

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

The Rapidly Changing world of Healthcare

The Collision of & the Era

Old school

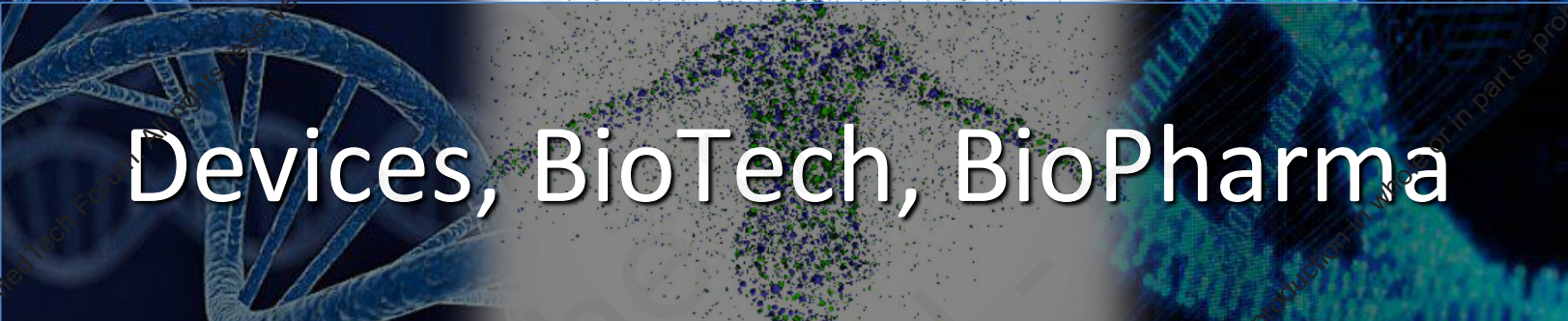


New
school



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

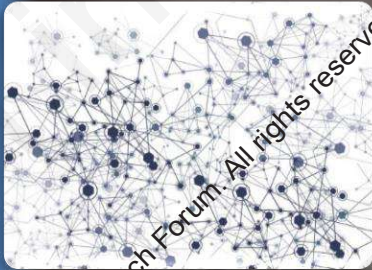
PREVENTIVE

PARTICIPATORY

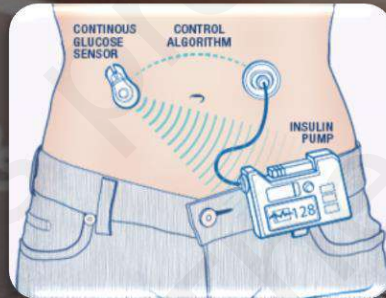
The next generation of Med Tech

bDASH

Big Data



Smart Devices



AI



Security in Healthcare

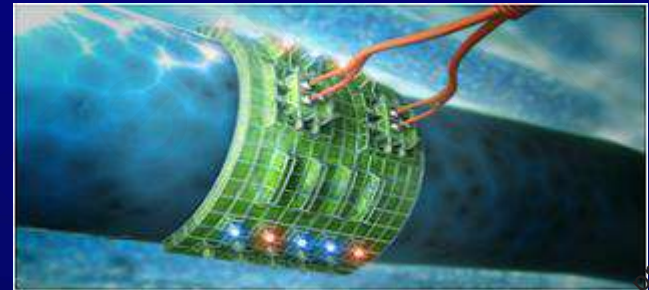
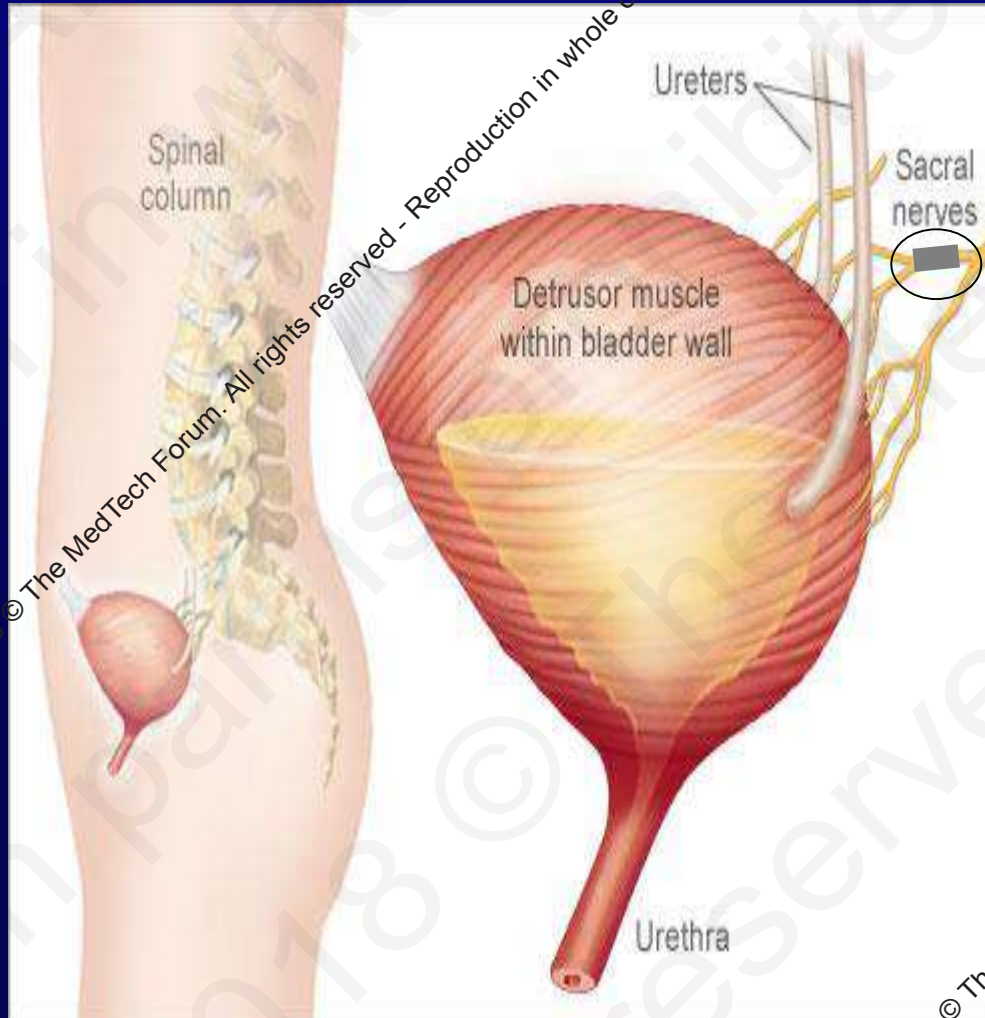


