Virtual Reality Gets Personal in Healthcare

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Speaker Introduction

Rick Krohn, M.A., M.A.S.
President
HealthSense, Inc.

An expert in corporate strategy and strategic marketing, business development, corporate communications and technology-enabled business transformation. Since 1998, Rick Krohn has served as President of HealthSense, an IT and digital transformation consultancy serving the healthcare, telecom and education industries. His prior industry experience was gained in the health plan, hospital, physician practice and vendor spaces. He has published over 100 articles on a wide range of health care subjects and written three mHealth texts. Rick has earned degrees from Towson University, American University and Johns Hopkins University. Further information about Rick can be found at www.healthsen.com
Speaker Introduction

David Metcalf, PhD
Director
METIL Lab, UCF Institute for Simulation & Training

More than 20 years’ experience in design and research of web based and mobile technologies converging to enable learning and healthcare. Dr. Metcalf is director of the Mixed Emerging Technology Integration Lab (METIL) at University of Central Florida’s Institute for Simulation and Training. The team has built mHealth solutions, simulations, games, eLearning, mobile and enterprise IT systems for Google, J&J, VA, the U.S. military and UCF’s College of Medicine among others. Recent projects include Lake Nona’s Intelligent Home prototype and Significant Technology, a mobile university toolkit. He frequently presents at industry and research events shaping business strategy and use of technology to improve learning, health and human performance. He is co-editor, with Rick Krohn, MA, MAS, of the HIMSS Books best-seller mHealth: From Smartphones to Smart Systems (2012). He is also co-editor, with Rick Krohn, MA, MAS and Patricia Salber, MD of Health-e Everything: Wearables and the Internet of Things for Health: Part One: Wearables for Healthcare (2016) and Health-e Everything: Wearables and the Internet of Things for Health: Part Two: Wearables and IoT (2016).
Conflict of Interest

Richard Krohn, M.A., M.A.S.

Has no real or apparent conflicts of interest to report.
Conflict of Interest

David Metcalf, PhD

Has no real or apparent conflicts of interest to report.
Agenda

- VR overview
- VR in Healthcare
- Applications
- Hurdles to Adoption
- Trends
- Combat Medic AR
- AR Wearables in the OR
- WHIT Microsoft HoloLens
Learning Objectives

• Analyze the disruptive application of VR technology throughout the healthcare landscape
• Describe how VR is architected to create immersive, personal health prevention and treatment
• Discuss actual cases of VR applications that address personal and population health
• Recognize VR healthcare solutions that are in development, pilot and launch pad
Value STEPS

IMPROVING PATIENT SAFETY & CARE

INCREASING ERROR PREVENTION IN THE OR

DECREASING MEDICAL TRAINING COSTS
Virtual Reality is a century–old idea ........
...that has evolved from a mass market entertainment medium to a personalized, immersive class of technologies
VR describes several related technologies

**Virtual reality** (“VR”) is an artificial environment created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment. In a digital environment, VR is primarily experienced through two of the five senses: sight and sound. (http://whatis.techtarget.com/definition/virtual-reality)

**Augmented reality** (“AR”) is the integration of digital information with the live video of the user's environment in real time. AR takes an existing visual digital feed and blends new information to create an augmented environment. (http://whatis.techtarget.com/definition/augmented-reality-AR)

While VR aims at immersing the user into a computer generated virtual world, AR takes a different approach, in which virtual computer generated objects are added to the real physical space.

**Real 3D** displays an image in three dimensions.

**Real Holographic** differs from 3D in that it has the ability to display binocular disparity, motion parallax, accommodation and convergence.
VR market snapshot

Healthcare has not been a headliner for VR investment....

...but that will change, according to Goldman Sachs. Healthcare VR applications are forecast to top $5.1 billion in sales by 2025, with 3.4 million active users, including 1.5 million medical professionals.
In healthcare, the tools and technologies of VR have evolved.....

February 1925 cover of *Science and Invention* magazine

...and a more recent depiction
...and the enabling devices have gotten better, too
VR in the healthcare enterprise

<table>
<thead>
<tr>
<th>A. SECTORS</th>
<th>B. DEVICES</th>
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<tr>
<td>First Responders (Police, Fire, EMS)</td>
<td>Google Glass</td>
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<tr>
<td>Emergency Department (ER Dr., Nurse, etc.)</td>
<td>Vuzix</td>
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<td>Neurology (Telestroke)</td>
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<td>Teletrauma (Primary Survey, Resuscitation &amp; FAST)</td>
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<td>Cardiologists</td>
<td>Pivot Head, GoPro, LoupeCam, Designs for Vision NanoCam</td>
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Source: Health –e Everything: Wearables and the IoT for Healthcare, Krohn and Metcalf, Editors

VR most effective as a training and education tool
AR effective in the ER, OR as 3D imagery, simulation and heads up display with checklists that improve outcomes
...but in other verticals it’s still early days – VR development is still largely in the pilot and boutique solution stage. *Industry-wide, it’s a green field for innovation.*

**VR in the Physician Office**
- Behavior change
- Virtual diagnosis
- Education and Prevention

**VR in Pharma**
- PTSD
- Rehabilitation
- Pain management
- Behavioral health (ex. pain management, drug efficacy)

**VR/AR applications for patients and consumers**
- Immersive health/wellness
- Gamification
- Brain injuries
- Behavioral health (ex. anxiety, body image, phobia)
- Chronic disease management
A short video that demonstrates the value of AR as a training and “Guidance System” in the ER.....
VA and DoD are leading development of VR and AR healthcare apps

• Training and Education – field medicine
• PTSD
• Rehabilitation
• Pain management
• Behavioral health
... some Enterprise VR Deployments

