STEM

Advances in Technology for Biomedical Research

and clinical
Advanced Technologies
Are these the game changing technologies?

Gene Editing
CRISPR is considered the “discovery of the century”. Makes it more possible to change human genes to remove disease causing mutations, and genetically enhance resistance to disease.

Nano Therapy
Usually engineered in size from 1 to 100 nm, they serve as contrasting and targeting mechanisms.

Brain Interfaces
These DARPA products work but need to be made more cheaply. Implant and external sensor devices let people control devices with brainwaves.
Where Biomedical Discoveries Come From

Different disciplines build on each other

- **BASIC SCIENCE**
  - New Targets

- **POPULATION HEALTH**
  - Effectiveness

- **CLINICAL**
  - Efficacy

- **PRE CLINICAL**
  - New Technologies

**CYCLE OF BIOMEDICAL DISCOVERY**
Biomedical Discoveries: Silos

The study of making this happen faster/better is called Translational Research.

Multidisciplinary Ecosystem

These disciplines are extremely fragmented and it can take 17 years before a basic discovery reaches clinical practice.

- **Basic Scientists**: Chemists, Biologists, Geneticists
- **Clinicians**: Physicians, Nurses, Pharmacists, Therapists
- **Applied Scientists**: Engineers, Designers, any of above
- **Information Scientists**: Health Economists, Epidemiologists, Data Scientists

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This Technology is the Game Changer
These produce the information we need to cure now and make the next discovery

Genomic Sequencers
Next Generation sequencers unlock the inherited contribution to disease and tailor treatments

Electronic Health Records
Not just for storing vast amounts of clinical data, EHRs are a platform with active decision support

Remote Monitoring
Blood glucose, heart monitoring, weight, etc. All captured and made available to you and your care provider

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Data Supports and Connects the Discoveries

Biomedical discoveries are information intense.
Data is Big in Health
Clinical, Research, Business...all data

Data Capture
Comes from clinical trials, clinical care, business and strategic systems, and everywhere else.

Data Storage
Full time Storage Engineers continuously grow petabytes of space

Data Analysis
Nearly everyone looks at data now as part of their jobs (even the physicians!)
Healthcare in U.S.

An information intense industry in crisis

• 5,700 Hospitals
• 16M Healthcare workforce
  • 893,000 Physicians (21% employed by hospitals)
• 17% of Gross Domestic Product
How big is clinical data?

This is the size of one person’s file

Remote Monitoring
Telemetry, continuously monitored labs, and other streamed data just keep on growing.

Genomic Data
Your genetic code (once processed) is only about 700Mb. But it takes 200Gb of short reads to get there.

Images
One CT/MRI image can have hundreds of image layers

Care Documentation
Diagnoses, labs, notes, procedure codes, are all in text format and grow slowly each year
Harvard Business Review: Data Science is the sexiest job in the 21st century
Data Science
A interdisciplinary field that is sexy

Data Management
Governance, cleaning, restructuring, and merging data. Not “database management”

Analysis
Analysis can be confirmatory or exploratory. One of these aims to answer a question, and the other intends to make new discoveries.

Visualization
Communicating information is both art and science. Metaphors and multidimensional charts are used in dashboards, alerts, etc.

Extremely High Demand
McKinsney and Co. projects a global demand of more than 1 million new data scientists!
Data Science in Healthcare

Although relatively new in other industries, data science has been completely flat for years in healthcare, yet has become an immediate critical need in the past couple of years.
Health Data Science: What Took So Long?

I just like to put these two guys on the same slide

- 1983: Prospective Payment System. A reason for healthcare to be efficient
- 2009: Meaningful Use. Clinical data is now available
- 2010: Value Based Purchasing. A reason to improve quality of care
Data Science Triangle

Jobs vary in the degree of each of these

Business Acumen
Analytics Methods
Communication
THANKS for LISTENING, THINKING, and ENGAGING

Contact me for any reason at: jpdeshazo@vcu.edu
Jon DeShazo