“The patch that communicates...”



E-C

“Programing OAB with mobile”



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

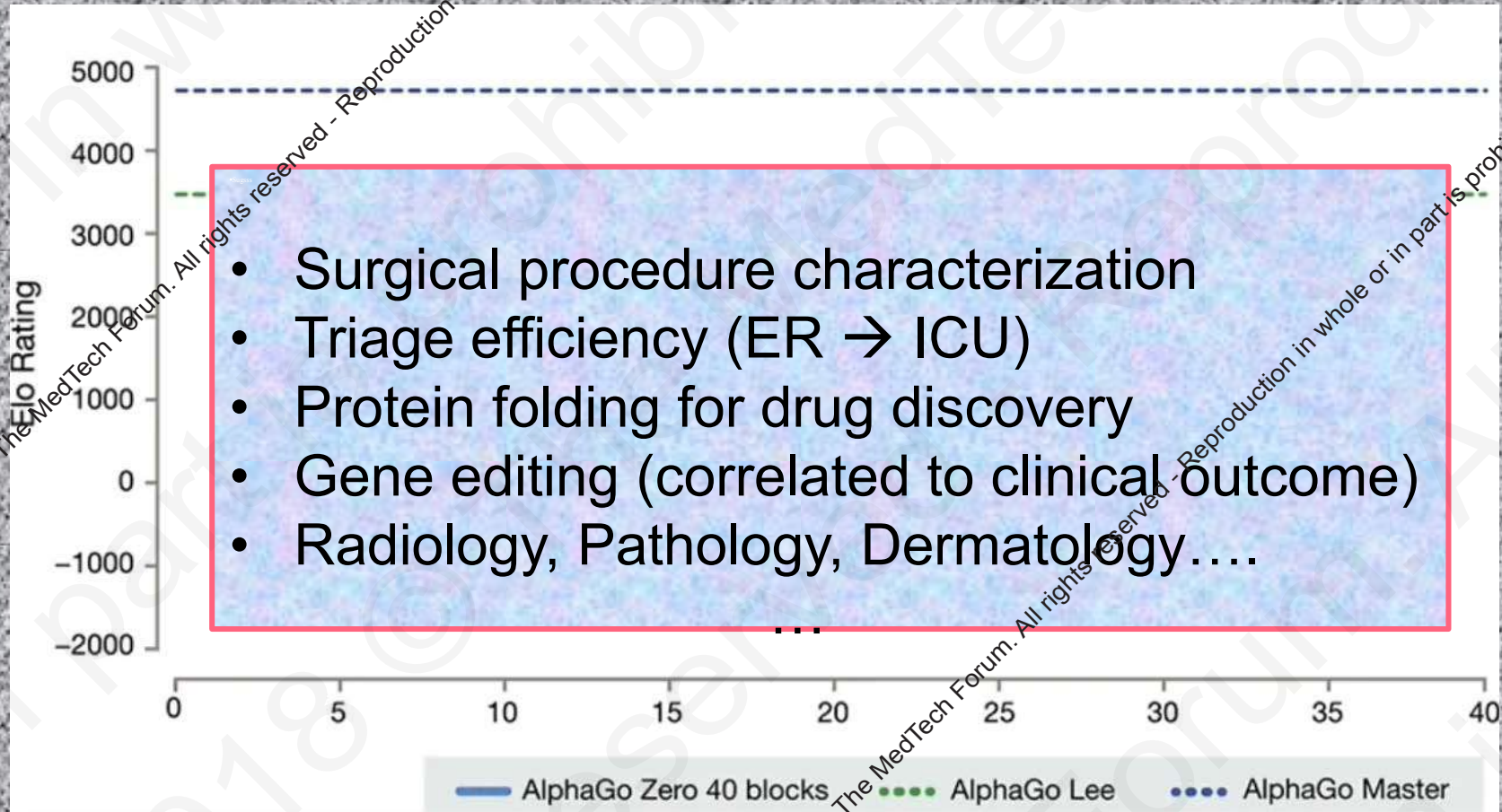
A.I. at a glance

- 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

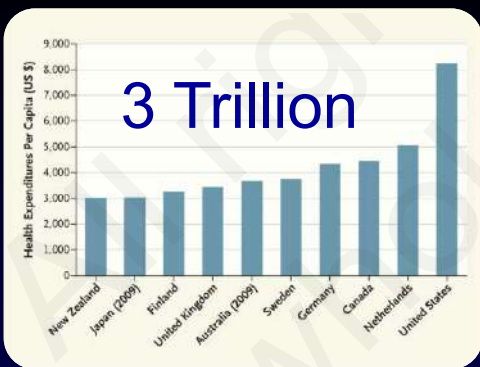
Google AI “AlphaGo”



