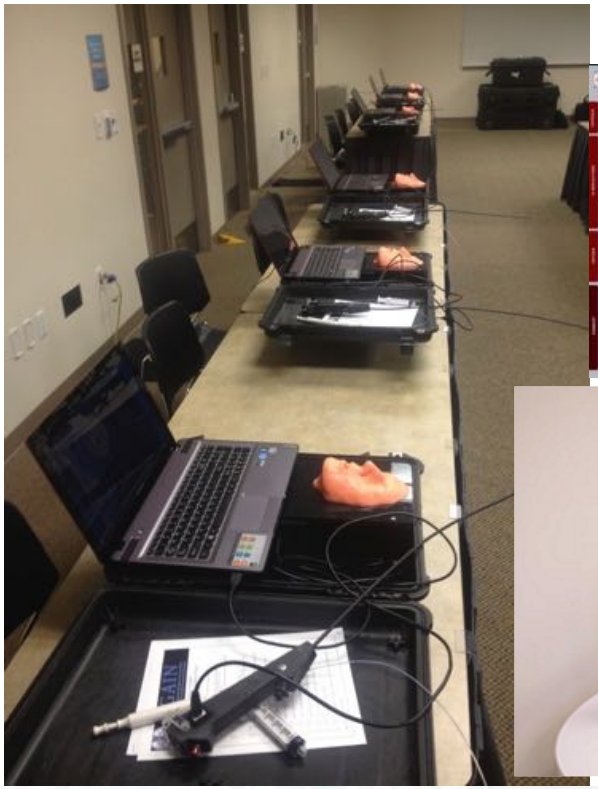
Additional Requirement: Travel to 50 US cities, and 14 EU countries in 45 days…

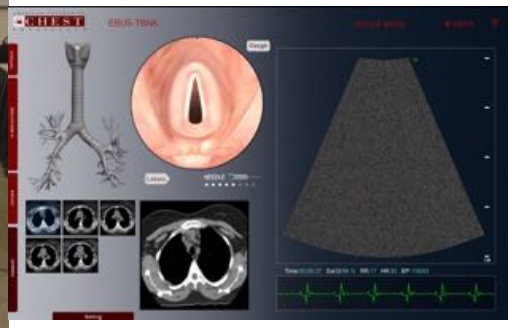
With only a $450K budget

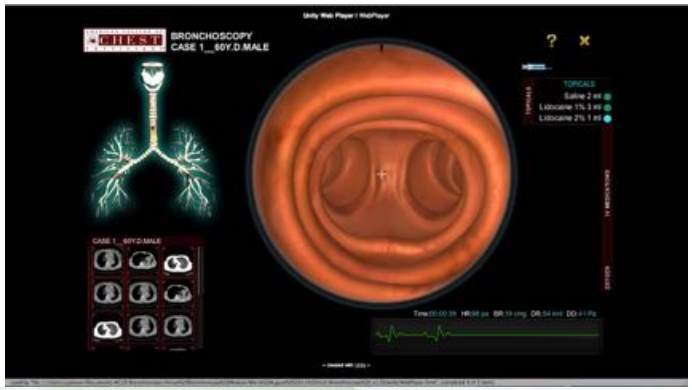
And a 3 month total development time!

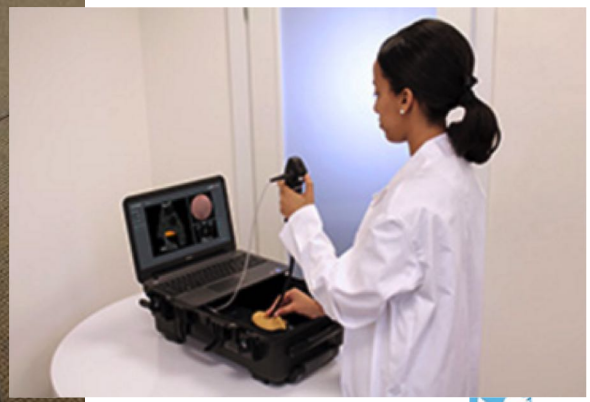
We built our own simulator: Bronch Express











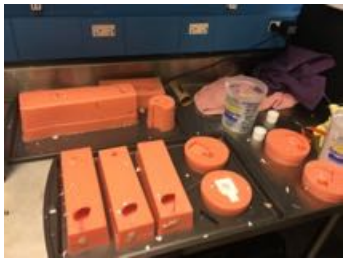
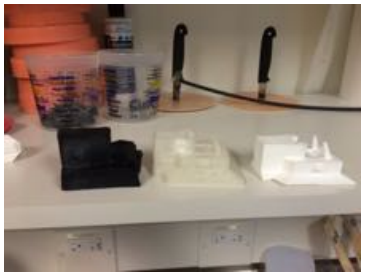
Case Study Number Four

- Providing an opportunity for physicians to practice the 15 steps of EBUS-TBNA bronchoscopy procedure
- Budget: $0K
- Goal: Help physicians practice the 15 steps of EBUS-TBNA safely, without damaging expensive clinical equipment
- Technical requirements: Must be able to place bronchoscope on nodule, hub against the wall, sample the node with EBUS needle, perform a slide smear
- Easy? Difficult?

