



# The Disruption of Healthcare...

## The collision of IT with MT

23-25 JAN.

2018

The EGG  
BRUSSELS

Peter J. Fitzgerald, MD, PhD, FACC  
Stanford University



A MedTech Europe event

The MedTech Forum

bringing HealthTech stakeholders together

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# The Rapidly Changing world of Healthcare


# The Collision of Old & the New Era





# Digital Healthcare..a revolution is coming

(Patients, Payors, Physicians and Practices)



Devices, BioTech, BioPharma

*Transforming Health "Care" & Health "Cure"*

biodesign

# The Era of Global Digitization

2020: 2.5 exabytes of information will be available for human health

2020: 80 Billion Machine 2 Machine

2025: Millennials/Gen Z = 2x over 65 yo

P4 MEDICINE

PERSONALIZED

PREDICTIVE

PREVENTIVE

PARTICIPATORY



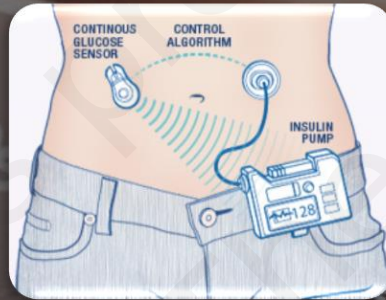
# The next generation of Med Tech

## bDASH

**B**ig Data



Smart  
**D**evices



**A**I



**S**ecurity in  
**H**ealthcare



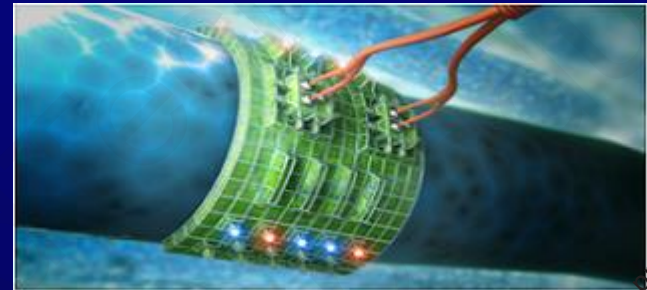
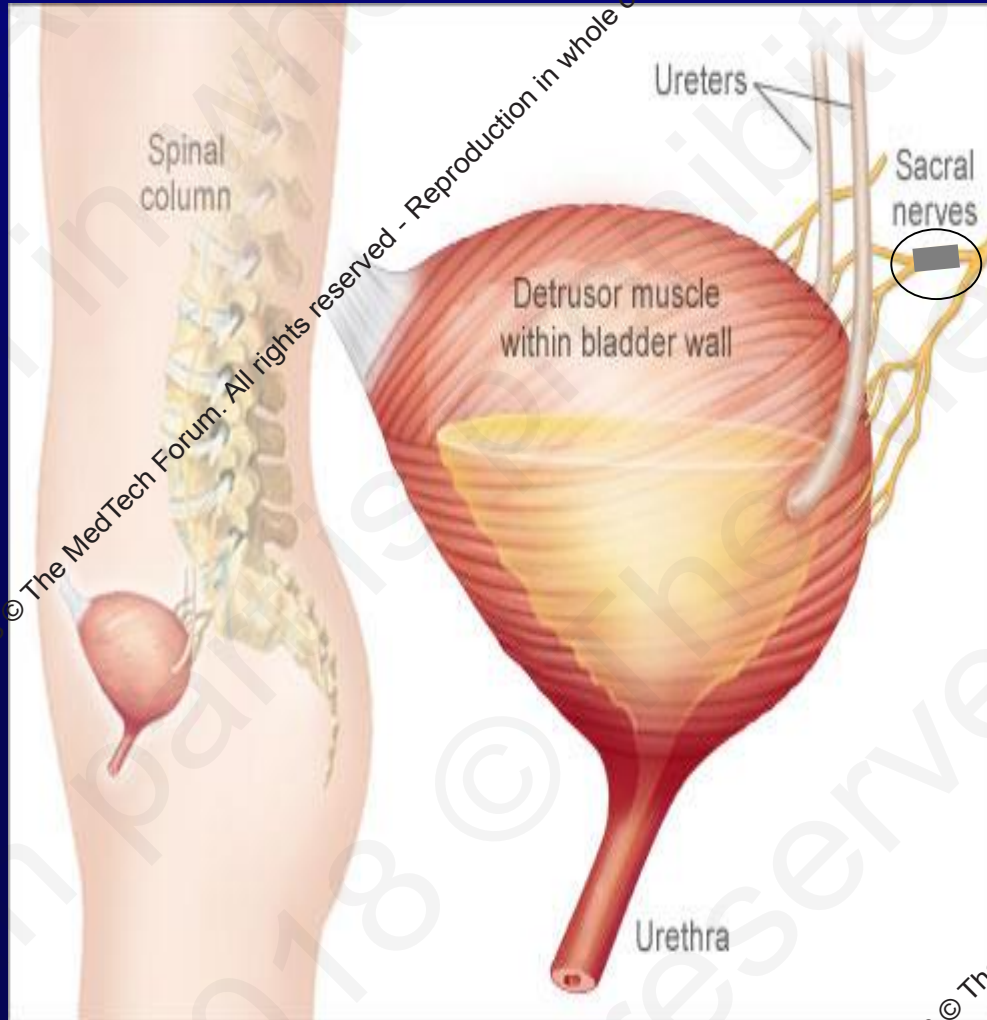
# “The patch that communicates...”



E-C



# “Programming OAB with mobile”



- Amplitude (voltage)
- Duty cycle (sec.)

# A.I. at a glance

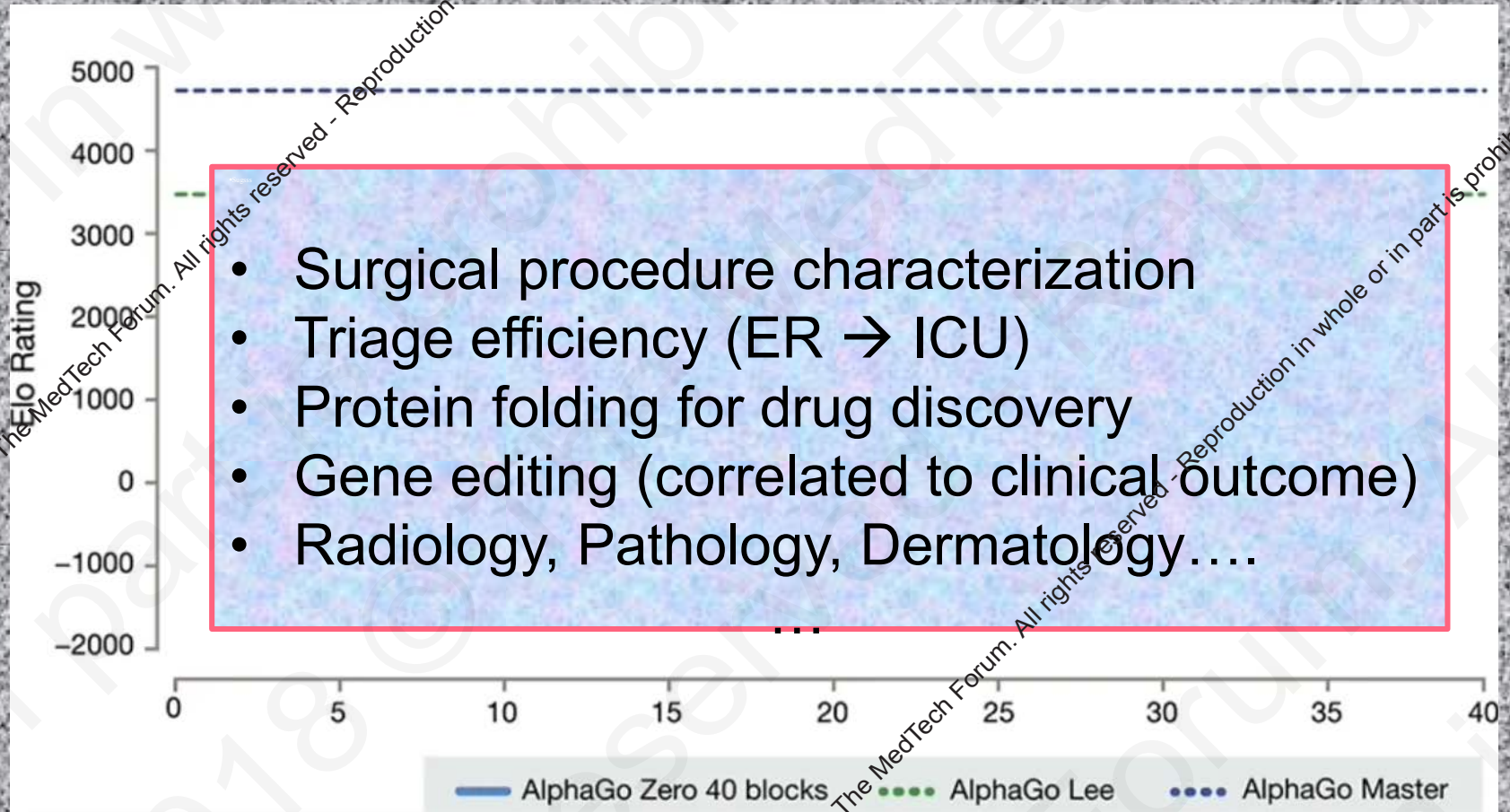
- Very Narrow ( domain specific)...
- Requires very large data sets (source constraints)
- Data sets must be objectified (contexture)
- Objective characteristics must have endpoints
- Large computing power for machine learning

...