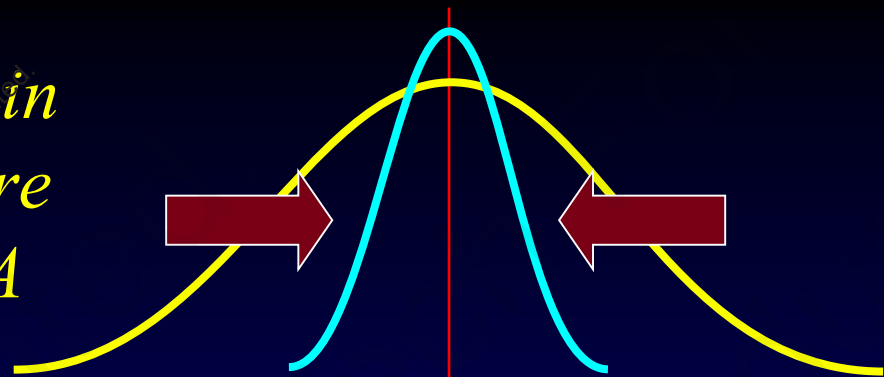
Convergence of Medtech & Hi-Tech

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

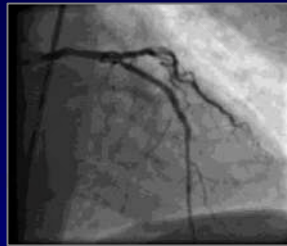




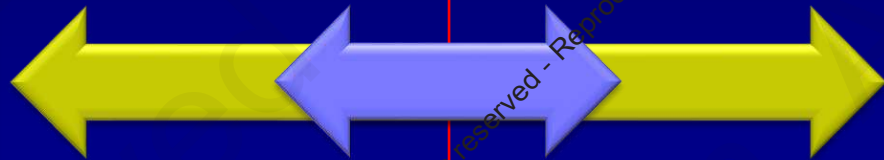
Variability in Patient Care In the USA



Diagnostics



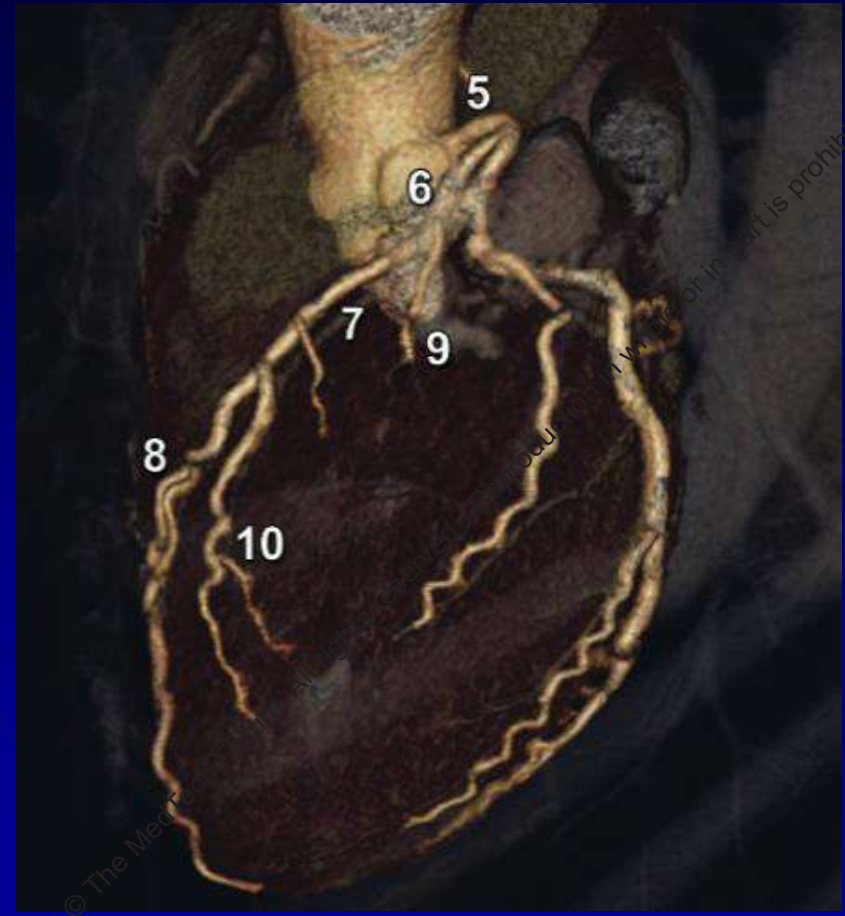
Treatments



Inventory

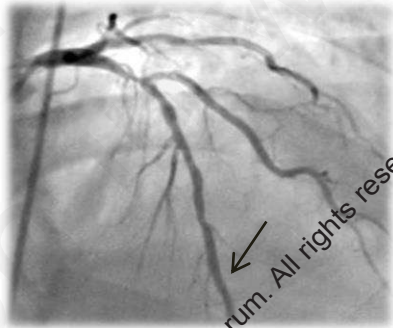


