The Integration of Pharmacogenomics into Clinical Practice Using Virtual Reality:

An Educational Innovation Project

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Objectives

- Evaluate the opportunities that Virtual Reality (VR) may provide in the delivery of clinical experiences for primary care providers and others

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Outline

- Background and Definitions
- Relevance to Clinical Practice
- Establishing the Problem
- Identified Solution(s)
- Implementation
- Preliminary results
- Future of Genomics in Education and Clinical Practice
- Future of VR in Education and Clinical Practice
- Q and A

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Background……

Precision Medicine Initiative was launched with a **$215 million investment** in the **President's 2016 Budget** to pioneer a model of patient-powered research that promise to accelerate **biomedical discoveries** and provide clinicians with new tools, knowledge, and therapies **to select which treatments will work best for patients**

Currently renamed: "**All of Us" Research Program**
FAQs for All of Us Research Program:
https://allofus.nih.gov/about/program-faq

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The Precision Medicine Initiative

Definition

- Disease treatment and prevention that incorporates individual genetic variation, environment and lifestyle

Overarching Aim

- To accelerate the pace of moving precision medicine into every day clinical practice

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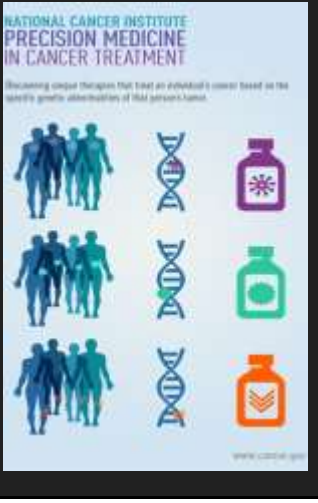
The Precision Medicine Initiative

- Expand efforts in cancer genomics
- Support trials testing combinations of targeted therapies based on tumor's molecular signature
- Develop solutions to drug resistance
- Develop approaches assessing response to therapy
- Develop new tumor cell models to predict response to drug combinations and define mechanisms of resistance



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Targeted Treatment to Specific Variant in Melanoma Gene

McDermott et al. (2011). Genomics and the continuum of cancer care, NEJM, 364, 350-360.

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Definitions

- Genomic Medicine
  - "An emerging medical discipline that involves using genomic information about an individual as part of their clinical care and health outcomes and policy implications of that clinical use" *NHGRI*
    - Influences include diagnostic or therapeutic decision making
- Examples of Genomic Medicine
  - Translational
    - Whole genome sequencing
    - Cell-free DNA
      - Transplantation Rejection
      - Biomarker for cancers
  - Clinical
    - Pharmacogenomics
      - Using an individuals genome to determine whether or not a particular therapy or dose of therapy will be effective
      - More than 100 FDA approves drugs have pharmacogenomic labels (analgesics, antivirals, cardiovascular, anti-depressives and anti-cancer therapeutics
    - DNA Sequencing for Ebola

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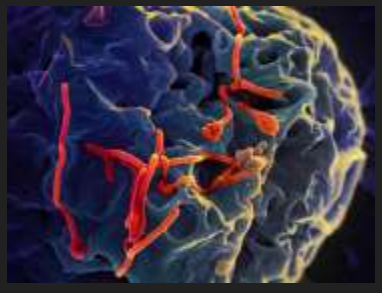
Clinical Relevance

The Ebola Virus on a Cell



Genetic Relevance

- Relationship between genes and the virus
- Genetic diversity and range of Ebola symptoms

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What does this mean for humans?