Clinical equipment vs. Virtual Simulators

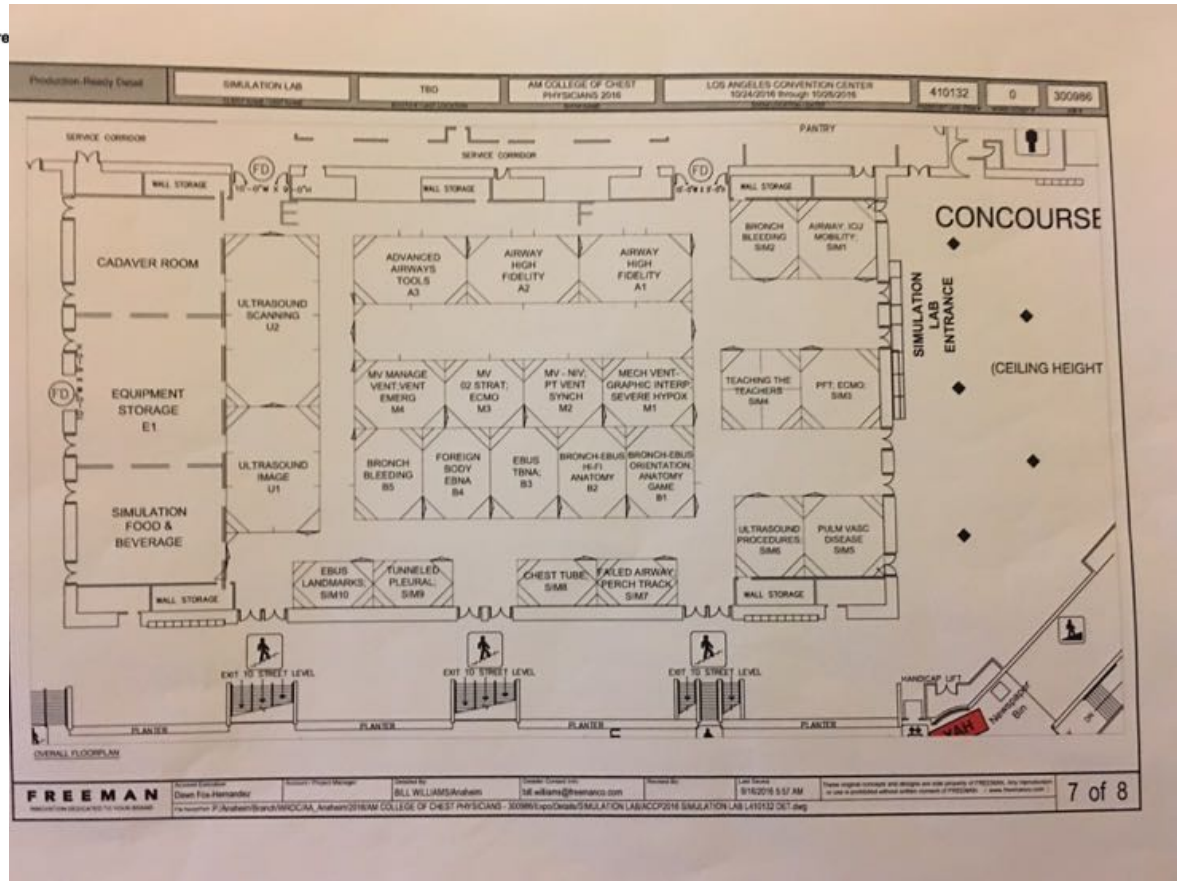
EFS low fidelity task trainer



Case Study Number Five

- Providing an opportunity for physicians to practice high fidelity simulation at the CHEST annual meeting
- Budget: $150K
- Goal: Help physicians practice as many pulmonary, critical care and sleep procedures as possible at a remote location
- Technical requirements: Take our 6 ICU rooms, and 8 training rooms, 2 auditoriums, and all of our equipment on the road. Create a simulated clinical environment in a ball room.
- Easy? Difficult?