Computed Tomography Angiography (CTA) *...the quest for accurate out patient Dx*

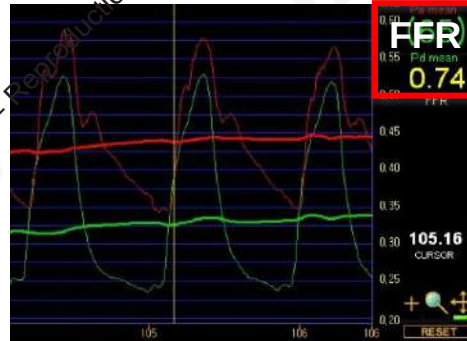


Outpatient Anatomy and Physiology

Invasive angiography



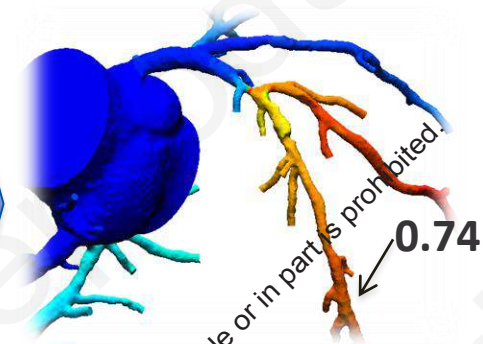
FFR



Coronary CTA



FFR_{CT}

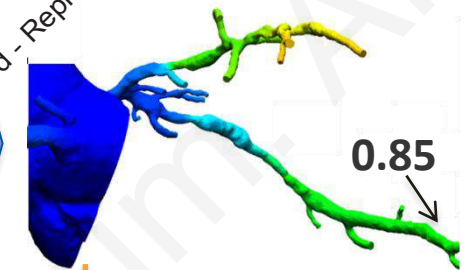
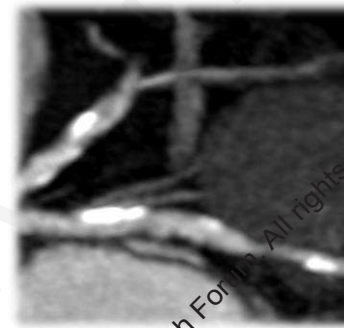
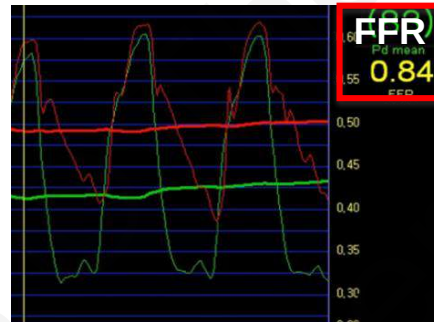
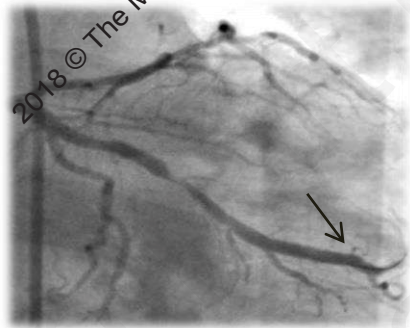