Cleveland Clinic VR
Parkinson’s Disease

St. Jude’s Children's Research Hospital
…and some Payor Deployments

Cigna Virtual Relaxation Pod™, an innovative 3D meditative experience

Disney’s Habit Heroes (sponsored by Florida Blue, Anthem), the EPCOT exhibit was built around educating guests about kicking some unhealthy habits, and improving health and fitness.
There are, of course, hurdles to VR/AR Adoption in Healthcare

- Infrastructure, Integration and Gadget cost
- New technology aversion – VR is a young technology not easily deployed in enterprise environments (but has shown effectiveness in ER, OR and with field staff to drive better outcomes).
- Creating a truly engaging augmented reality experience in a practical, consumer-ready device.
- User experience (disorientation, motion sickness)
- Initial training on 3D environment degrades experience
- Privacy, compliance
- Pushback from doctors unaccustomed to retail solutions
  - Why should providers care? (managing risk, education, outreach, outcomes, chronic disease management, compliance).
VR Innovation – Trends

• Blending of VR and AR products
• Commoditization and retail availability of VR tools, devices and solutions
• Increasingly immersive – from passive viewing to active engagement
• Granular range of apps, better resolution, heightened expectations for creative content
• Form factor – lighter, more comfortable, less scary
• Gaming industry will provide substrate for NextGen VR - from VR experience to VR environments – ex. The Void
Combat Medic AR

Combat Medic Cards & Mobile Training

Combat Medic Mobile AR

Combat Medic Online Game
The introduction of the head mounted wearable computer Google Glass (2013, Fig 2) generated enthusiasm from healthcare providers due to the promise of seamlessly integration of data without the interruption of workflow (Fig 1). In addition to Google Glass, several other basic head mounted computer devices (See Table 1B) are also available that can be divided into either Soft AR or Hard AR. The current available applications involve simple telementoring with telestration and two-way audio communication (Third Eye Health, Pristine, and CrowdOptics). These platforms provide data collection in the FPPOV and surgeons may review them for process improvement in real time. In the future, FDA regulation is on the horizon, as these devices evolve to provide a clinical function (Soft AR).

**Wearable Operating Room Technology in the Future**

![Image of wearable operating room technology](image)

The emergence of wearable technology uses in healthcare today will likely provide the foundation for training at all levels and evolve into enhanced patient safety. In the near future, binocular augmented reality devices will have the capability of producing immersive simulation for training, overlay content in the visual field during procedure performance, real time access to patient specific data, on-demand reference content delivery and on-demand mentoring such as Aether One and...
AR Wearables and IoT in the OR (1/3)

- UCF Experiment in conjunction with VA SimLEARN and Army Research Lab STTC-MST
- Healthcare providers are embracing the use of wearable devices to facilitate their work in various areas of care
- Use of checklists improves patient safety during surgery, and facilitates navigation of complex tasks

- Incorporating wearable technology and checklists useful and effective for post-operative action review of team-based operating room (OR) procedures?
  - Iterative instructional approach
  - Support for provider during uncommon operative procedures
AR Wearables and IoT in the OR (2/3)

• Use of wearable devices in healthcare
  – Google Glass
    ❖ for guiding trainees through surgical procedures (Peregrin, 2014)
    ❖ for team collaboration (Armstrong, Rankin, Giovinco, Mills, & Matsuoka, 2014)
    ❖ record and archive surgeries for training (O'Connor, 2014)
    ❖ live surgery

• Checklist effectiveness in OR
  – Improve team participation and ensure completion of critical steps
    (Porter, Narimasu, Mulroy, & Khoeler, 2014)
  – Reduction in post-operative complications and fatality during team training
    (Ross-Richardson et al., 2012)
AR Wearables and IoT in the OR (3/3)

• Potential of combining wearables and checklists
  – Combine Google Glass with hands-free safety checklist application to potentially reduce OR errors (Peregrin, 2014)
  – Smart watch system deemed useful by ICU nurses for monitoring vital signs and sending to-do reminders via an automated checklist (Bang, Solvenik & Eriksson, 2015)

• We developed a simple shared checklist application
  – The checklist was converted to a web application for mobile device use
  – Designed to promote team-work in clinical settings; a checklist, as well as checked items, can be viewed simultaneously by all team members.

Mockup of checklist application
Current Effort

• Use commercially available head-worn and wrist-worn wearable technologies to incorporate and display checklist in medical training simulation

• Tools to perform post-operative action review of team-based operating room (OR) procedures

• Assess the utility and effectiveness two conditions: a shared checklist, and one without a checklist

• Team-based simulated operating room scenario for a mock code event, aided by healthcare providers simulating the tasks of health professionals, including doctors and nurses

Wearable devices used in the study
Results: Phase 3

• User recommendations
  – Use wearable devices for hospital procedures
  – Google Glass recommended for code simulations, CPR with children, ACLS with medical students, BLS with general population
  – Pivothead/Tablet for sepsis protocol adherence; and using Apple Watch for experiments with trauma patients, and with pediatric patients
  – Using a wearable device would be an extra step (Samsung Watch Gear S).
Discussion: Principal Findings

• Participants did not experience issues with audio quality, battery, or overheating, or attention to task. Samsung Gear S and Apple Watch users experienced lag in video mirroring and audio capture.

• The utility of the wearable devices in the mock code scenario and the use of an HD monitor is unclear.

• Overall, the use of the checklist during the experiment was not distracting. However, Apple Watch, Pivothead/Tablet, and Google Glass users found that the checklist was an extra step in an already complex task, which led to an increase in mental effort.

• The TAM revealed that participants thought the wearable devices in the mock code scenario were both useful and easy to use. This implies that the use of wearable devices could be incorporated in mock code scenario training.
WHIT Microsoft HoloLens Demo
Value STEPS

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Questions

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