27 rooms
26 programs
64 offerings
1163 HCPs trained in 4 days

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Logistical Challenges at CHEST annual meeting






Organizational and Process Challenges

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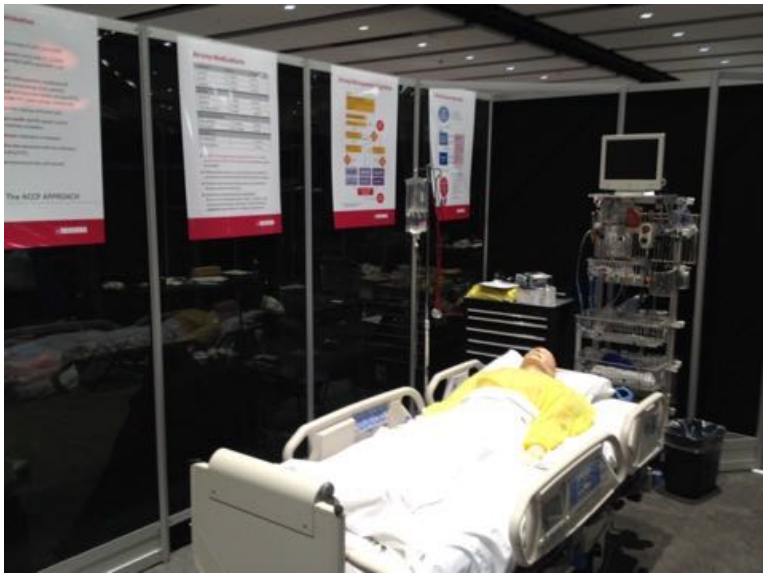
Everything has a place, everything in its place



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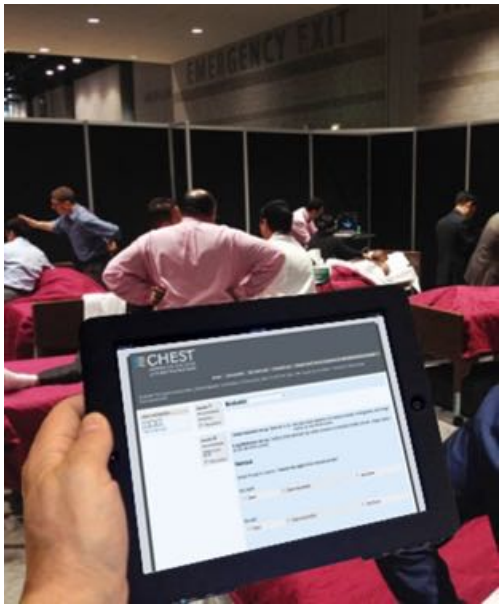
Simulation done ideally…








Case Study Number Six

- Providing an opportunity for physicians to practice an esoteric concept like guideline application to clinical practice (COPD)
- CHEST produces 7 clinical guidelines (gold standard)
- Budget: $25K
- Goal: Help physicians apply to their practice the COPD guideline (1300 pages, 923 recommendations)
- Technical requirements: “Do it cheap and make it fun!”
- Must collect learner data (LMS), interface (SCORM pkg)
- Easy? Difficult?

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Serious Games and Gamification




Why Gamification in Simulation?

- Games increase conceptual knowledge by 11%.
- Games increase learning retention by 90%.
- Games boost engagement with a particular topic.
- Games put skills into practice.
- Games provide immediate feedback.
- Games encourage emotional and social connection.
- Games hone problem-solving skills.

Sitzmann, T. (2011). *A Meta-analytic Examination Of The Instructional Effectiveness Of Computer-based Simulation Games.* Personnel Psychology 64: 489–528

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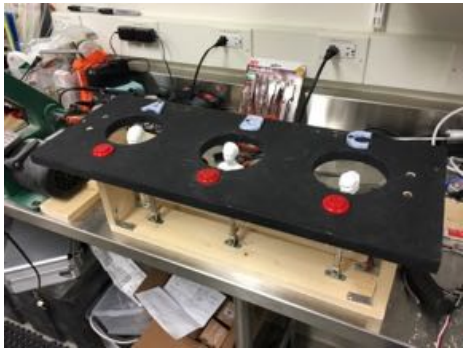
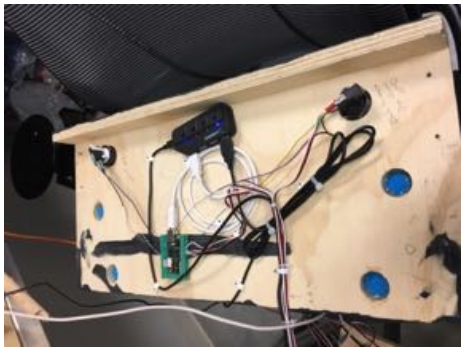
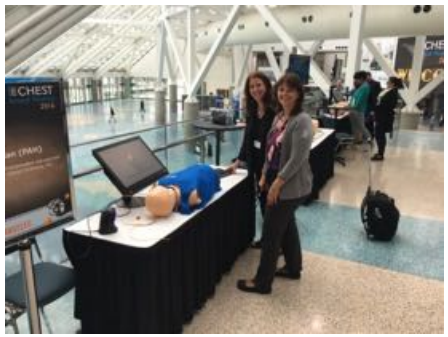
COPD Whack-a-Doc