>50% diameter stenosis

FFR 0.74 → ischemia

>50% diameter stenosis

FFR_{CT} 0.74



>50% diameter stenosis

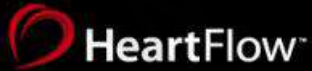
FFR 0.84 → no ischemia

>50% diameter stenosis

FFR_{CT} 0.85



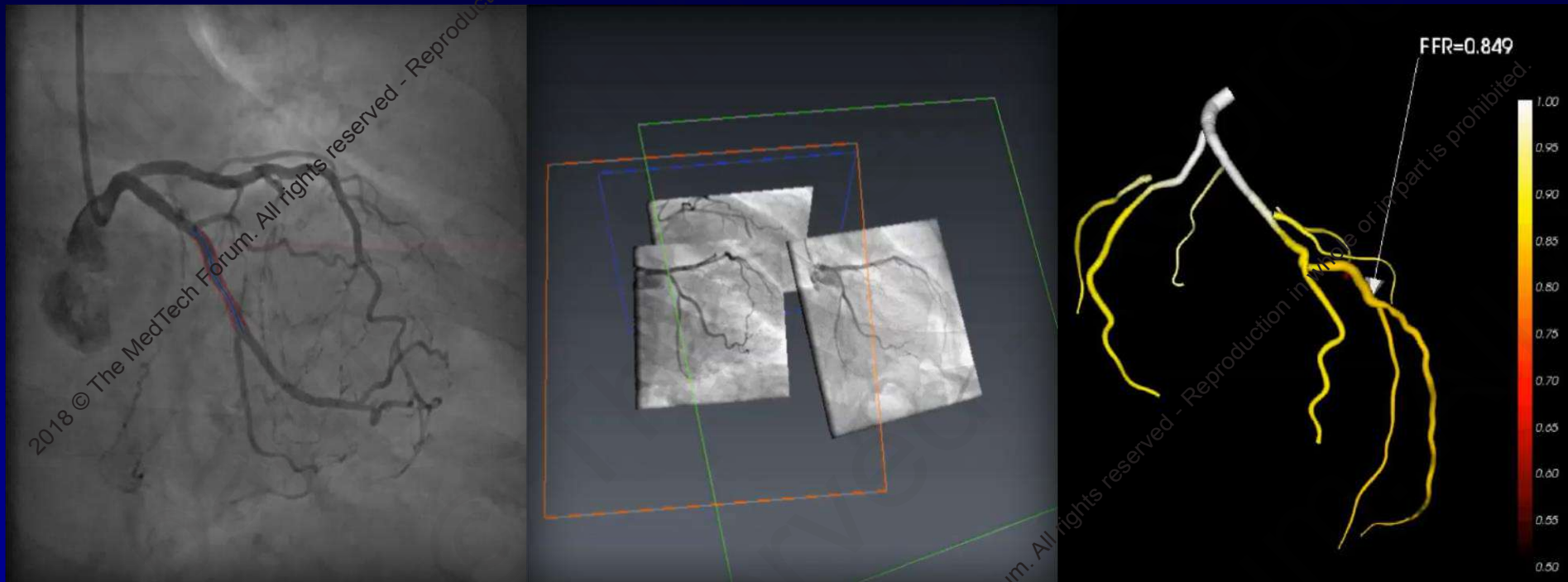
Non-Invasive Flow parameters— derived from 64 slice CTA



simulation

This is possible in the Cathlab as well...

