

Digital Technologies and Mental Health

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**ASU's 8th Biannual Law and Neuroscience Conference:
Mental Health and the Court
Sandra Day O'Connor U.S. Courthouse: Phoenix, Arizona
9 December 2022**

The Strategic Landscape for US Healthcare

technology convergence

escalating chronic disease burden

data capture and
analysis for better
care and outcomes

precision health (PH)

- defining disease at the molecular level
- predisposition risk
- disease subtyping and optimum treatment selection

digital health (DH)

- ML/AI for large data analytics
- clinical decision support
- empowered patients

biomedicine

engineering

computing

new
product/service
combinations

mental
illness

cardio-vascular,
cancer,
diabetes

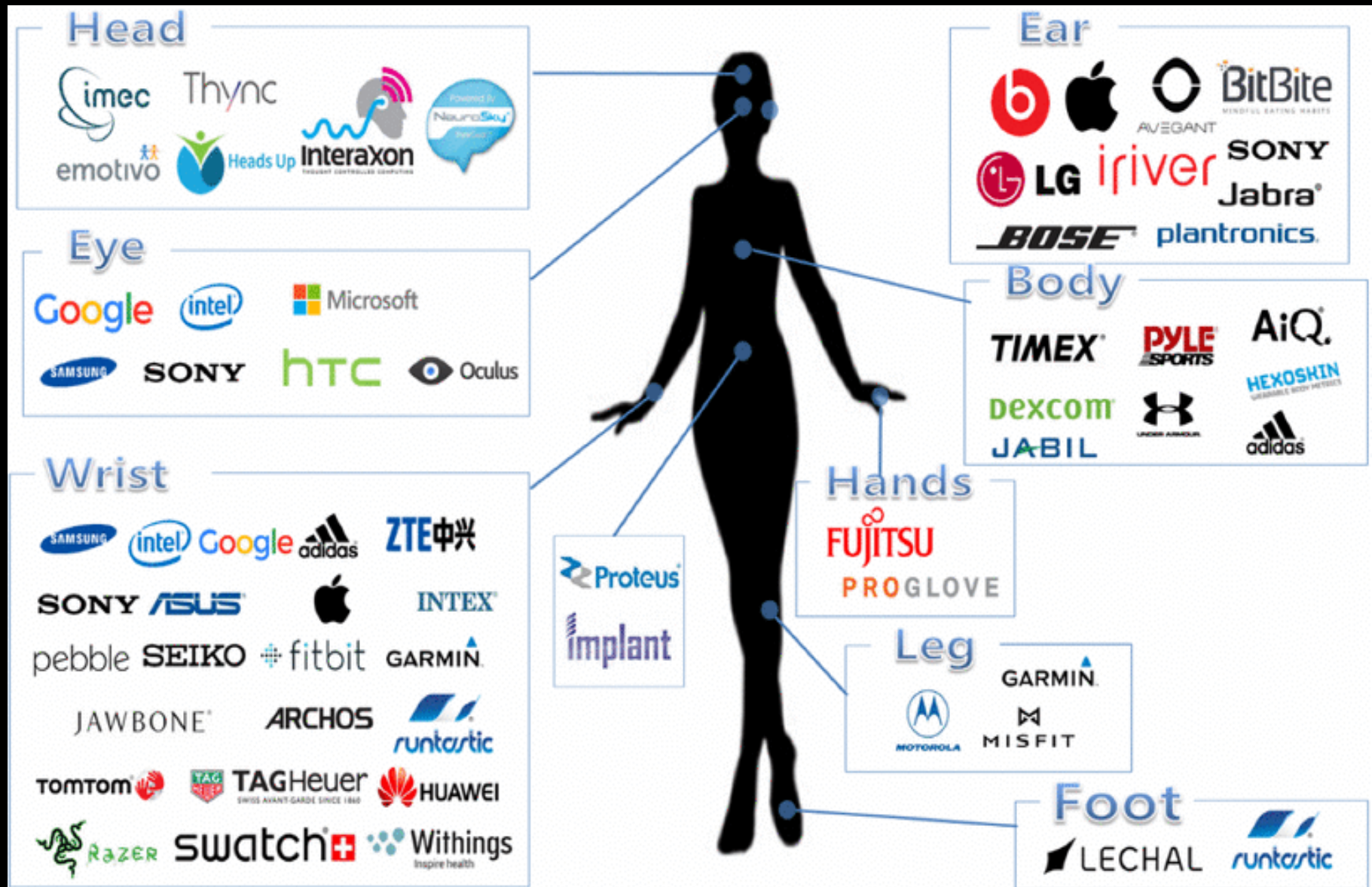
neurodegeneration
dementia

comorbidities

Wearables and Mobile Devices: Key Drivers in Remote Health Monitoring and Care Delivery



Wearables and Remote Health Status Monitoring



Smart Devices for Automated Drug Delivery and Improved Therapeutic Adherence