Gift that keeps giving



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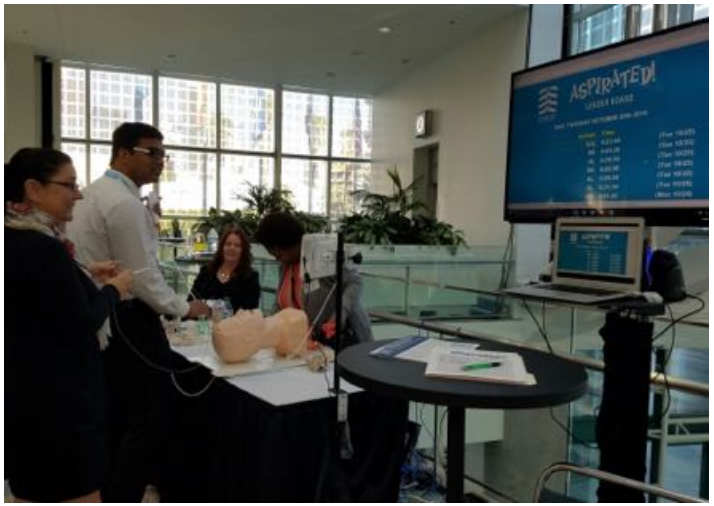
Scalable – each year add a little more



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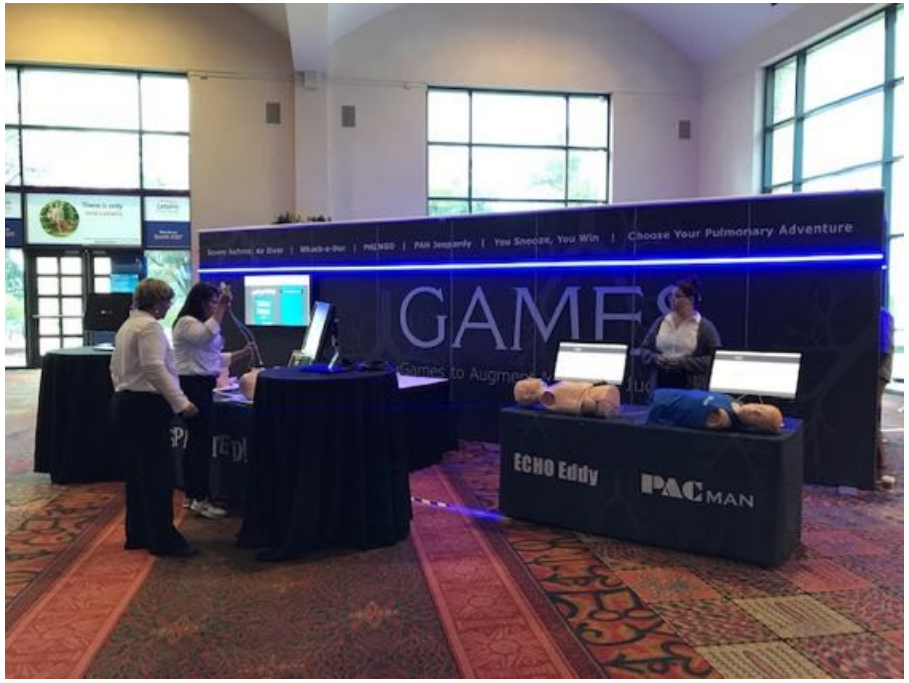
And More…