SaaS; Cloud-based algorithms



Routine angiograms

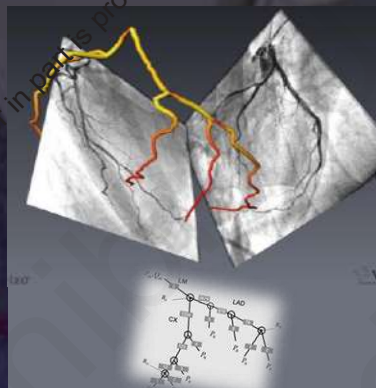
3D tree & Flow analysis

FFR_{Angio}

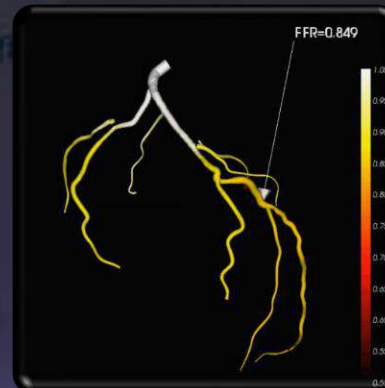
“Wireless” FFR



Routine angiograms



3D tree & Flow analysis



FFR_{Angio}

“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

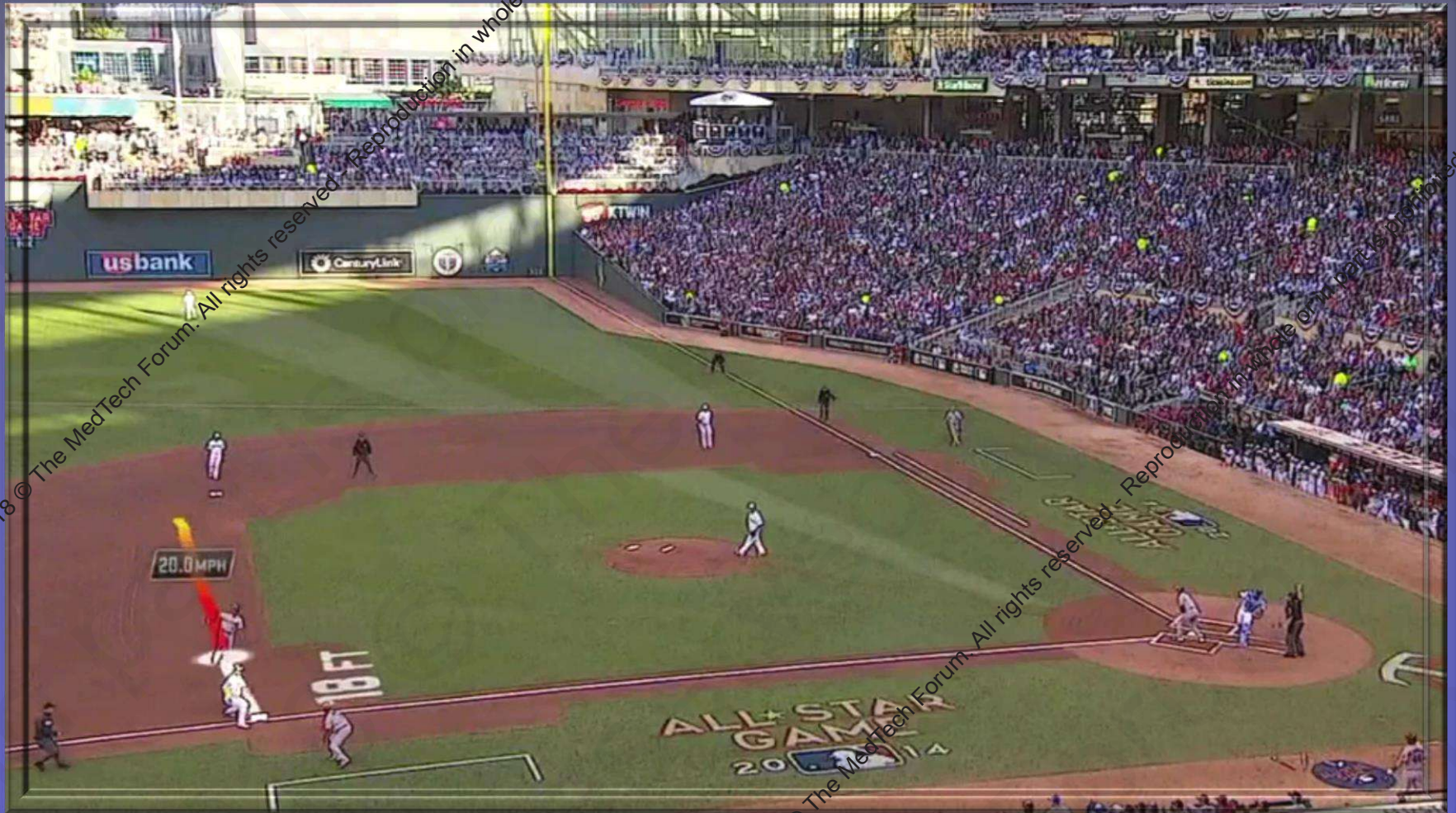
Cockpit Monitors (Live/Reference Angio, Hemo)