# Evolution of Machine Learning

## Google AI “AlphaGo”

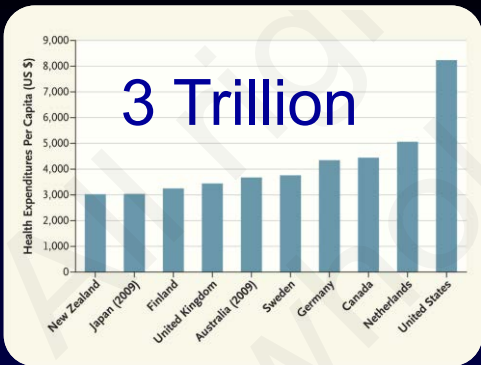


# Convergence of Medtech & Hi-Tech

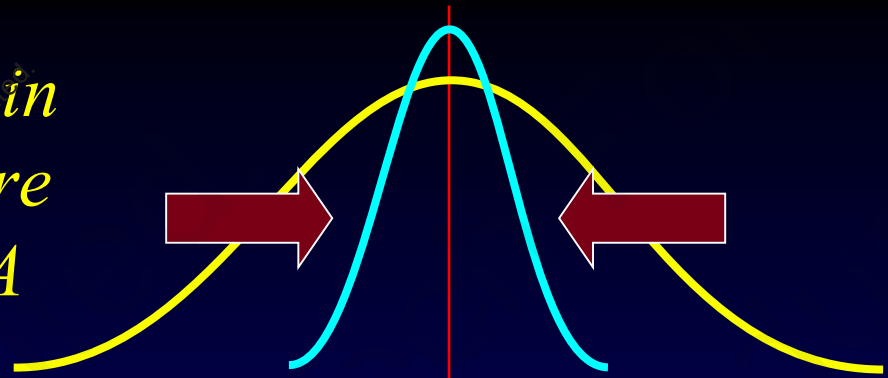
- IoT + Big Data + Machine Learning + AI = Opportunity for tech players to introduce new platforms for “people”
- Convergence = strategic opportunities for startups beyond traditional medtech



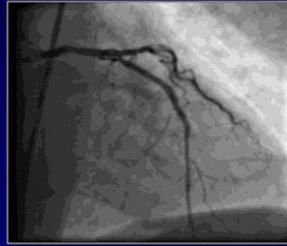




# Variability in Patient Care In the USA



Diagnostics



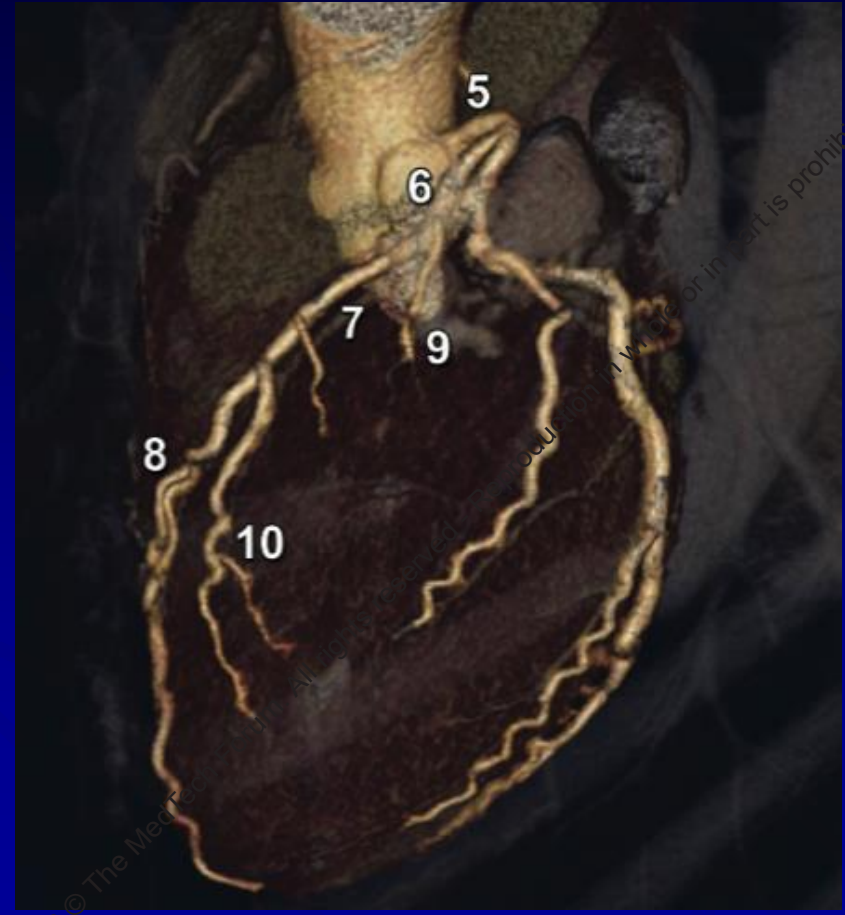
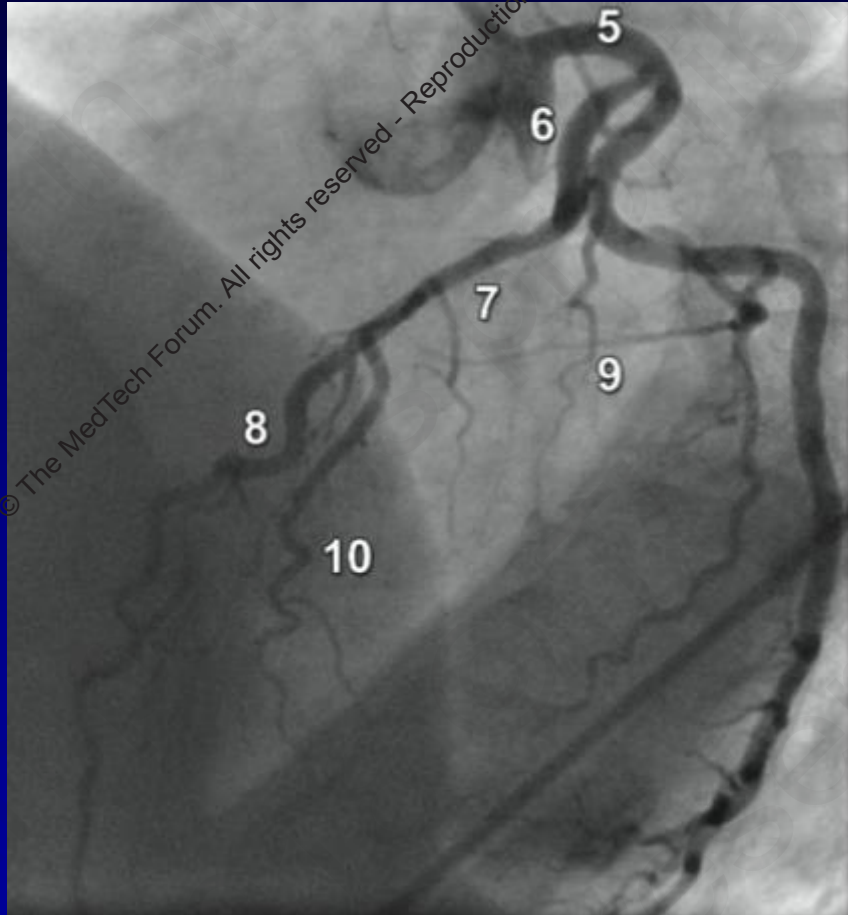
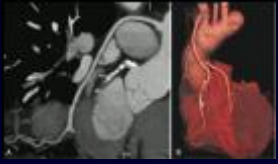
Treatments