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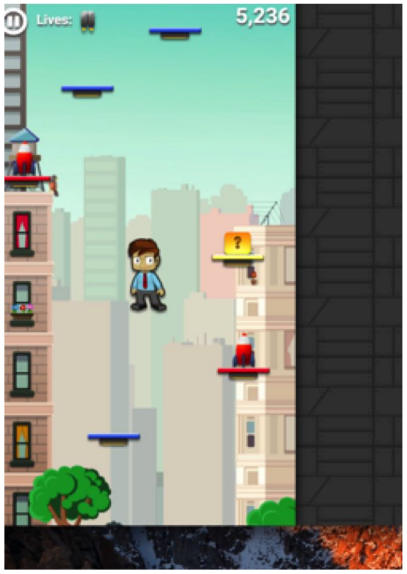
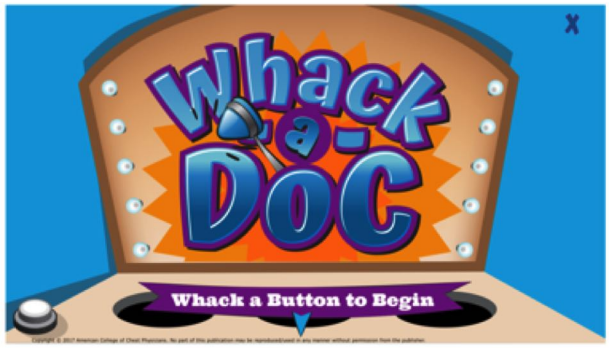
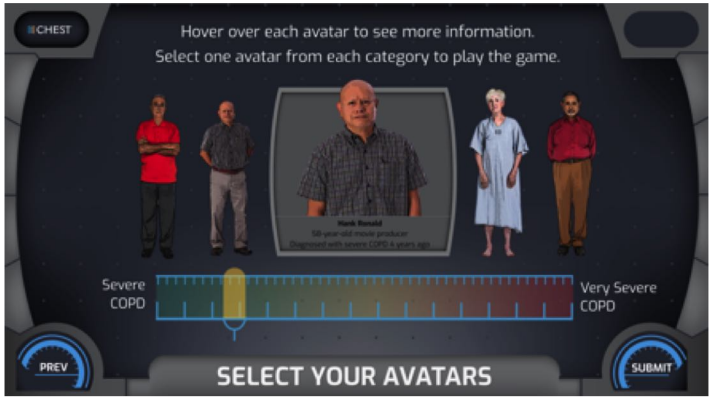
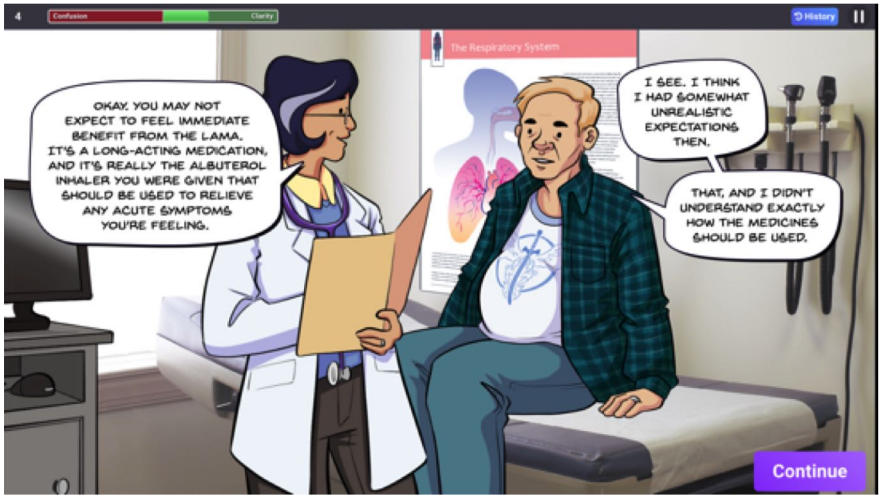
And More…