Propeller Health



Gecko (now Teva)



CapMedic



Biocorp Inspair



Help patients get *onboard* with *onbody* injections

Onbody Trainers

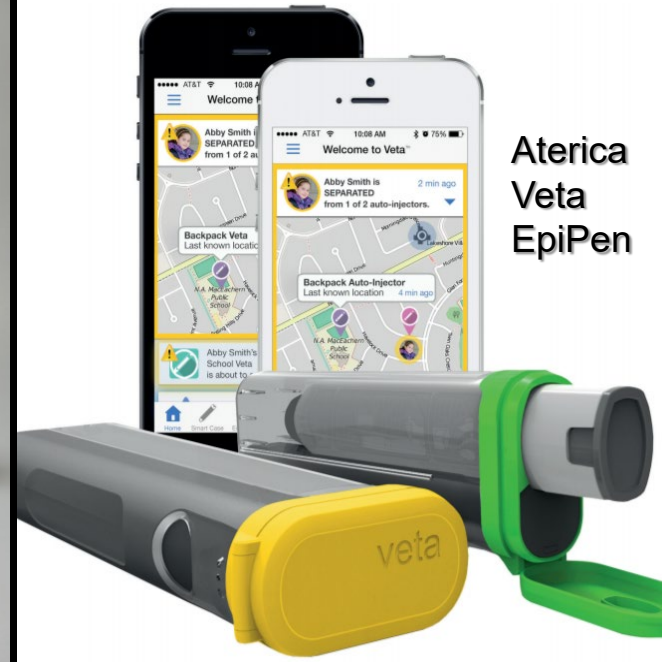
Device Replication
Actuation Simulation
Cartridge Simulation
Replaceable Device Adhesives
Injection Speed Simulation



noble

Find out how a Noble onbody trainer can improve patient onboarding and boost your platform's competitive edge.

Contact us today **888.933.5646** or **GoNoble.com/Onbody**



Aterica
Veta
EpiPen

Digital Technologies and Aging in Place: Independent But Monitored Living for Aging Populations



Rx adherence



**cognitive
stimulation**

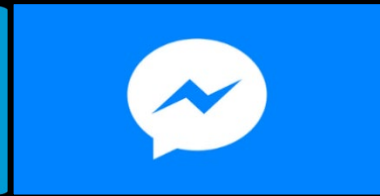
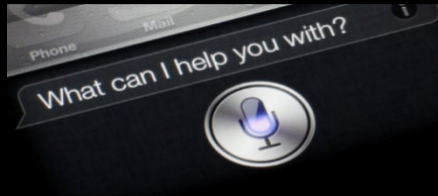


**in-home support and reduced
readmissions**



reduced office visits

Chatbots and Support Robots in Healthcare



AR/VR/MR Neuromodulation in Clinical Care



- injury rehabilitation
- reduce apprehension/distraction in painful procedures
- anxiety, depression, PTSD, phobias