Inventory



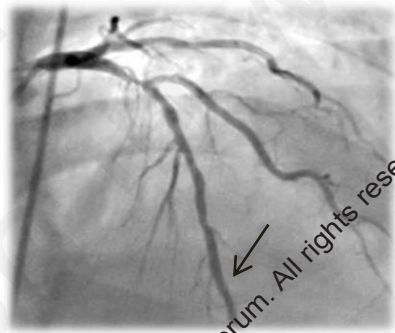
# Computed Tomography Angiography (CTA) ...the quest for accurate out patient Dx





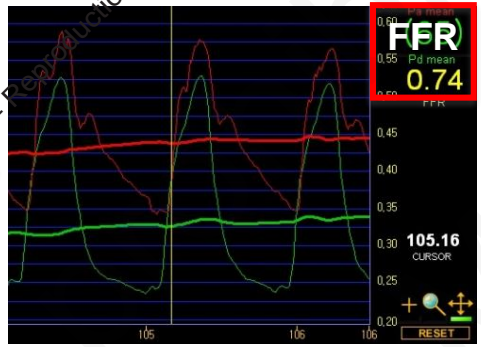
# Outpatient Anatomy and Physiology

Invasive angiography



>50% diameter stenosis

FFR



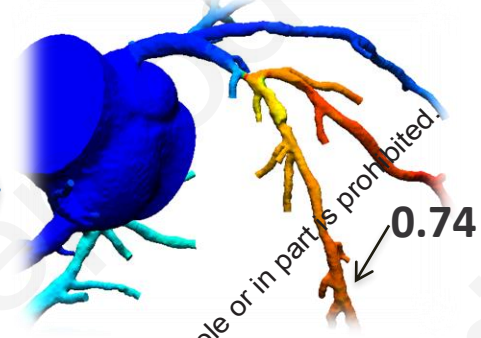
FFR 0.74 → ischemia

Coronary CTA



>50% diameter stenosis

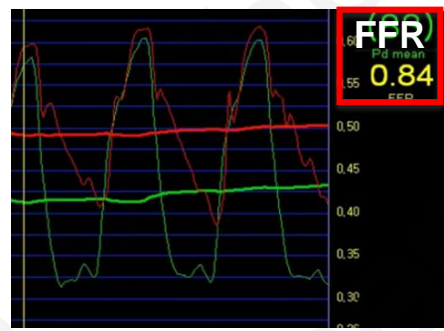
FFR<sub>CT</sub>



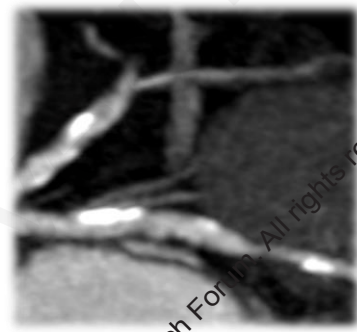
FFR<sub>CT</sub> 0.74



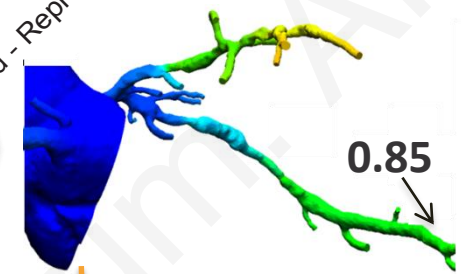
>50% diameter stenosis



FFR 0.84 → no ischemia



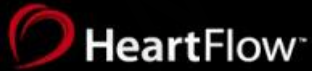
>50% diameter stenosis



FFR<sub>CT</sub> 0.85

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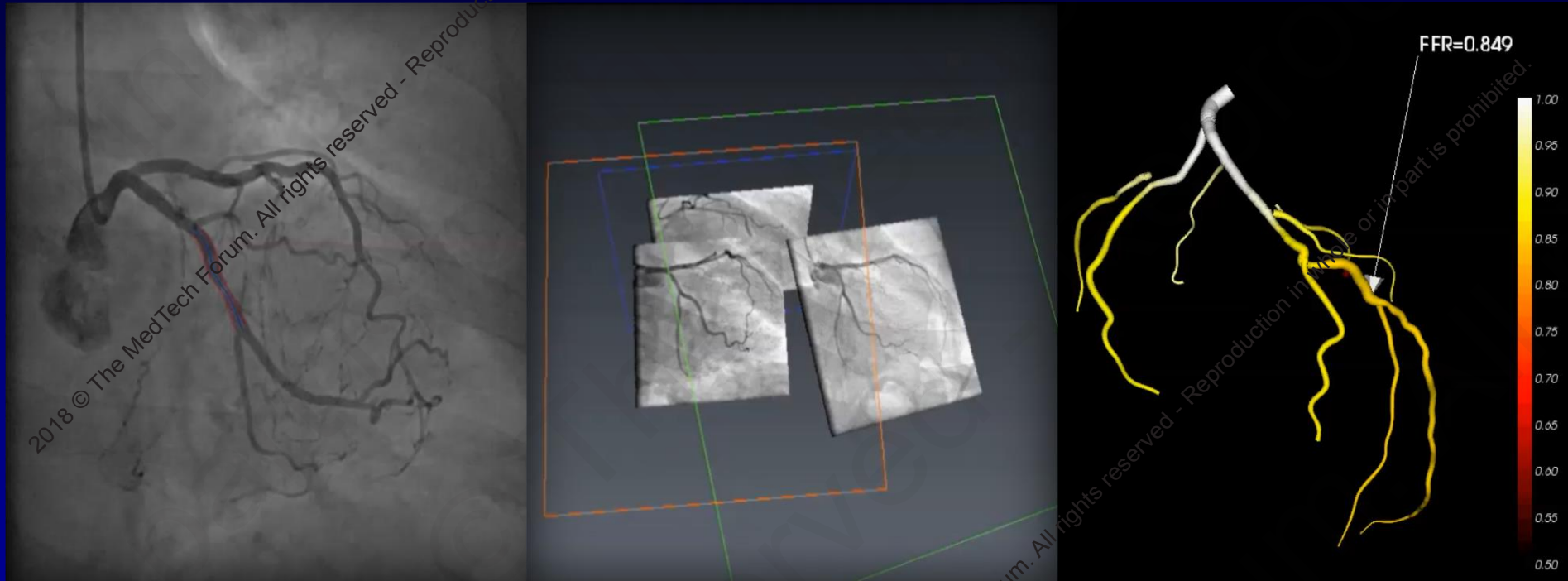
# Non-Invasive Flow parameters— derived from 64 slice CTA



simulation

This is possible in the Cathlab as well...

## SaaS; Cloud-based algorithms



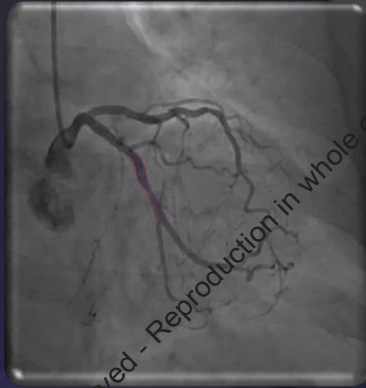
Routine angiograms

3D tree & Flow analysis

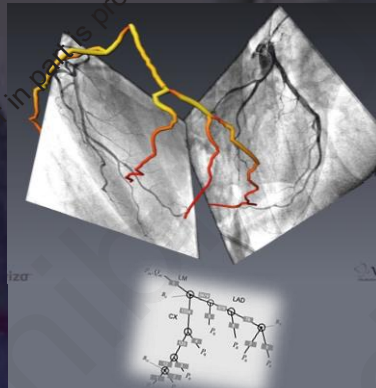
FFR<sub>Angio</sub>



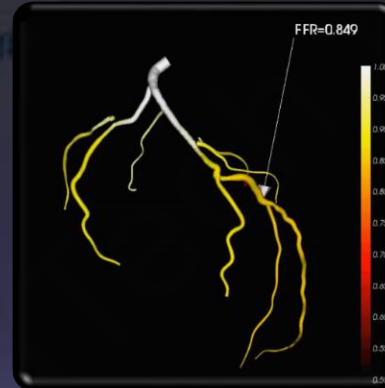
# “Wireless” FFR



Routine angiograms



3D tree & Flow analysis



FFR<sub>Angio</sub>

## “Cloud” Wireless



# Haptics meets Catheter motion

Gaming Industry: "Wii" of Medicine



Today's 30 yo is much better at "hand-eye"