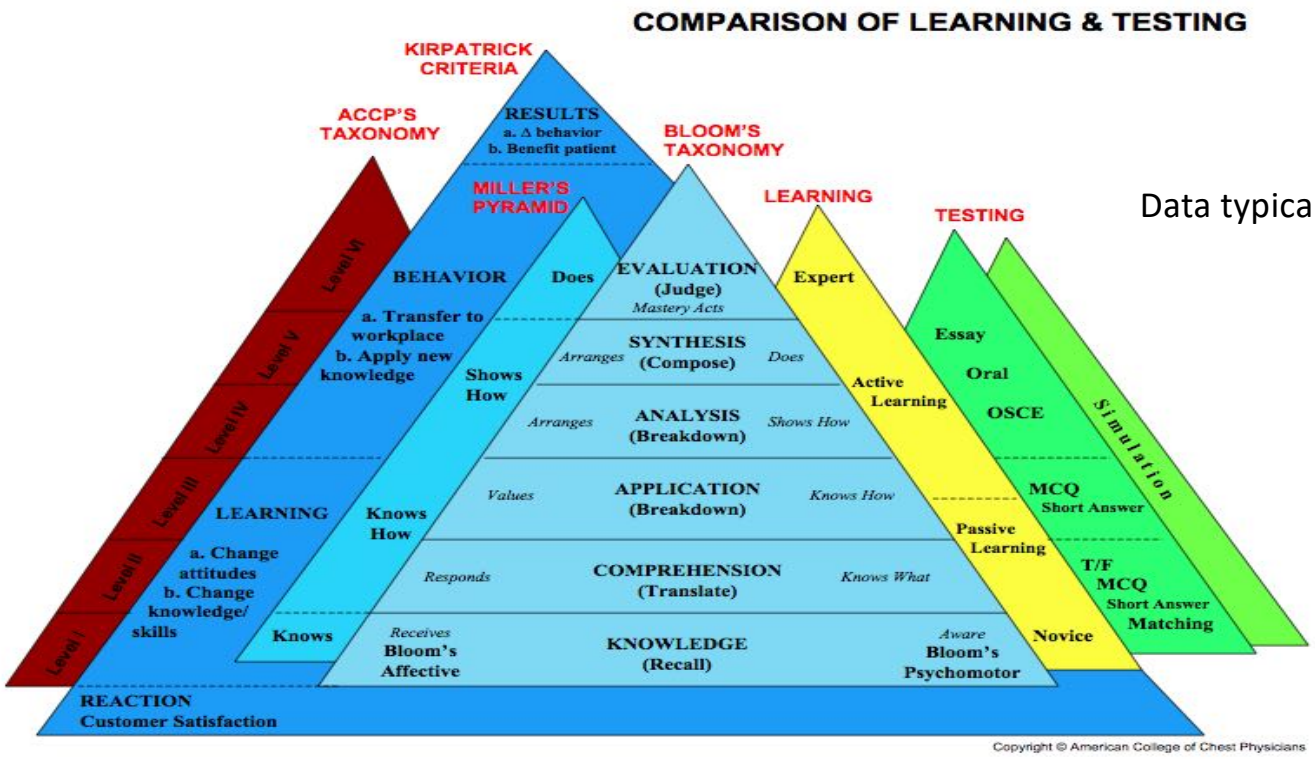






How does simulation work this way?

- We identify the key attributes of learning that we want the learner to come away with from this *microlearning example*
- We don't focus on the whole procedure most of the time
- We break the tasks down into very basic, but key achievements
- **These elements are designed to address quality issues in clinical practice**
- Ensure that the learners understood the how and the why most importantly
- Reinforced those skills in FUN and meaningful ways
- Increases engagement and retention



Data typically collected on learners:

- Demographics
- Practice survey/confidence survey
- Pre-knowledge exam
- Pre Skills-based checklists
- Post Skills-based checklists
- Post knowledge exam
- Commit to change/post confidence
- Spaced Learning follow up

Case Study Number Seven

- Providing an opportunity for physicians to do something else besides talk on their phones if they leave a session early
- Budget: $35-300K
- Goal: Keep physicians engaged at the annual meeting
- Technical requirements: “Do it cheap and make it fun…, that worked last time!”
- LMS, SCORM, Spaced-learning follow up
- Easy? Difficult?

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Virtual Patient Tours





Case Study Number Eight

- Providing an opportunity for more than ONE physician to do a fun and engaging activity that is clinically relevant on the exhibit floor
- Budget: $25K
- Goal: Keep physicians engaged at the annual meeting, increase traffic in the exhibit hall for vendors who pay a lot of money to be there
- Technical requirements: “Do it cheap and make it fun…, I think that is your mantra now”
- Clinically relevant, case-based questions that can become an enduring product (LMS, SCORM)
- Easy? Difficult?