Plasma transfusions presumably transferring antibodies

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Ebola Crisis

Individual genetic differences may affect Ebola survival

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Why…..Clinical Application

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Pharmacogenomics

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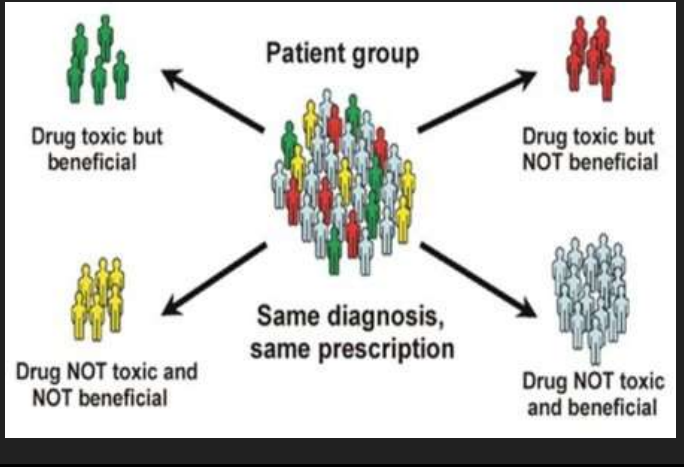
Basics of Pharmacogenomics



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Example: Treatment for Depression

Dosing recommendations for sertraline based on CYP2C19 phenotype

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Therapeutic Recommendations based on Phenotype

- CYP2C19 phenotype
  - Ultra-rapid metabolizer *
  - Extensive Metabolizer
  - Intermediate Metabolizer
  - Poor Metabolizer**

*consider an alternative drug not predominantly metabolized by CYP2C19
**consider a 50% reduction of recommended starting dose

Clinical Pharmacogenomics Implementation Consortium (CPIC) guidelines:
https://cpicpgx.org/content/guideline/publication/SSRI/2015/25974703.pdf

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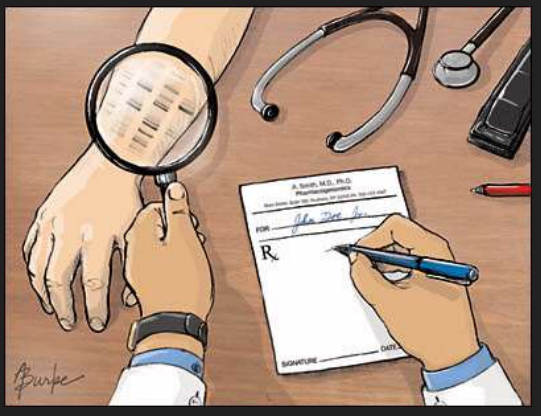
Genotype in clinical practice….



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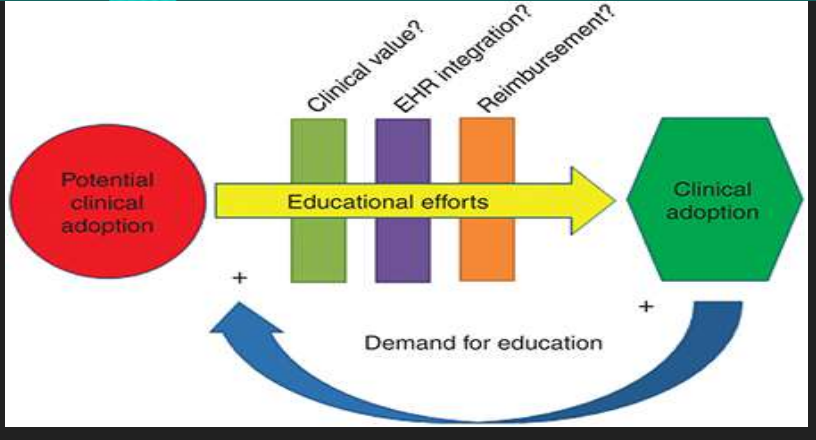
Genomics Education



Feero, Manolio, & Khoury. Genetics in Medicine (2014) 16, 871–873

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Problem(s)…..

- Lack of Genomics in the Classroom
- Lack of Genomics in the Clinic
  - Clinical practice
  - Mentorship
- Education of Current Clinicians with regard to Clinical Implementation

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Problem(s)…..