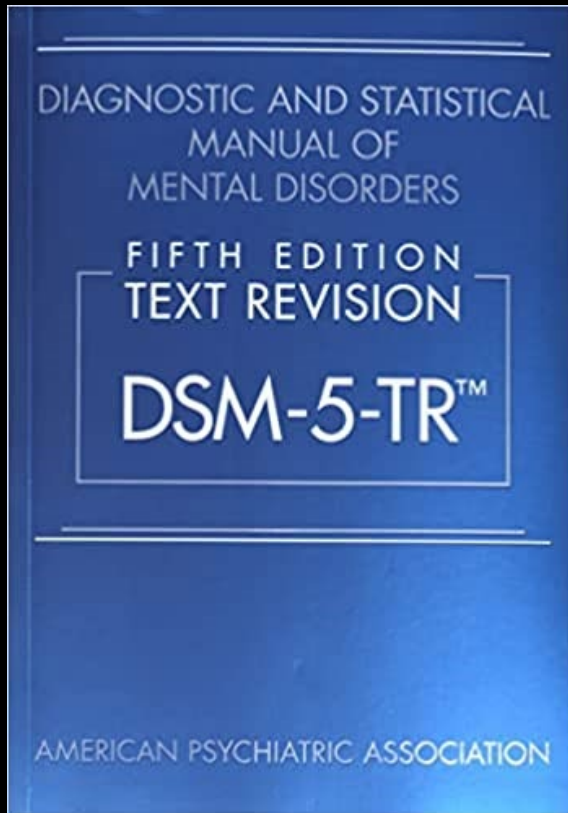
- **the majority of events that influence wellness/disease risk and treatment adherence occur largely outside of formal interactions with the healthcare system**
- **daily decisions by individuals have greater effects on their health than decisions occurring within the healthcare system**

Digital Technologies and Mental Health

- two trajectories
- **validated** applications in patient care
- far larger direct and indirect effects on mental health and behavior from pervasive digital dependencies in daily life
 - individuals, institutions
 - long term societal implications
- policy vacuum for oversight and regulation
- complex landscape of new clinical, ethical and legal issues
- new dual-use risks
 - abuse, manipulation and control
 - vulnerable populations

**The Urgent Imperative for More Quantitative Metrics to Improve
Diagnosis and Treatment in Neurology and Psychiatry**

The “DSM Bible” Under Increasing Siege



**10 categories of
personality disorders**

- **criticism for blurring boundaries between normal and abnormal behavior**
- **imprecision in mapping co-occurrence of personality disorders**
- **arbitrary diagnostic thresholds**
- **inadequate taxonomy for clinical staging across the continuum of disease severity**
- **clinical largesse for misclassification to meet ICD-10 codes to ensure insurance coverage or avoid stigmatization**
 - **eating disorders, SUD**

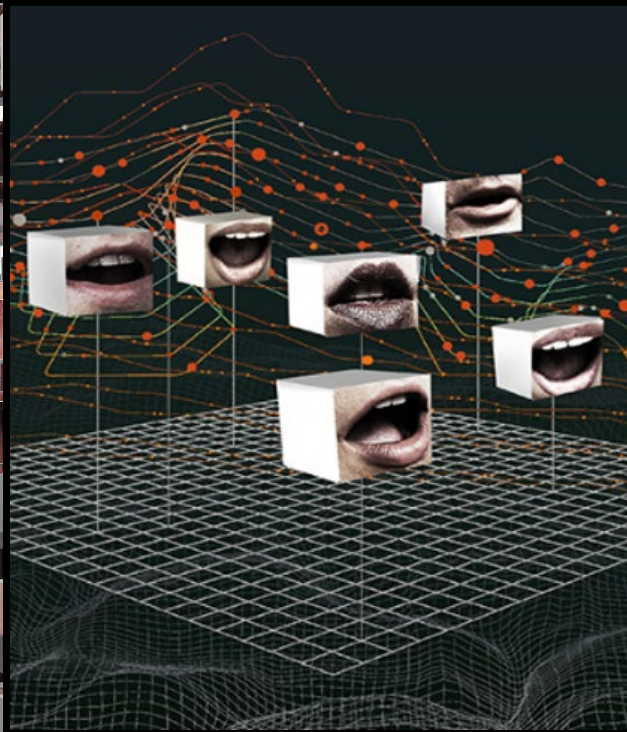
Identification of (Epi)Genetic Contributions to Neurodevelopmental and Mental Health Disorders: Still A Long Way to Go