# *Deep Learning ; Augmented Reality (Consumer applications → healthcare)*







**CorPath 200 System**  
**Control Console** \_\_\_\_\_  
**Interventional Cockpit** \_\_\_\_\_  
**Cockpit Monitors (Live/Reference Angio, Hemo)** \_\_\_\_\_

# Remote Robotics: Treatment in Time

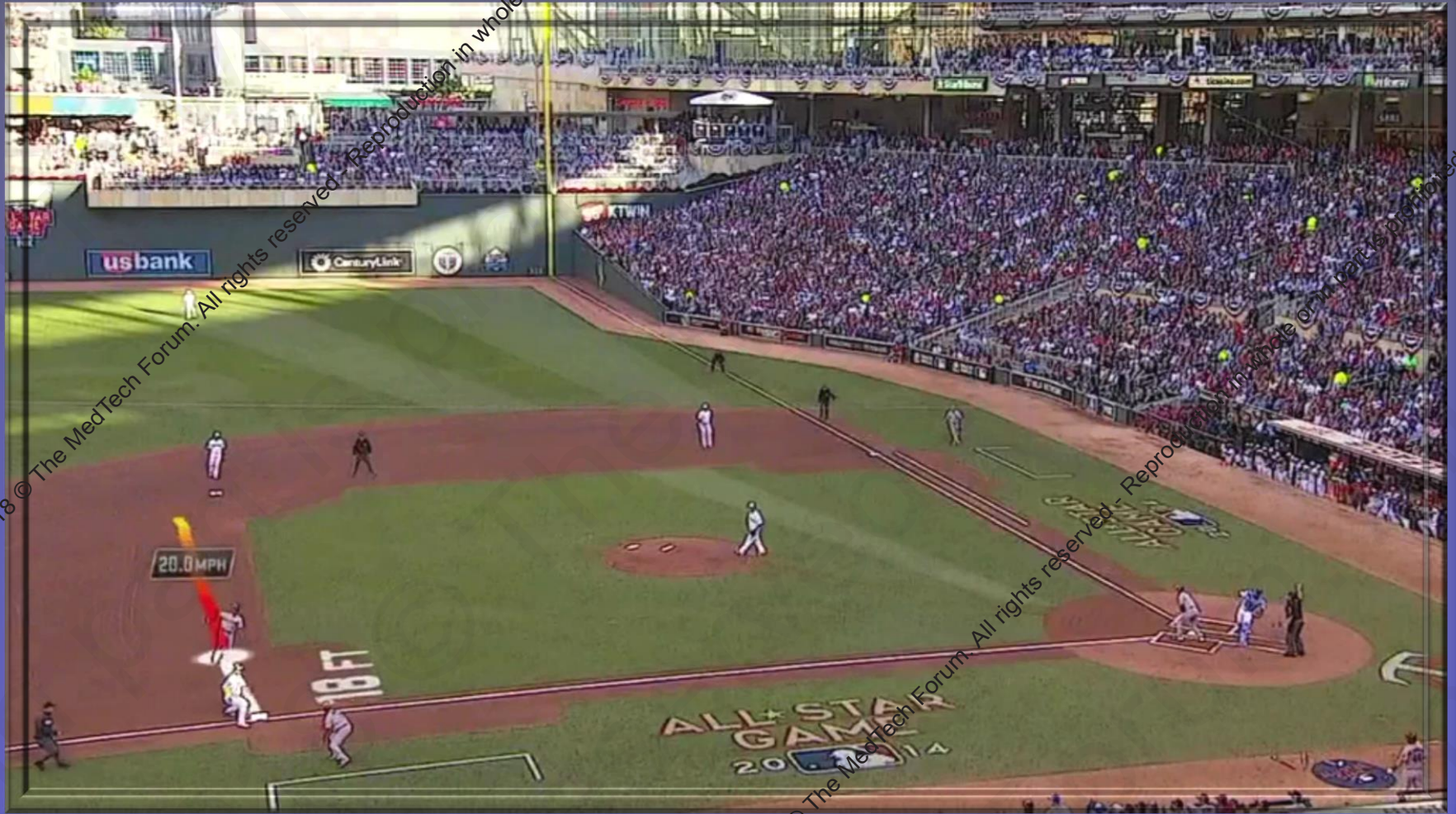
## Minimal Latency



Cloud GPU Grid

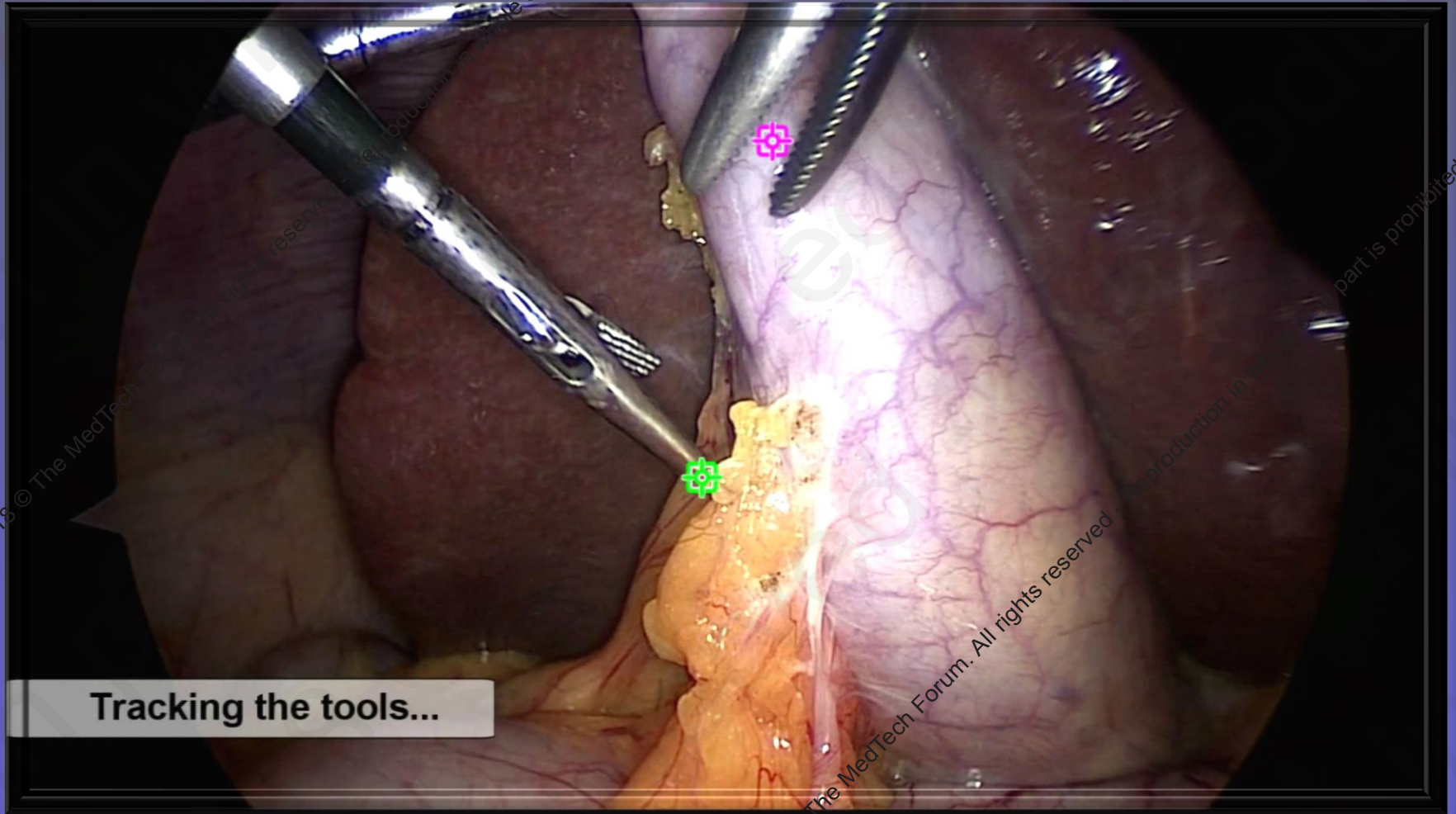


# *Consumer quantification...consistency is key (AWS)*





# *Consumer quantification...consistency is key*



Tracking the tools...