Remote Robotics: Treatment in Time

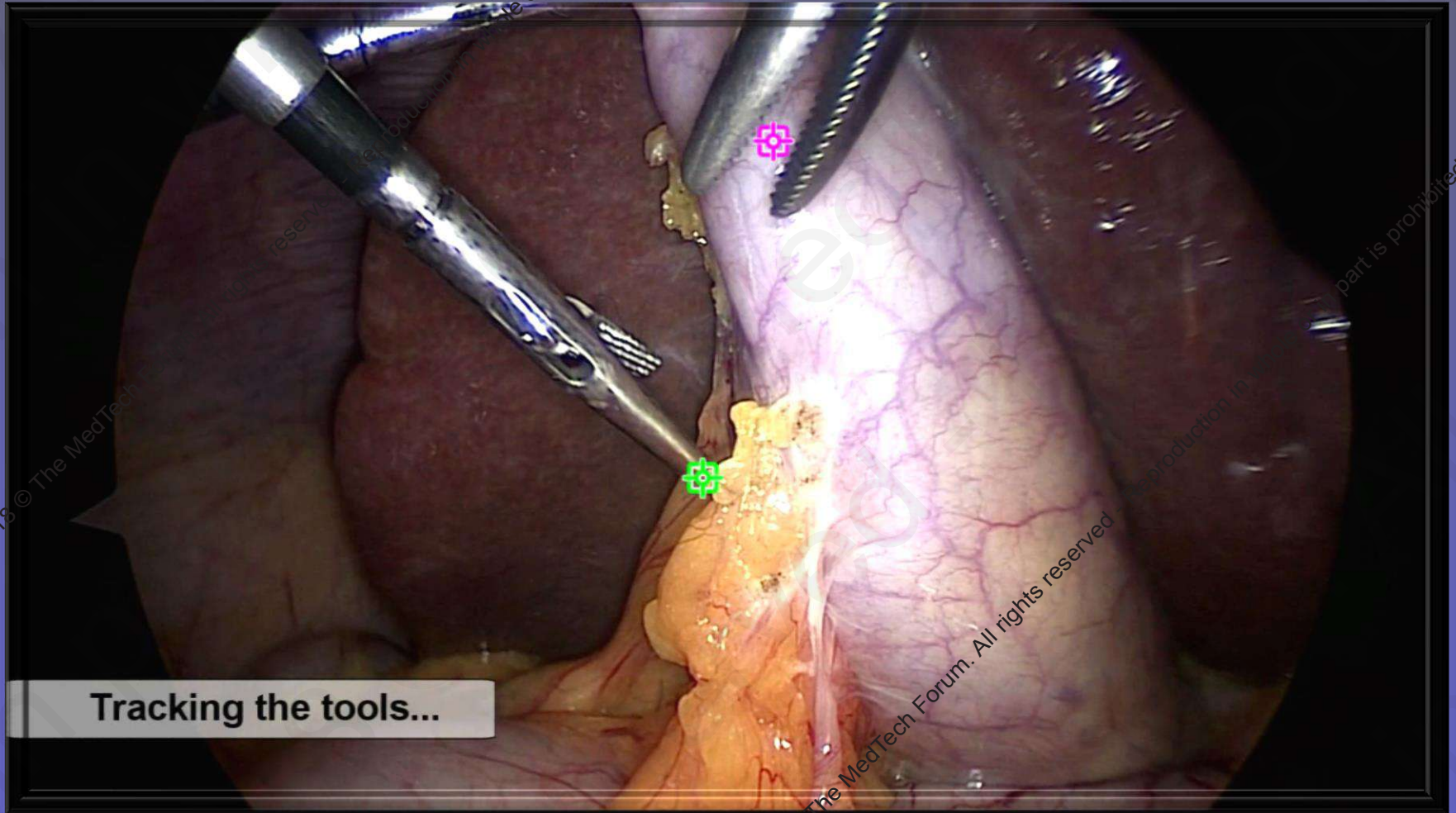
Minimal Latency



Consumer quantification...consistency is key (AWS)



Consumer quantification...consistency is key



The Wave of Digital Data Will Change Healthcare

Cybersecurity

“Retail”, personal
Medical care

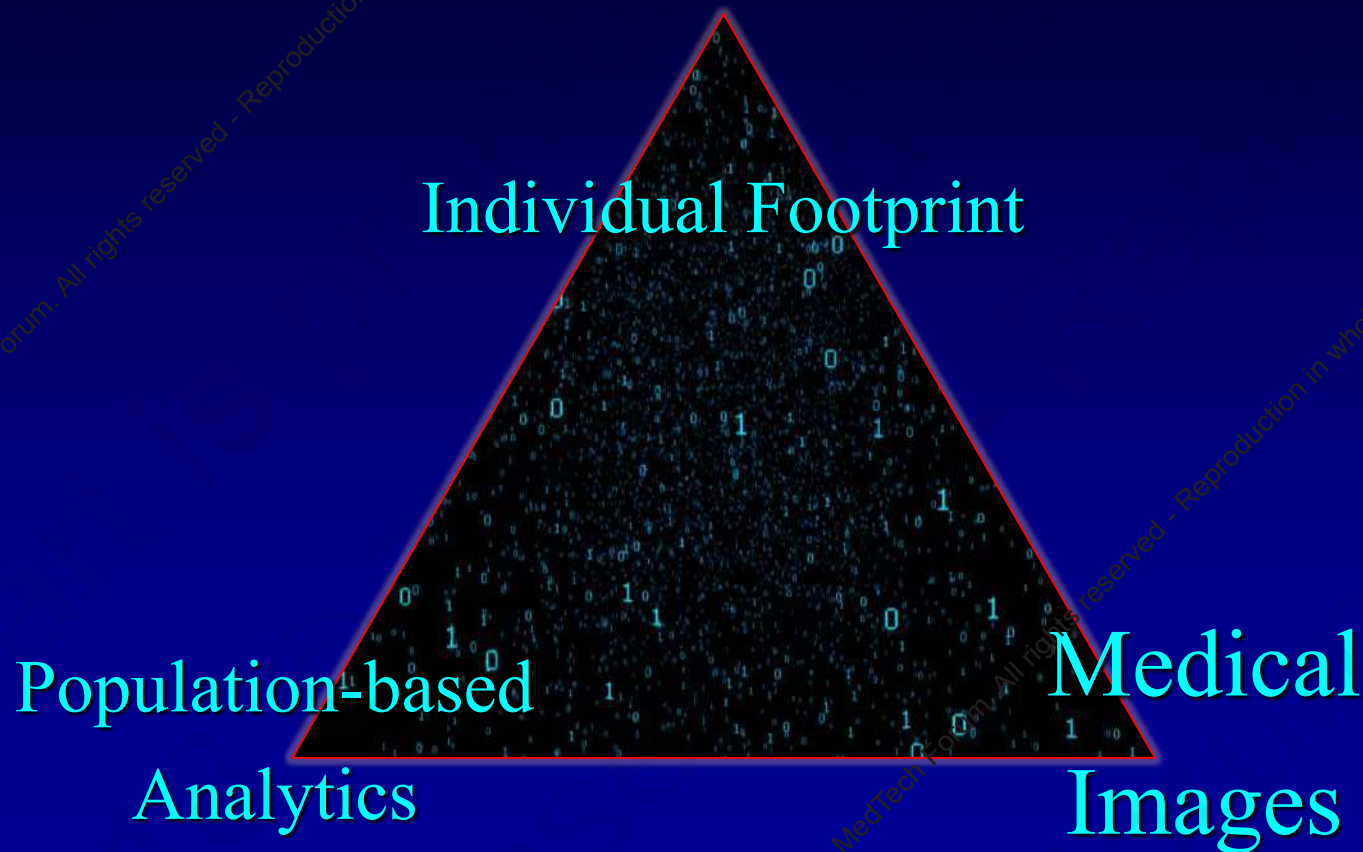
DATA
“Predictalytics”

