## How Virtual and Augmented Reality Will Transform Healthcare

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#### **Political Conflict**

## **Global Warming**

## **Depletion of Resources / Pollution**

## Healthcare Crisis - Aging Populations



#### Healthcare Crisis: Aging Populations







## **Transforming HealthCare with Technology**

# Digital Health Revolution

- Mobile Health / eHealth
- Wearable Sensors
- Patient Centered
- Leverages Internet: social, competitive, collaborative



# New Technologies for Healthcare

Major Trends:

- Transformation from analog to digital
- Transformation from location-based and time limited to any location, and available 24/7
- Patient focused patient engaged in their own care
- Emphasis on prevention and behavior change

The Quantified Self Movement: Early Adopters



makes sports funtasti

THE ULTIMATE SKI COMPUTER

# Every medical device reinvented





Digital Health Platforms deliver interventions to patients, and parses data for enhanced decision-making



# Digital Health Platforms deliver interventions to patients parse data for enhanced decision-making



Objective data Behavior and activities Linked to intervention Population trends



# **Digital Health Revolution**

Medical Applications of Virtual Reality Technology



## Virtual Reality Technology For Medicine



- Current technologies and concepts are founded on more than 30 years of research and development
- Recent changes in cost and access make VR affordable
- VR tech is currently used for prevention, evaluation, treatment and chronic disease management
- After years of validation and use by early adopters VR technology is poised to move to the mainstream
- On the horizon: enhanced, ubiquitous, informative and integrated

## VR and AR technology will significantly impact Medical Care

- Prevention and Wellness
- Objective Assessments
- Improved Adherence
- Facilitated Behavior Change
- Distributed Care Delivery
- Management of Chronic Conditions



# **VR Technology Has Evolved**

First general purpose and commercially available VR systems.

Now, after more than 30 years of research and development...



Virtual Reality Technology On the way to becoming a commodity – available at consumer prices

Oculus



## Now is the time for VR

VR technology is now affordable, scalable and accessible to the marketplace. The VR category is attracting interest and investments from major players.







#### Within 6 years, VR will likely be adopted by 40-70 million users

Initial adoption will be driven through game console, PC gaming and mobile phone bundling.

Within <u>3 years</u>, VR will likely be adopted by 15-30 million users.



## AR Technology





## **Medical Applications of Virtual Reality Technology**

Although entertainment, social connection and gaming will drive the initial adoption of VR technology, the deepest and most significant market for VR will be in clinical care and in improving health and wellness.

The list of clinical interventions made possible by VR is long. VR technology also facilitates clinical assessments and medical training, as well as providing for improved surgical skill training and procedure planning.

Personal health and wellness can be improved by using VR to engender better nutrition, promote healthy lifestyles, and to reduce stress and anxiety.

As the cost of healthcare rises, VR technology can serve as an effective telemedicine platform to reduce costs of care delivery, and improve clinical efficiency

Academic research has demonstrated that Virtual Reality can effectively treat a wide variety of clinical problems– ranging from addictions, to stroke, to PTSD

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# **MEDICAL APPLICATIONS OF VR**

- Health & Wellness
- Medical Training
- Clinical Assessments
- Medical Interventions



# **Medical Training**

- Clinical Skill Training
- Surgical Skill Training
- Interpersonal Skill Training
- Use of Equipment and Tools
- Team Training eg: Emergency Department, Surgical Team
- Emergency Response Training and Rehearsal
- Empathy



#### Surgical Training: Preoperative Planning & Image Guided Surgery

Rapidly becoming the standard for training...

...and soon to be part of the standard of care.



# **DIAGNOSTIC ASSESSMENTS**

- Medical Image Review
- Neuropsychological Assessments
- Activities of Daily Living Assessments
- Physical Medicine OT / PT
- Behavioral Medicine psychology, psychiatry



## New Approaches for Cognitive Assessment

#### **RESET** Digitized Neurocognitive Tool Set

This product evolves traditional paper and automated evaluations to a more sophisticated level..

It also produces a robust intervention that challenges cognitive skills.



# A LONG LIST OF MEDICAL INTERVENTIONS

- Physical Therapy and Rehabilitation
- Neuro-rehabilitation Stroke and Traumatic Brain Injury
- Speech Therapy
- Optical Rehabilitation –

Strabismus, Amblyopia

- Acute and Chronic Pain
- Surgical Planning

# Virtual environments are used clinically to treat several important mental and behavioral health problems

- Drug and alcohol abuse
- Schizophrenia
- Post-traumatic stress disorder (PTSD)
- Generalized Anxiety Disorder
- Mood Disorders Depression
- Mild Cognitive Impairment
- Autism Spectrum Disorder
- ADHD



# Virtual environments are used clinically to treat several important behavioral health problems

- Phobia and anxiety disorders
- Obsessive Compulsive Disorder (OCD)
- Developmental disabilities
- Conduct disorders
- Anger management
- Eating disorders
- Impulsive disorders
- Learning disabilities
- Neuro-cognitive disorders



# HEALTH AND WELLNESS

- Weight Management
- Cognitive Function Training –

Sequencing, Situational Awareness, Decision Making

• Exercise

- Stress Management
- Disability Solutions
- Addressing Isolation
- Grief Counseling
- Mood and Resilience





## Why Now?

Over 40 years of academic research and over 3000 studies demonstrate that VR can improve behaviors, attitudes, and health.

Until now, the technology was expensive, bulky, and difficult to use. Today, we have the advancements to bring VR to scale in healthcare.

#### **Portable Telemedicine Platform**



#### Virtual Humans For Training, Confidential Interaction, and Telemedicine Support



## Some Examples





# PTSD, Phobias, and Anxiety Disorders

- Exposure-based treatments can be conducted in the safety and comfort of an office setting
- Effective tools for treating a variety of clinical problems, in particular anxiety and addictive disorders
- Fully immersive environments, with include the use of a head mounted display, 3D sound, tactile stimulation via shaking platform, and olfactory stimulus are used for PTSD therapy



# **RISK AVOIDANCE TRAINING**

#### Refusal skill training for those who need help with addictions



# **Stress Inoculation – Risk Preparation**









#### Virtual hospital tours could be used to relieve pre-procedure anxiety

## **Build Empathy for Underserved Populations**



VR can be used to help train doctors and staff to better understand the patient perspective.



## How does it work?



# The Neuroscience of How VR Promotes Behavior Change

VR can promote behavior change by taking advantage of the way our brain's learning and reward systems function

VR systems can:

- Activate neuroplastic change via reward systems
- Shorten the feedback loop show progress
- Leverage mirror neuron systems



# The Neuroscience of How VR Promotes Behavior Change

- It is necessary to activate the associated brain system to enable neuro-plasticity
- Repetition is required
- It is critical to engage the brain's reward systems
- Attention drives Cholinergic system
- Novelty drives Noradrenergic/Serotonergic system
- Reward drives Dopaminergic system



# Leveraging Mirror Neurons

Ability to change attitudes and behavior after "being" one's future self.

# Your Future Self



- Students interacted with 3-D avatars of future self.
- Asked to allocate \$1K between present expenses, a fun splurge, checking account, & retirement account.
- Participants who interacted with future self put more than twice as much money into retirement account.

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#### **For More Information:**

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