# The Wave of Digital Data Will Change Healthcare

Cybersecurity

“Retail”, personal  
Medical care

DATA  
“Predictalytics”



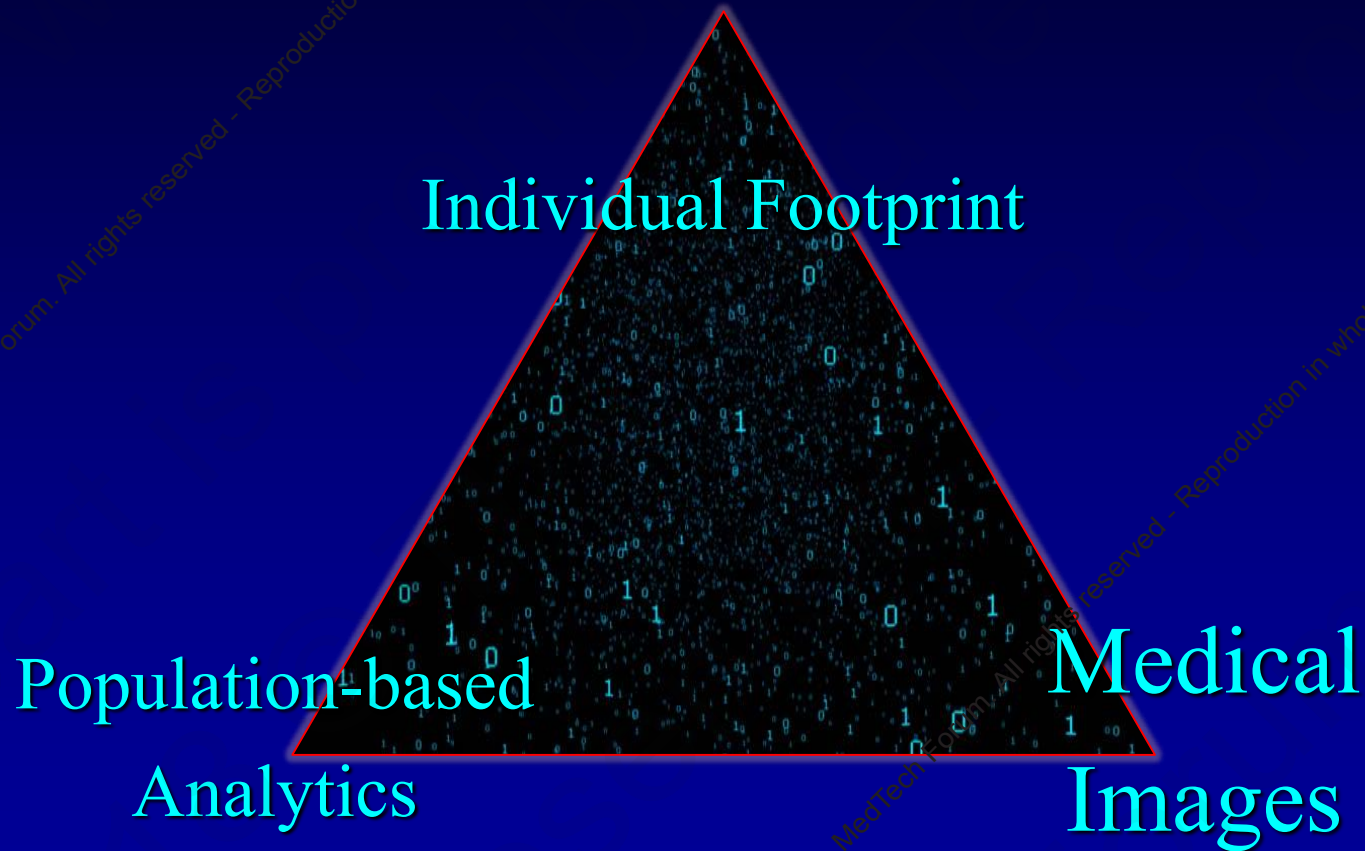
...we are becoming uniquely characterized with our digital exhaust and footprints...



Digital exhaust from phones, wearables, and implants...



*“Bermuda Triangle” of Digital Data  
across the continuum of life...*

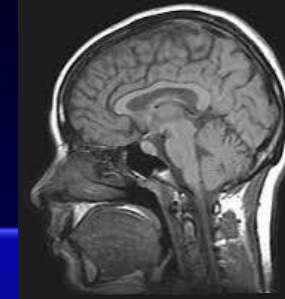
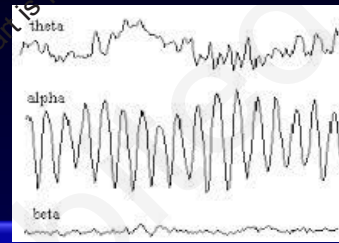


# Clinical Diagnosis and Treatment Strategy

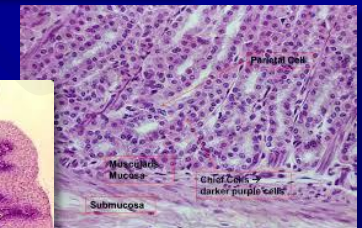
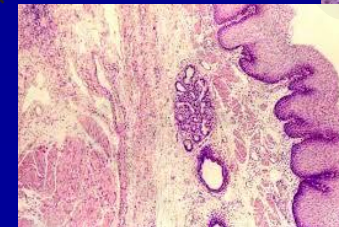
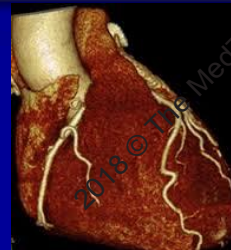
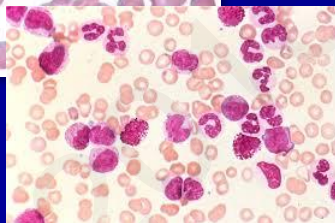
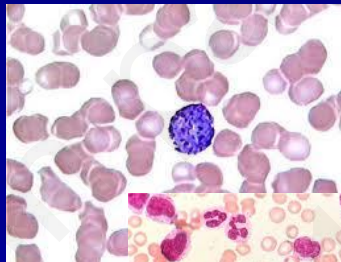
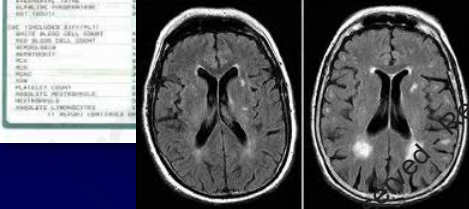
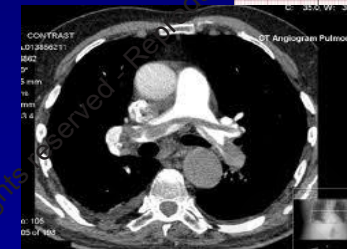
Parameter	Value	Unit	Reference Range
WBC	12.2	10 <sup>9</sup> /L	4.0 - 10.0
Hb	11.8	g/dL	12.0 - 16.0
Hct	35.2	%	37.0 - 47.0
PLT	133	10 <sup>9</sup> /L	150 - 400

Chemistry	Value	Unit	Reference Range
GLU	104	mg/dL	70 - 140
CRP	15	mg/dL	0 - 2.5
CHA	1.2	mg/dL	0.4 - 1.8
WBC	12.2	10 <sup>9</sup> /L	4.0 - 10.0
Hb	11.8	g/dL	12.0 - 16.0
Hct	35.2	%	37.0 - 47.0
PLT	133	10 <sup>9</sup> /L	150 - 400



Patient: L.J.Y.  
Age 37



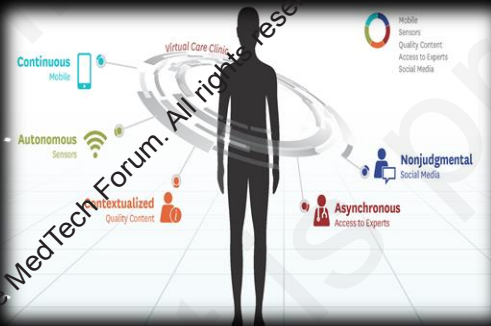
# The era of deep learning, decision analytics and compassion collide in Medicine

- A computer can read 20,000 chest CT's in two minutes, augmented by a training set of millions of similar CT's
- 250 stress echo's in 5 minutes...
- CPU interpretation of pathology slides exceeds manual reading by 1:100,000