- development of polygenic risk scores (PRS)
 - disease predisposition, diagnosis and prognosis
- complex diseases involving hundreds of low penetrance genes plus environmental effects on gene expression (GxE)
- daunting scale and cost of clinical validation studies to establish causality
 - >100,00 patients

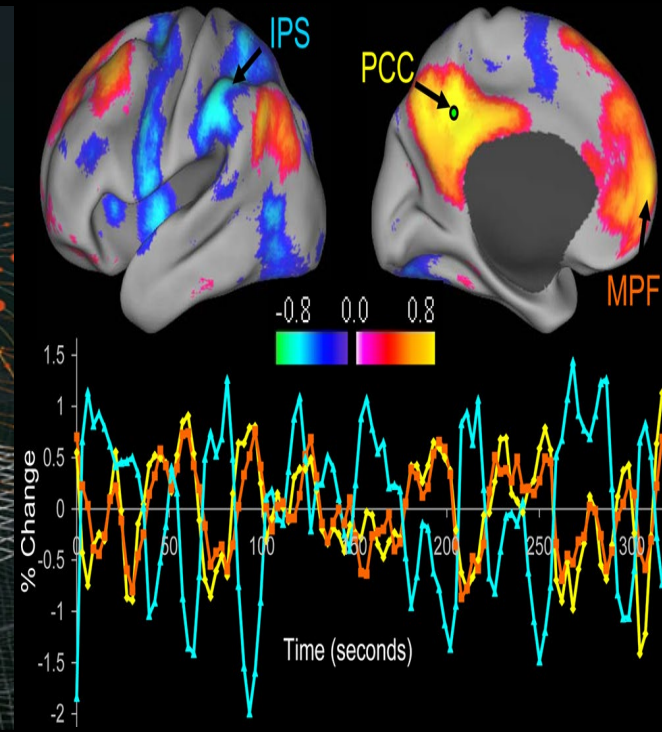
Computer Vision, Facial Recognition and New Digital Psychometrics in the Evaluation of Mental Illness



- eye movements
- facial dynamics
- stimulus response reaction and interaction speeds



- speech patterns (rhythm, tone, volume)
- semantic construction



- 256 lead EEG
- brain imaging functional MRI
- altered signal pathways

ML/AI analysis of individual multiparameter responses matched to large-scale analysis of video data banks of patients with clinically validated mental disorders

The Internet, Social Media and the Road to the Metaverse

- **who knows why people do what they do?**
 - **the fact is that they do!**
- **the confessional of social media**
- **these actions can now be traced and measured with unprecedented precision**
- **with sufficient data the numbers reveal increasingly predicable behavior and individual risk patterns**
- **blurring of private and public spaces**
- **blurring of the real and the imaginary**
- **complex ethical and legal issues**
 - **consent, privacy, security, surveillance**

Toxic Social Media and Mental Health



- **‘clicks’ revenue model drives ‘social contagion’**
 - purposeful propagation of controversy, conflict, divisiveness, disinformation
- **increased psychological/psychiatric distress, particularly in adolescents**
 - anxiety, depression, fear, loneliness, suicidal ideation
 - eating disorders, body dysmorphia
 - gender identity, puberty blockers
- **adverse effects of overuse**
 - attention-deficit disorders
 - disrupted sleep
 - social isolation and lower emotional and social intelligence

The Neurobiology of Instant, Repeated Gratification



interactive multiplayer
gaming and modulation
of reward neurocircuitry

virtual immersion and
education in the most plastic
phase in the development of
human analytical skills
and socialization