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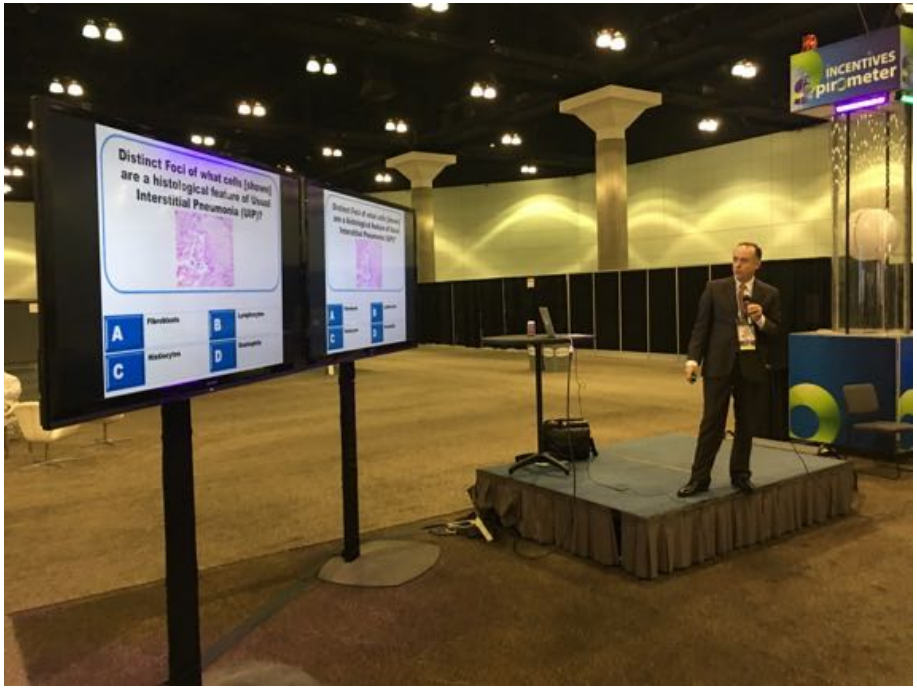
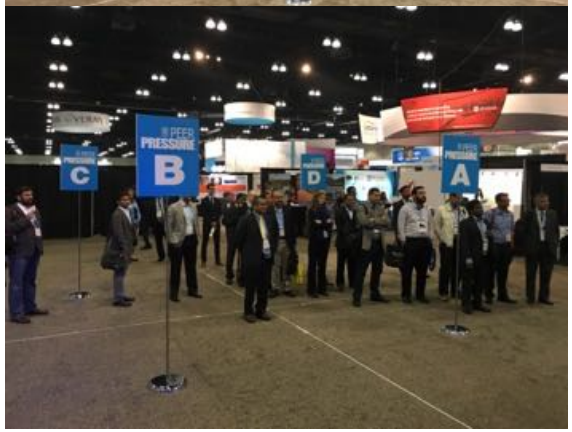
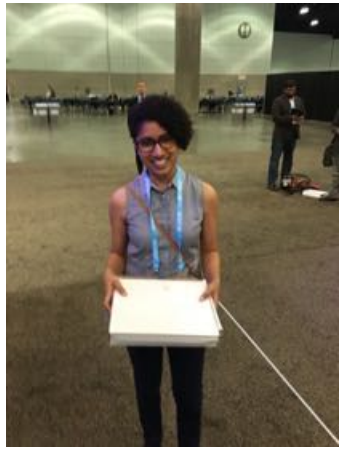
Gameshows – Incentives Spirometer

Gameshow – Peer Pressure







Case Study Number Nine

- Providing an opportunity to do something “real” in AR
- Budget: $25K
- Goal: Design an Augmented Reality Program that is useful to clinicians in the pulmonary, critical care and sleep space
- We chose tasks related to mediastinal airway anatomy
- Technical requirements: Deploy it using an iPhone or iPad
- Easy? Difficult?

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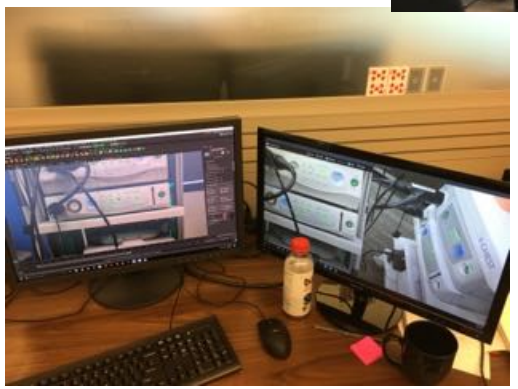
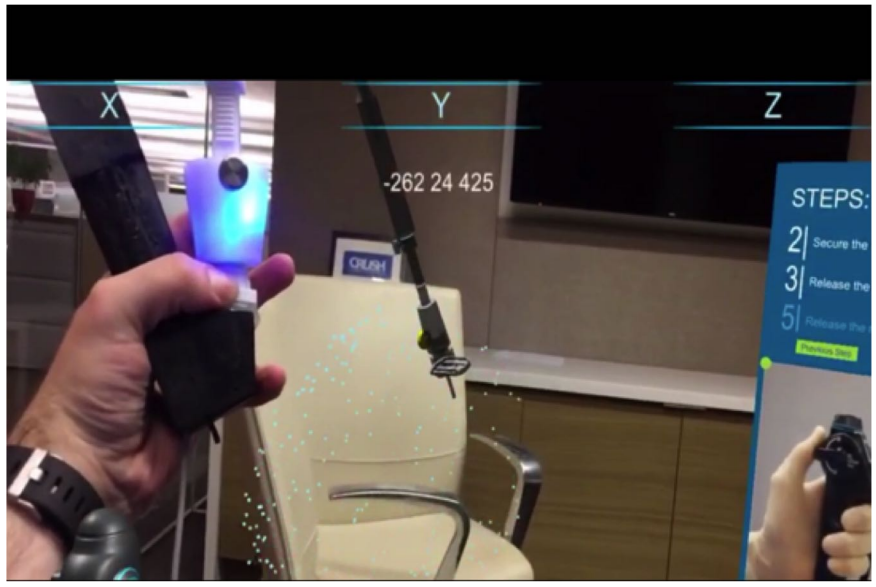
Augmented Bronchoscopy