# The Algorithm will now see you..

*“A.I versus M.D.”*

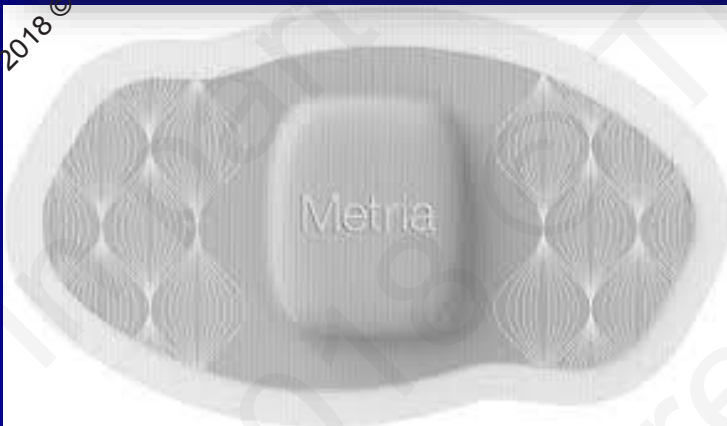


***Still need doctors for sure....***

- ***Computers can determine actionable items***
- ***But Doctors need to turn those items into action***

# The Wearable Decade

..from watches, patches and tattoo's





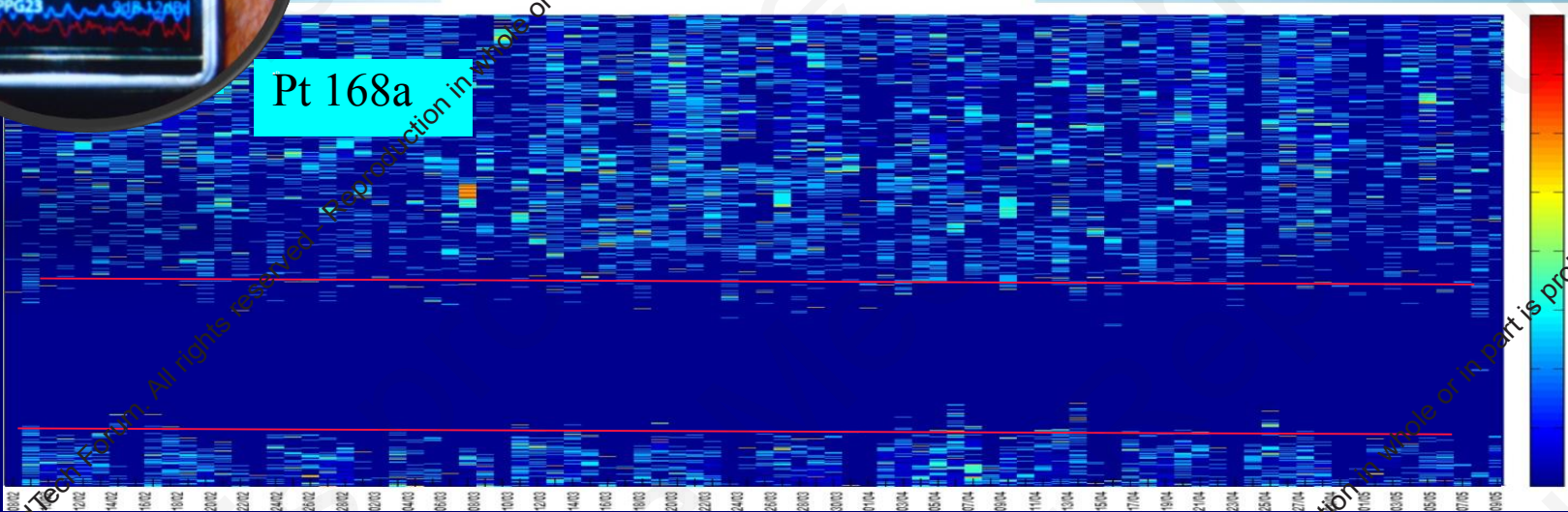
# Cardiac Index “dashboard” (HRV & Blood Pressure)



Pt 168a

HRV

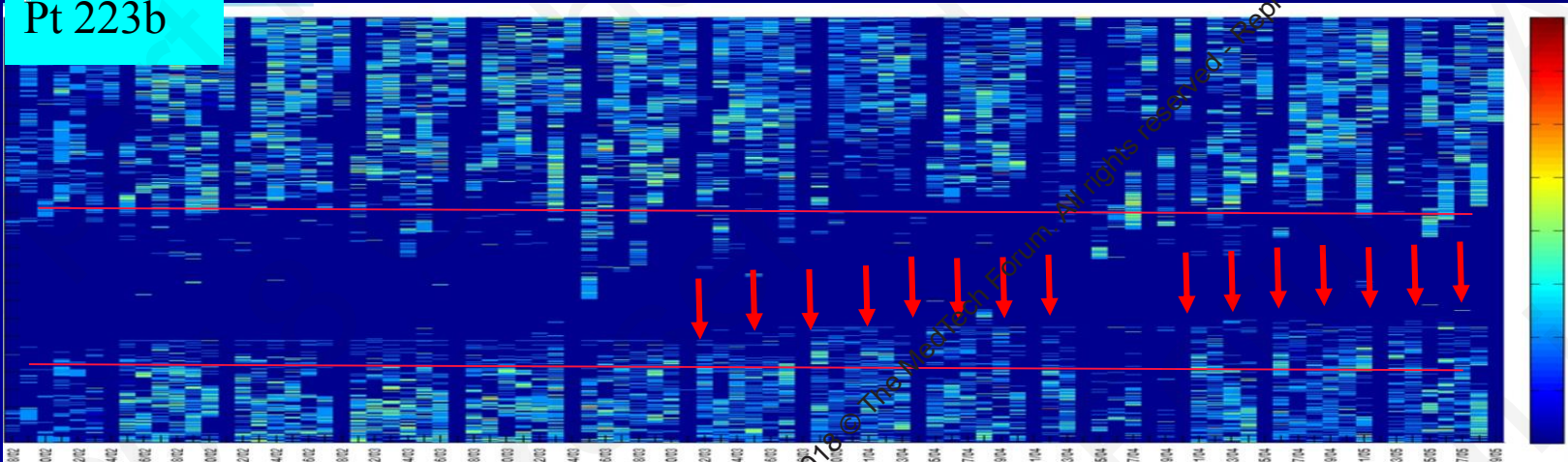
80



Pt 223b

HRV

80





# 'Wearables will become Prescribes' Healthline

Analytics as the vortex...

Sensors



Service

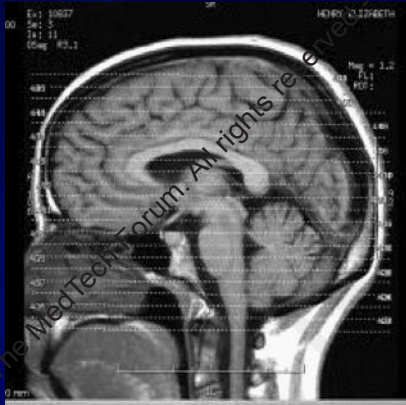
Solution



ML/AI algorithms

# It's not the Product...its the Process in Healthcare

AI/Machine learn



Head CT's



Solution



Service



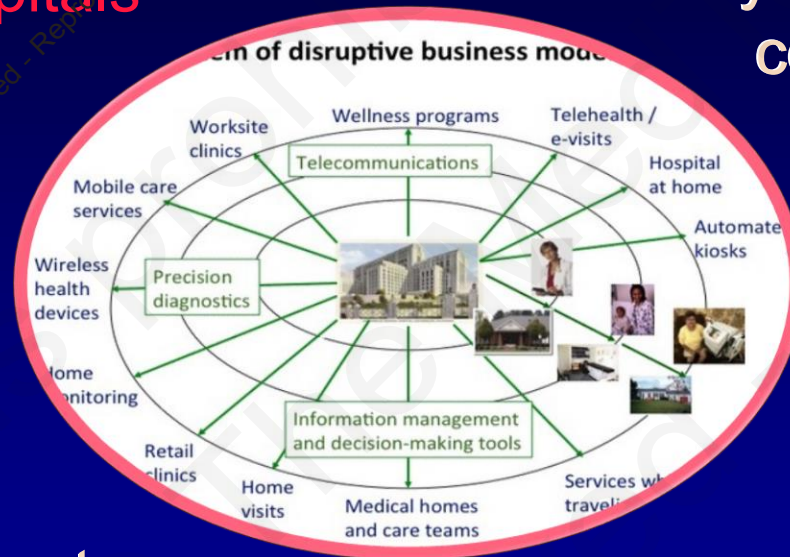


# Who Pays ?....Key to deploying new technology in healthcare

Hospitals

Payors/Insurance companies

Patients ("pop")



