PRECISION MEDICINE, BIG DATA & SMART CITIES

Suzanne Holt Ballard PhD, Teratec Forum, Paris, June, 2016

The Global Digital Health Market Is Valued at $55.3 billion (2015-2020)

Top six categories in 2015 in the US (51% of funding):

- Healthcare consumer engagement (B2B and B2C)
- Wearables and biosensing
- Personal health tools and tracking
- Payer administration
- Telemedicine
- Care coordination

What is the future of digital health?

Let’s enumerate the ways in which the future is beckoning us ….

Third Wave of the Internet:

involving the vast transformation of entire sectors, including healthcare.

Steve Case, Entrepreneur, Chairman and CEO of venture capital firm, Revolution LLC, 2016

Fourth Industrial Revolution –

VELOCITY, SCOPE, IMPACT

Fusion of technologies that blur the lines between physical, digital, and biological systems . . . cyber-physical systems will embrace living organisms and 'inert' machines

Klaus Schwab, founder and executive chairman of the World Economic Forum, 2016

The Seventh Sense: the new sensibility required to live and work in the age of dynamic networks. The age of enmeshment.

“We have to go deeper. We have to cultivate a new instinct, one intended to make us more human, in a sense, not only more technical”.

Joshua Cooper Ramo, vice chairman and co-chief executive of Kissinger Associates, Beijing and NYC, 2016

THE RISE OF PRECISION MEDICINE

FIVE FACTORS ENABLING THE RISE OF PRECISION MEDICINE

- Health IT (electronic health records)
- Proactive patients
- Developments in mHealth
- Cost-effective genomic analysis
- Burden of behaviorally-based chronic epidemic diseases

PRECISION MEDICINE INITIATIVE

In his State of the Union address in January, 2015, President Obama announced the **Precision Medicine Initiative (PMI)**, a $215 million plan to collect personal information from a million US volunteers.

Long-term Objectives of the PMI

To "generate knowledge applicable to the whole range of health and disease" ….

To "enable better assessment of disease risk, understanding of disease mechanisms … with the goal of expanding the benefits of precision medicine into myriad aspects of health and healthcare"

National Institutes of Health 2016

Citizen-Generated, Contextualized Big Data

“NIH is committed to including behavioral, physiological and environmental measures in the cohort”

Mobile and wireless sensor technologies to assess behavioral, physiological, and environmental parameters are an integral aspect of the Initiative

Cohort participants will be research partners – fully engaged with the process, able to access their data and the research findings derived from the data

Precision Medicine: Not Just "Genes, Drugs and Disease"

The PMI will integrate social, behavioral, environmental and biomedical data to form a more complete, continuous picture of individual health

Data analytics for the PMI will require expertise from the related fields of Computational Health Sciences and Computational Behavioral Sciences

COMPUTATIONAL BEHAVIORAL SCIENCE

In the context of the PMI, treatments can embrace Digital Behavior Change Interventions (DBCIs)

Computational models to support behavior change will drive these DBCIs

Challenge: move toward dynamic modeling of behavior that has the capacity to reflect shifting, complex changes in behavior and the drivers of that behavior

The goal is to develop **multiscale models of behavior** with interoperable subcomponents that can be refined and integrated over time

These models, and the computational behavioral framework in which they fit, will enable personalized, predictive and responsive Just-in-Time Interventions

This approach acknowledges the malleability of time, physical location and individual psychological states – and how these factors impact health

CITIES AS HEALTHCARE DELIVERY SYSTEMS

What if we designed environments that are responsive to human data points (physical/mental health via multi-layered sensing systems)?

What if we designed material environments, both public and private, to recognize distress and dysfunction?

What if we thought of cities as material environments in which technology – and data – converge to prime and prompt us to reach our optimum physical and mental health?

City4Age: H2020 (2015-2018)

City4Age project is a response to the following initiatives:

- Active and Healthy Aging (European Innovation Partnership)
- Age-Friendly Cities (World Health Organization)
- Smart Communities and Cities (European Innovation Partnership)

Rationale

- to design an urban analytics system comprised of a wide range of devices and technologies
- to unobtrusively collect data to model and predict the risk of adverse health events
- to intervene to prevent these events (via behavior change)

The clinical conditions under study are frailty and mild cognitive impairment (MCI)

Our demonstration sites

The populations included in the project are elderly people living in various types of accommodation in

- **Madrid**
- **Singapore**
- **Montpellier**
- **Birmingham**
- **Lecce**
- **Athens**