The Road to The Immersive Metaverse

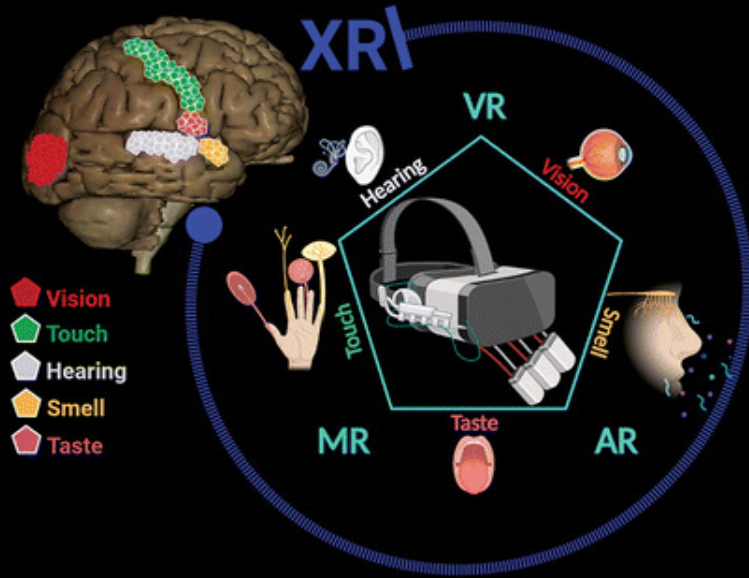


Welcome to Avatar World: Metaverse V. 1



Welcome to Metaverse World:

3



**extended reality (XR):
building the virtual
sensorium**

**new virtual
experiences:
Tamagotchi babies**



Welcome to Metaverse World:

ONE OF THESE PEOPLE DOESN'T EXIST



Malicious AI created her picture, yet she has never been seen by a camera. It made her an online profile, yet she has never logged in.

Malicious AI built her to attack you.
Now it's time for AI to fight back.

darktrace.com

 **DARKTRACE**
World-Leading Cyber AI

**fake identities:
new vistas in
predation, crime
and psychological
manipulation**

Metaverse Market Map



Health Effects of Ubiquitous Immersion and Dependencies in Digital Environments

- unknown long term socio-cultural implications of new sensory, cognitive and behavior patterns positively reinforced in digital ecosystems
 - individuals, institutions, society
 - the new evolutionary selection pressure? (digital Darwinian fitness)
- atrophy of physical prowess?
- erosion of adaptive resiliency of individuals and institutions to cope with rude intrusions from the physical world?
 - COVID-19 pandemic and spiking of mental illness?
 - climate change angst in Gen Z and Millennials?

“Digital Twins”: The Janus Face of Digital Identities

Individual Data

Population Databanks



- intellectual foundation for precision health to improve wellness, disease diagnosis, treatment and outcomes
- versus**
- relentless expansion of opportunities for nefarious exploitation, including use by adversarial nations

'Big Tech' and the Global Digital Ecosystem

- increasing pervasive reach of data collection on individuals, institutions, societies and governments

amazon

Alphabet



facebook

NETFLIX

Microsoft

LexisNexis

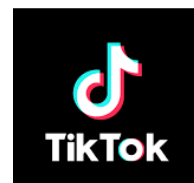
Яндекс

Baidu

Alibaba.com

Tencent 腾讯

ByteDance



HUAWEI

Big Data Analytics



from
consumerism

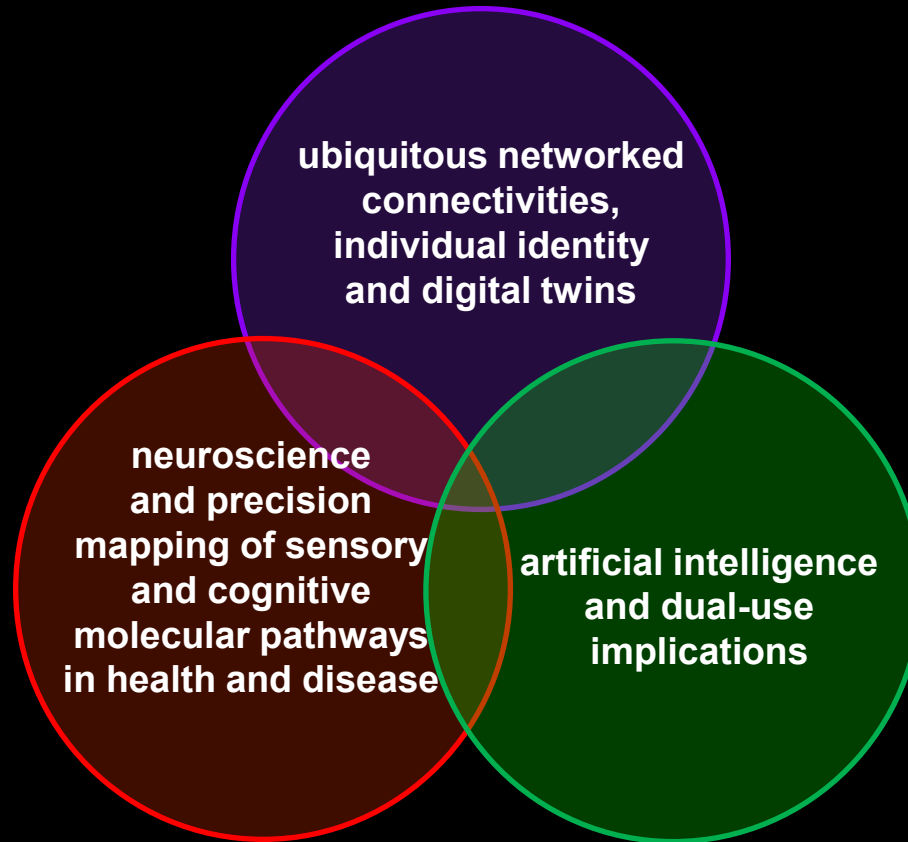
to graded levels
of surveillance,
control and
surrender of
autonomy?