Pharma Companies/PBM's

Government "Medicare"

Retail health (CVS, Walmart, Walgreens)

Employers (HR)

# *Healthcare is undergoing an exponential transformation*



- *Alexa self diagnosis with one-hour pill delivery*
- *Chatbots to make ER's and clinics improve*
- *A.I. to aid rapid diagnosis and treatment*
- *Biosensors dash boards for care continuum*
- *POC/Liquid Bx at retail centers (CVS, Walmart)*

*June 2017*

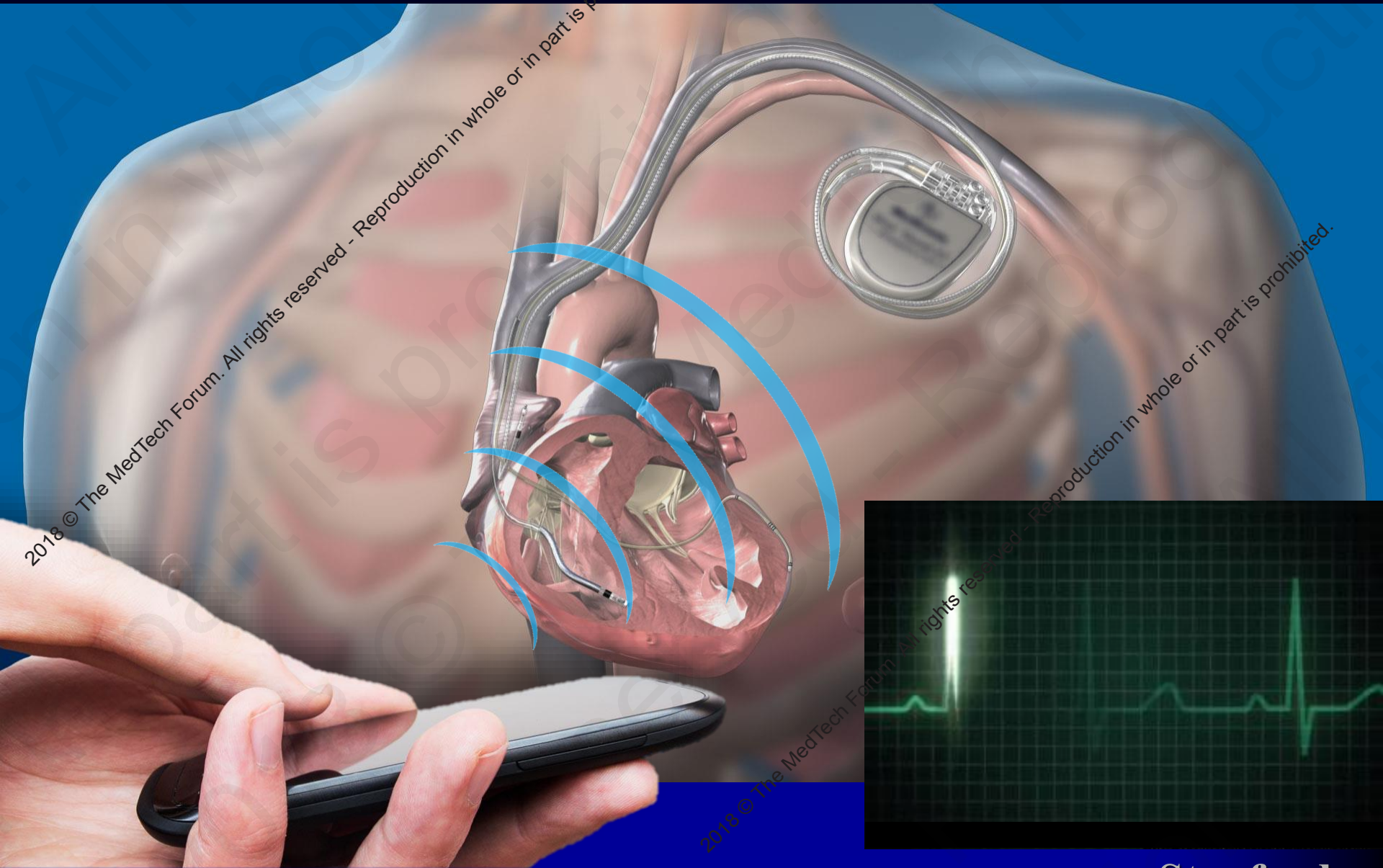


# *BUT, there is a **dark side**: IT Vulnerability*





# Cybersecurity....an real emerging need



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# Cyber Security: It's All About Nodes

## The Value of Hacking Healthcare Records

- Social security number (tax returns)
- Medical records (Medicare billing)
- Pharmacy History (Renew scripts)

Form 1040  
Department of the Treasury—Internal Revenue Service  
U.S. Individual Income Tax Return  
For the year-end 12-31-2008, or other tax year

Form 8812  
Department of the Treasury—Internal Revenue Service  
Additional Child Tax Credit  
Complete and attach to Form 1040

Form 8868  
Department of the Treasury—Internal Revenue Service  
Application for Automatic Extension of Time to File U.S. Individual Income Tax Return

### Medicare Two-way claim

#### Health fund member's details

- 1 Name of private health insurer
- 2 Health fund membership number
- 3 Family name
- 4 First given name
- 5 Postal address
- 6 Do you want this recorded as your permanent postal address?  No  Yes

DD FORM 1289  
1 NOV 71  
DOD PRESCRIPTION

FOR (Full name, address, & phone number) (if under 12, give age)

John R. Doe, HMB, USN

U.S.S. Neverforgotten (DD 178)

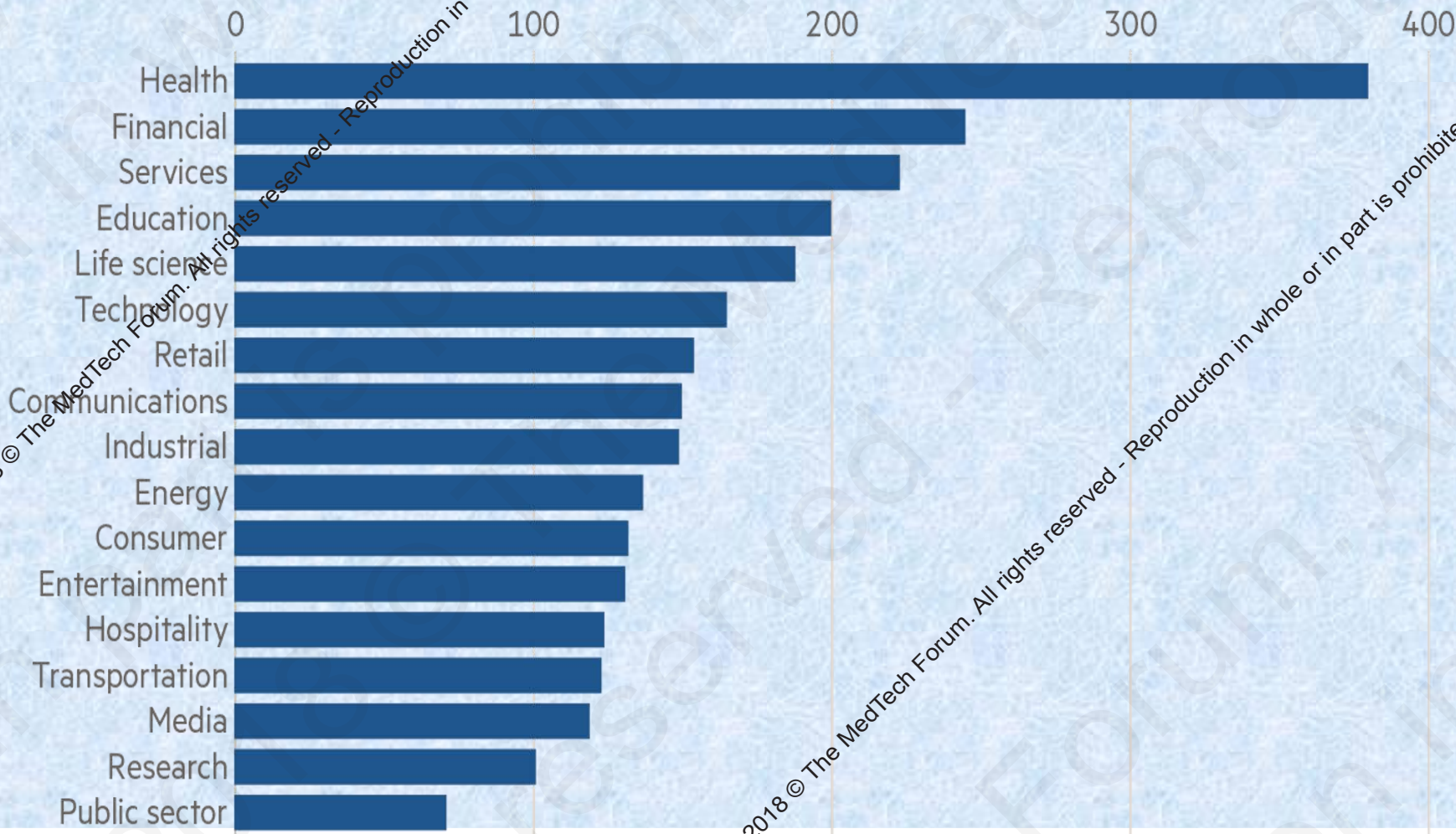
MEDICAL FACILITY U.S.S. Neverforgotten (DD 178) DATE 23 JAN 99