- Lack of Genomics in the Classroom
  - Curricular Integration
- Lack of Genomics in the Clinic
  - Clinical practice
  - Mentorship
- Education of Current Clinicians with regard to Clinical Implementation

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Virtual Environment Technology

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What is VR?

- Virtual Reality
  - An artificial environment that is created with software and presented to the user in such a way that the user accepts it as a real environment. On a computer, virtual reality is primarily experienced through two of the five senses: sight and sound.

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What is AR?

- Augmented Reality
  - Augmented reality is the integration of digital information with the user's environment in real time. Unlike virtual reality, which creates a totally artificial environment, augmented reality uses the existing environment and overlays new information on top of it.

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Early Use of Augmented Reality: First Down

Digital information in real world in real time

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Early Use of Virtual Reality: Second Life

Patient treatment room in Evergreen Island
(Photo Courtesy Dr. Chris Stuart Hutchison)

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Evolving Case Studies

G3C: Global Genetics and Genomics Community
https://genomicscases.net/en

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Not exploring today….

- Augmented Reality
- Second Life
- High Fidelity Sim (Manikin-based VR)

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Virtual Reality

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Virtual Reality

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Experience in Elementary Education

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Virtual Environment Technology

- Clinical Decision Making with regard to genomics

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National Institutes of Health

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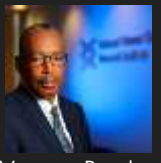
Collaboration

Dr. Kathleen Calzone
Research Geneticist
National Cancer Institute
Center for Cancer Research,
Genetics Branch



Vence Bonham JD
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Head Immersive Virtual
Environment Test Unit

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Equipment

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Collaboration and Training




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FNP Program (5 semesters)

Semester 3

- Simulation with Evolving Case Study and Supplemental Education

Semester 5

- Virtual Reality Clinical Experience
- Evaluative Experience
- Debrief

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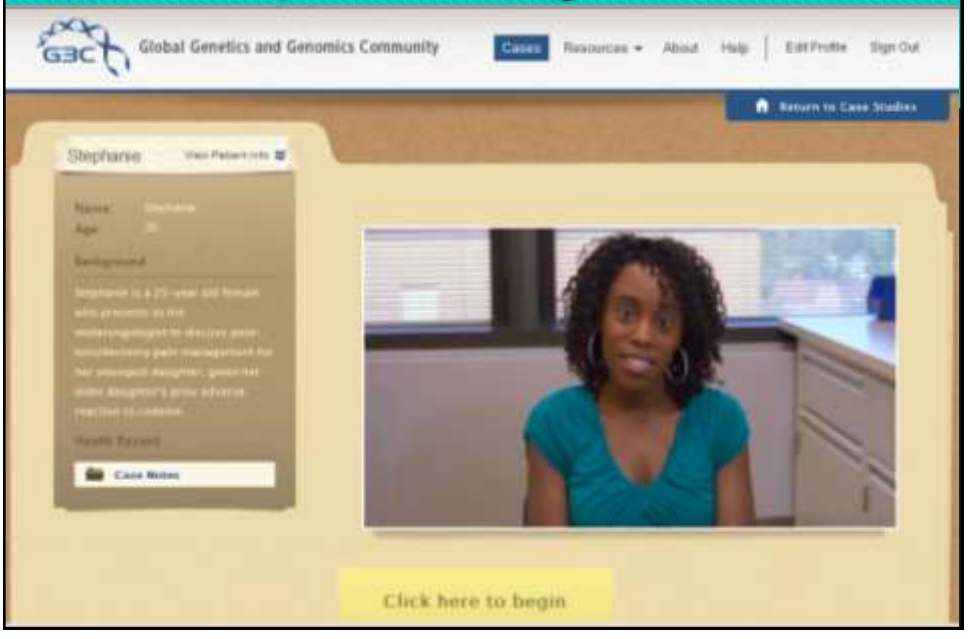
G3C and pharmacogenomics