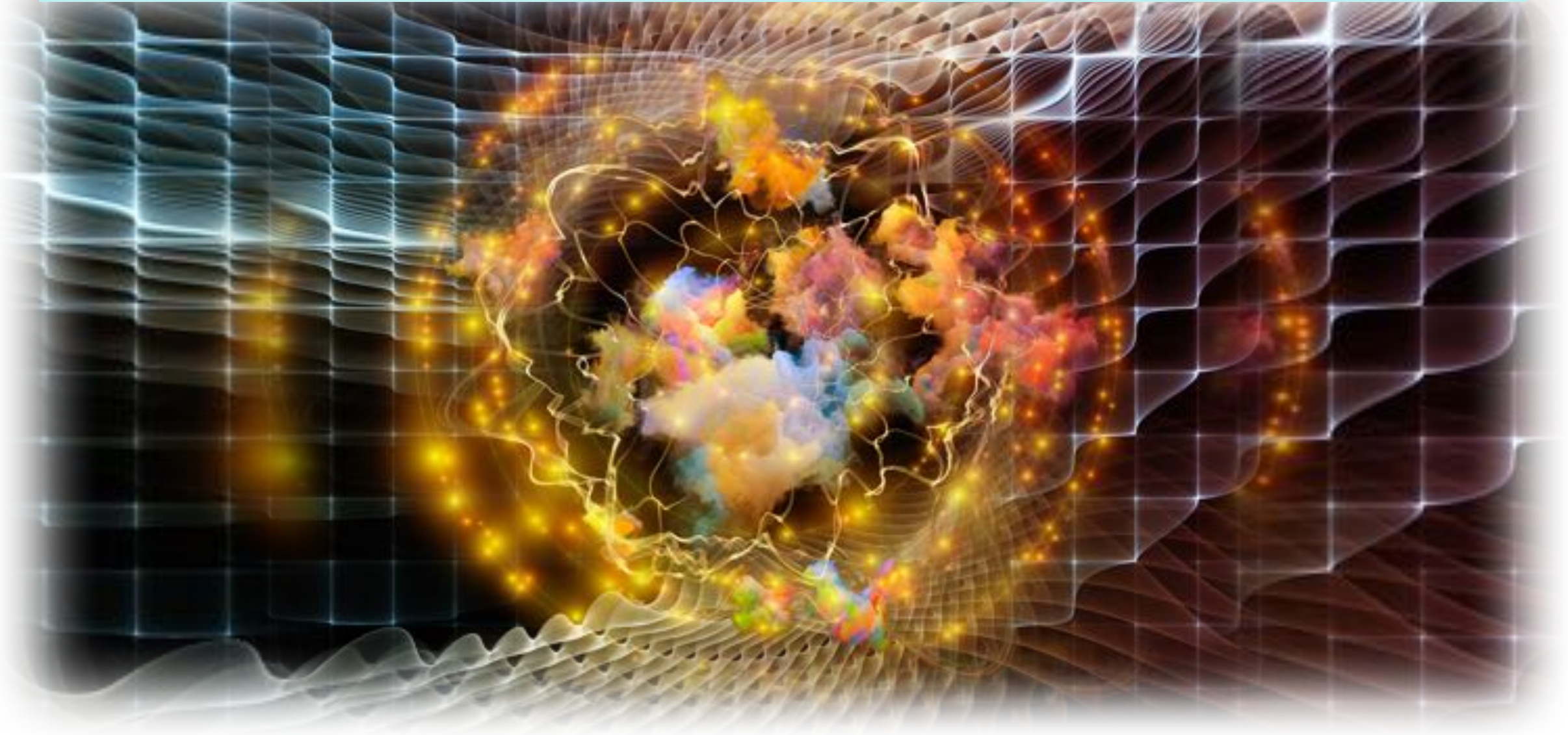
Birmingham

Future Cities Lab Ltd (FCL) is collaborating with Birmingham City Council, the NHS, and Public Health Birmingham to design a Neighborhood-Specific Behavioral Surveillance, Support and Intervention System for elderly citizens

We are sourcing our participants from local GP practices

These patients are already on the NHS eFrailty Register but continue to live in their homes

Future Cities Lab: early-stage Precision Medicine Platform for urban environments



PRECISION PUBLIC HEALTH

Definition: the application and combination of new and existing technologies to more precisely describe and analyze individuals and their environment over the life course in order to tailor preventive interventions for at-risk groups and improve the overall health of populations.

PRECISION PUBLIC HEALTH: PROBLEM-SOLVING WITH BIG DATA

PULSE (PARTICIPATORY URBAN LIVING FOR SUSTAINABLE ENVIRONMENTS) (H2020: funded 2016-2020)

The overall goal of the PULSE project is to **accelerate the Big Data vision** by designing a system to **exploit Big Data Value (BDV) in the public health sector**.

This is consistent with the goal of creating an **integrated, interoperable single data market across the EU.**

PULSE is an urban project.

We chose to work directly with cities in response to the EU Urban Agenda.

The cities with which we chose to work are Barcelona, Paris, Birmingham, New York and Singapore.

The objective of **PULSE** is to **transform public health from a reactive to a predictive system, focused on both risk and resilience**.

WEAVING THE THREADS TOGETHER

VALUE FOR THE FUTURE DIGITAL HEALTH MARKET WILL COME FROM THE NEXT ITERATION OF INTEGRATION:

1. **Digital health models with emerging models of health and medicine, such as NIH's vision of Precision Medicine and also Precision Public Health**

2. **Digital health models/products with smart city environments and services**