R (Superscription) gm or ml.  
(Inscription) Tr Belladonna 15 ml



# Data breach cost per capita

By industry classification, 2017 (\$)



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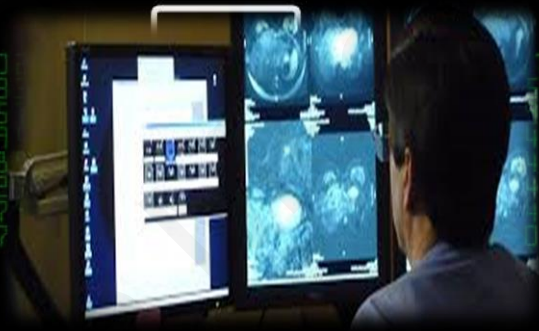
# Hospital Networks: A True Security Vulnerability

## Contextual Machine learning of each IP address

CT-1	00111111000000111110010011000110111001010011111111111101
PM-2	111011111100001110101111101100011110111111010101100110
CT-3	110111100001110001101010010111010011111000110001000110
CT-4	110001110111101111110111111111010001111110111011111110
MRI-1	11111001101110111100011110111010111010001111110111110
MRI-2	11001101111110110001001000000101110111011101111111111
MRI-3	111110001111110001111111111111001111001111110010111111
ECG-1	0111111011001110111101111110101111101111111101100111010
ECG-2	111111110001111111001010010100011111011110110100111101
ECG-3	0001111111111011000101000011110010000000111100100100011
ECG-4	1011111001111111101010111111000101110111000001001111110
ECG-5	0111000011110111011111001111110011111111001100000110111
Pump-1	1011101101000010011001100011101110000110010000001100111
Pump-2	1101100110001010111101101000111110100011010111110010111
Pump-3	111111110011000111100111101010000110100111000100100010
Pump-4	111010000101110011111100000111110111111011110101111100
EMR-N	1110010011010111111111001111111111111111111001010111111
EMR-E	000000001111111100001100111101100100011011011010110001
EMR-S	010001001111110011111111111111110011111000111110011110101
EMR-W	0100011110010011111110000101111011100110111110110011111



# Visibility forms the basis for Protection



Thousands of IP addresses doing thousands of things...

Stanford



# Medicine tracks consumer trends...just later

## The Display of Digital Disruption

- World's largest taxi company owns no taxis ( Uber )
- Largest accommodation provider owns no real estate ( Airbnb )
- Largest phone companies own no telco infra ( Skype, WeChat )
- World's most valuable retailer has no inventory ( Alibaba )
- Most popular media owner creates no content ( Facebook )
- Fastest growing banks have no actual money ( SocietyOne )
- World's largest movie house owns no cinemas ( NetFlix )
- Largest software vendors don't write the apps ( Apple & Google )

The Largest Hospitals may have the fewest beds in the future



# Pharmacy taking a stake in health evolution...



## Patient Care

- Prevention
- Chronic
- Urgent

- Telemedicine
- POC, blood test
- Pill dispensing
- Wearables

Continuum  
of Care



# Drug stores- an important Health HUB



22 Million Members

10,000 Locations

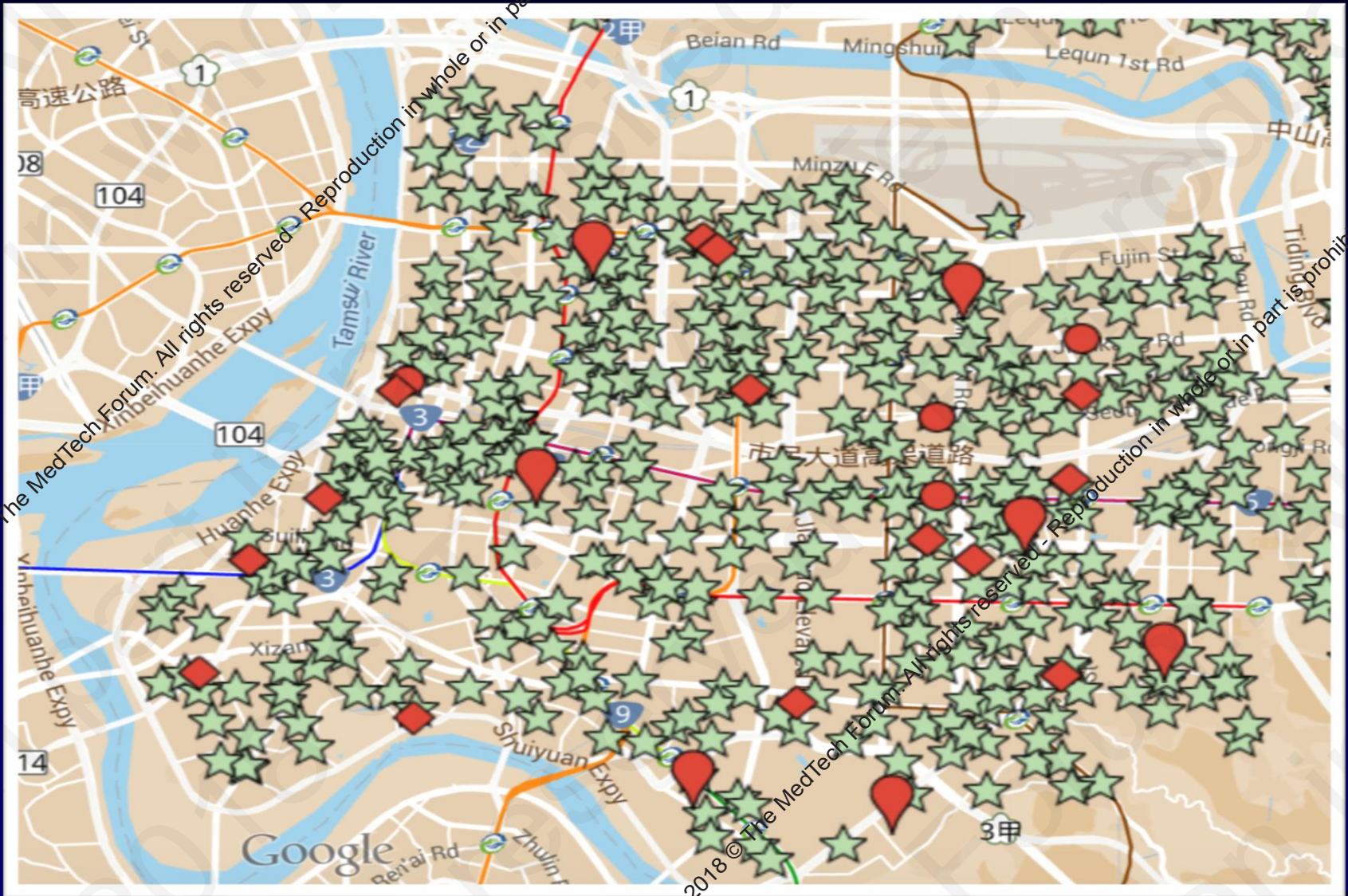


# Retail Health...like the “Genius Care Bar”





# The “Uberization” of Health







security

Stanford

# Medicine & the integration into the “IT/Digital” generation

- Innovation in Medicine is thriving-- we just need to think different in digital era
- Med Tech and IT are integrating at a very fast pace...  
(Imaging, Decision analysis/AI, Cybersecurity)
- Variability will narrow (Re-F ML, Haptics, Data analytics)
- Hospitals will decentralize, Care will centralized in the community, for Preventative, Urgent and Chronic care.....