Practical Augmented Reality: 15 Steps of EBUS-TBNA



Case Study Number Ten

- Providing an opportunity to get more out of our high fidelity simulators
- Budget: ~$50K
- Goal: See if we could use xAPI (Tin Can) to get more data out of our simulators
- Technical requirements: Help create standards for verbs that can be used for anyone doing high fidelity human patient simulation
- Easy? Difficult?

CHEST use of high fidelity sim and education

Using xAPI

- What is xAPI?
  - Versus SCORM
  - Versus AICC
- Standardized communication method
- Great for gluing systems together and talking to each other

- xAPI Statement

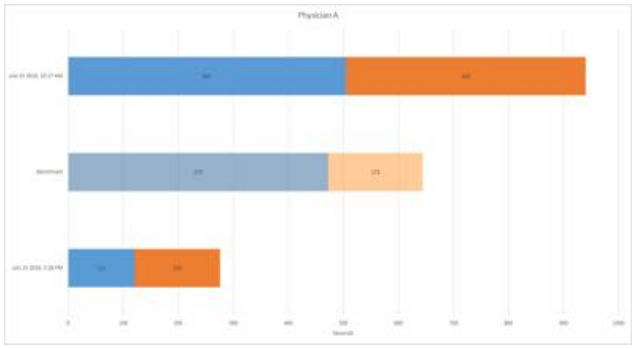
How does xAPI work?

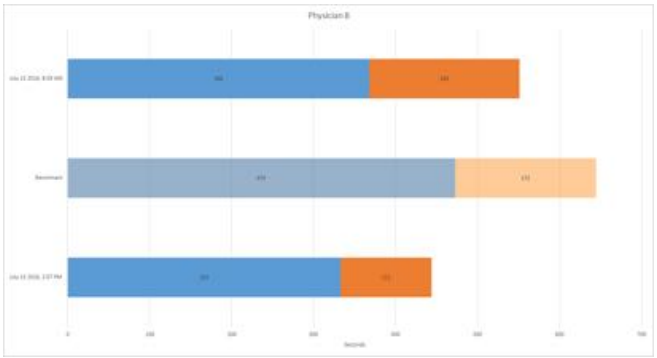
- Central Storage Point
- Speaks a Common Language
- May Include Advanced Reporting and Analytics

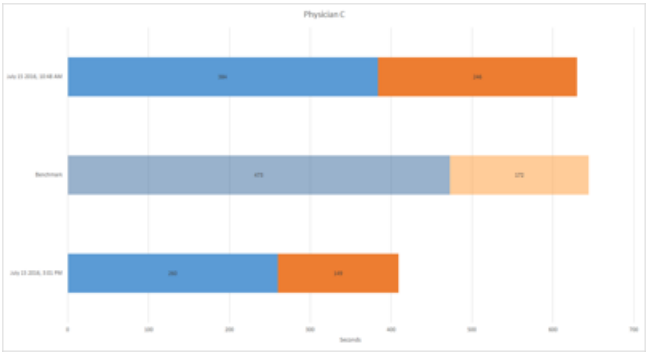
Integrating the simulation into the LMS

Early Results

- Vision for improvement
  - Pre/Post Data
  - Prediction Models
  - Benchmarks Estimated Long-term
  - Metrics







Challenges of xAPI

- Technological Infancy
- Lack of Definitions
- Tipping Point
- Lack of Robust Tooling
- More Data than Less Data
- Taxonomy
- Complete Specification

- Our Next Steps
  - Collecting data from external sources
  - Mobile quizzing application from LMS based on learner performance

INCOSE Healthcare Working Group
5th Annual Systems Engineering in Healthcare Conference
May 1-2, 2019
Minneapolis, MN

How Using Simulation in Healthcare Can Reduce Cost & Improve Quality

- Identify specific tasks that are clinically relevant to your learners that they are not good at currently
- Assess how you can teach those using simulation techniques
  - High fidelity human patient simulation
  - Low to medium fidelity patient simulation
  - Gamification
  - Augmented or Virtual Reality
- What is realistic for your application/experience level?
- Apply what you have learned
- Gather Data
- Re-assess, Improve and Re-deploy (Iterate)

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Thank you for attending!

Share your experiences at #HWGSEC