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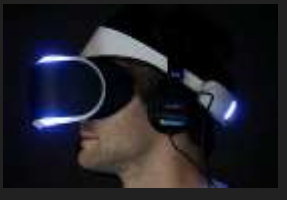
Clinical Experience with Virtual Reality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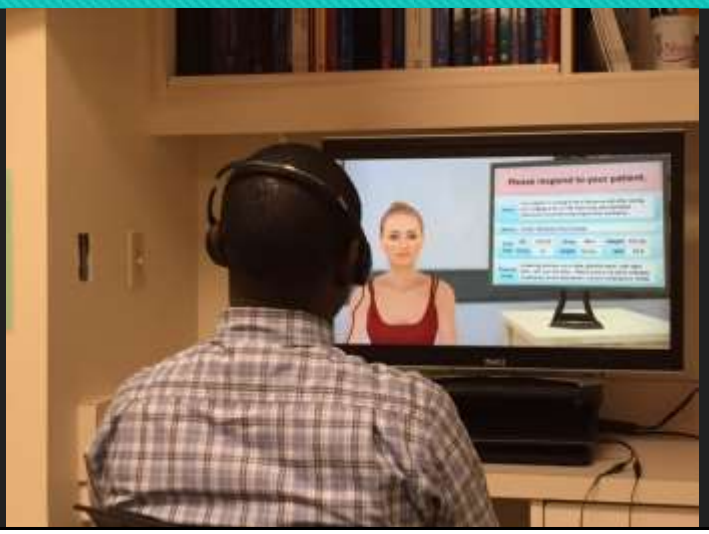
Alternative Clinical Experience



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Observations and Student Comments

- "Really felt like I was in clinic"
- "This needs to be used throughout the curriculum"
- "I felt as though I was speaking to a real patient"
- "This is amazing….way better than using standardized patients, or practicing with our colleagues."
- "This could be used for in-service training for practicing NPs!"

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Other Potential Opportunities

- Immersive Educational Experiences
- Simple to Complex Equipment
  - Cardboard and smart phones
  - Oculus Rift and beyond
- Recreational to Clinical application
- Clinical Intervention

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Where Else Could VR Lead Us? Immersive Technology and Education

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Simple…to complex

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From Cardboard and beyond….

….from cardboard

……still using our own cell phones

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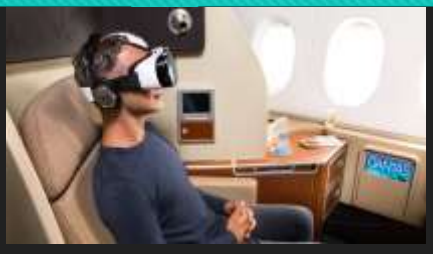
From Recreation to Clinical Learning……



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Clinical Interventions using VR

Pre-op relaxation therapy

Surgical Training

VR Assisting with Dementia Care

Exposure Therapy for PTSD

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Additional utilization of VR…for patients and providers

Pain Reduction

Example Laparoscopic right hemicolectomy on 360 video

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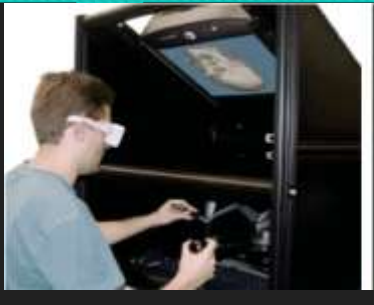
Immersive Touch Technology



Immersive Touch is working on creating simulation based surgical training and exploration

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Questions

- Are our students being exposed to these interventions?
- Is there a place for VR as a clinical supplement and/or in place of unavailable clinical experiences (ie: pharmacogenomics in the clinic)
- How do we make this happen?
- What are the challenges?
- What are the opportunities?

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Thank you…..

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