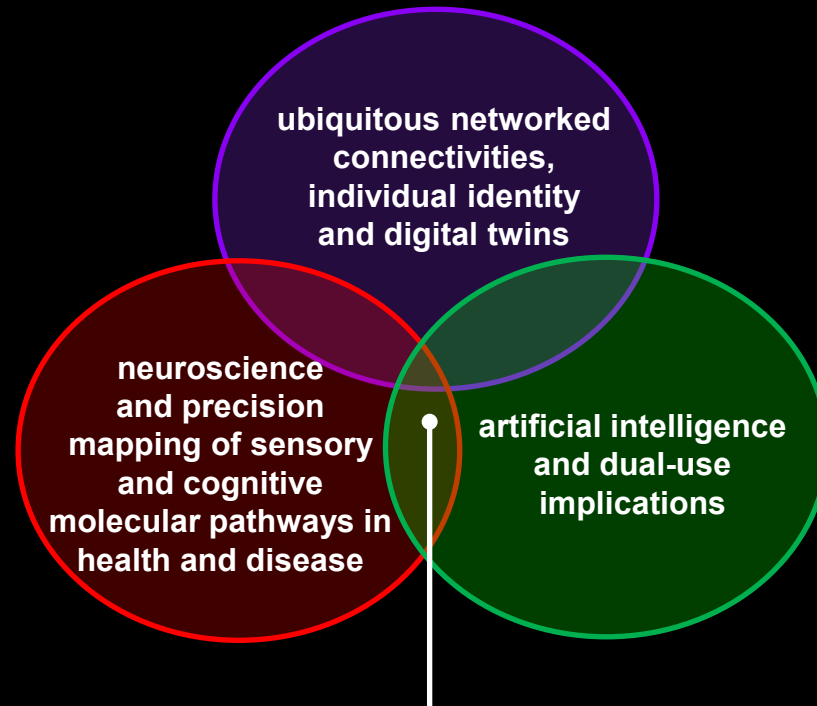
Validation of 'Black Box' ML/AI Algorithms

- regulatory frameworks for ML/AI platforms used for clinical decisions for patient care
 - 'software as medical device'
- “interpretable AI”
 - uncoupling of learned intermediary from comprehension of how the output(s) for decision opinion(s) were derived
- getting ready for “primetime”?
 - generative adversarial networks and transformer platforms
 - artificial general intelligence (AGI)

Big Data Meets Neuroscience: The Convergent Technological Triad



Big Data Meets Neuroscience: The Convergent Technological Triad



Oversight and Regulation

- keeping pace with the speed of technological change
- different incentives for diverse stakeholders
- legislative sclerosis and technological illiteracy
- protection of autonomy and privacy
- data ownership and consent
- expanded legal and ethical domains of escalating multidimensional complexity

Slides available @ <https://casi.asu.edu/presentations/>