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



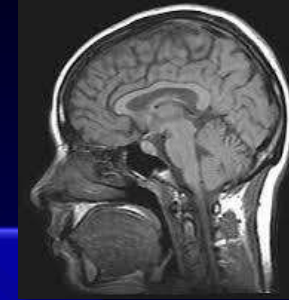
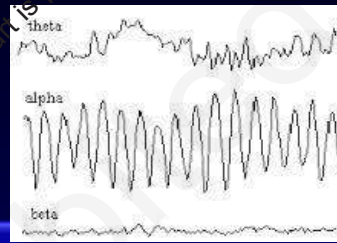
Digital exhaust from phones, wearables, and implants...

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

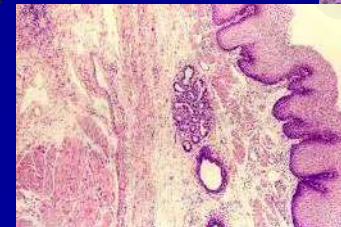
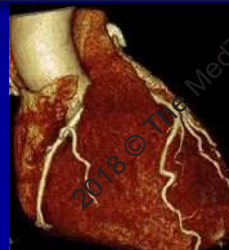
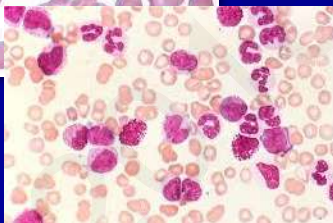
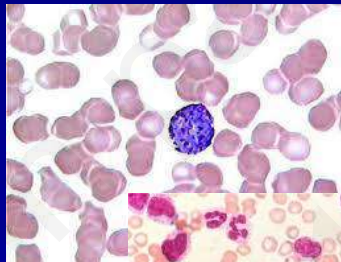
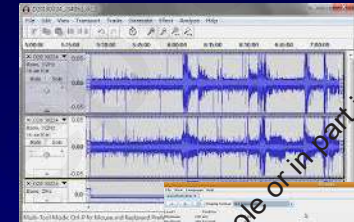


Clinical Diagnosis and Treatment Strategy

Test	Result	Unit	Ref
Complete Blood Count			
Hemoglobin	10.8	g/dL	12.0-15.0
Hematocrit	32.4	%	37.0-47.0
MCV	102.8	fL	84-101
MCH	27.8	pg	27-32
MCHC	26.9	g/dL	31-36
RDW	14.1	%	11.6-14.0
Platelets	144	10 ⁹ /L	150-400
Chemistry			
Glucose	104	mg/dL	70-100
BUN	13.7	mg/dL	7-20
CREA	1.2	mg/dL	0.8-1.3
ALT	12.5	U/L	7-56
AST	4.4	U/L	0-37
ALP	7.9	U/L	35-100
TBL	146	mmol/L	144-160
Ca	9.3	mg/dL	8.8-10.2
PO4	3.5	mg/dL	2.5-4.5
CO2	24	mmol/L	22-29
Na	131	mmol/L	136-145
K	3.9	mmol/L	3.5-5.3
Mg	1.1	mmol/L	0.7-1.3
Cl	102	mmol/L	98-107
Urea N	9.8	g/dL	5.2-8.2
Urea Cr	1.4	g/dL	0.7-1.3
Urea BUN	3.4	g/dL	2.5-4.5
Urea Creat	1.1	g/dL	0.7-1.3
Urea Glucose	100	mg/dL	70-100
Urea ALT	22	U/L	7-56
Urea AST	22	U/L	0-37
Urea ALP	7.9	U/L	35-100
Urea TBL	146	mmol/L	144-160
Urea Ca	9.3	mg/dL	8.8-10.2
Urea PO4	3.5	mg/dL	2.5-4.5
Urea CO2	24	mmol/L	22-29
Urea Na	131	mmol/L	136-145
Urea K	3.9	mmol/L	3.5-5.3
Urea Mg	1.1	mmol/L	0.7-1.3
Urea Cl	102	mmol/L	98-107



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.”

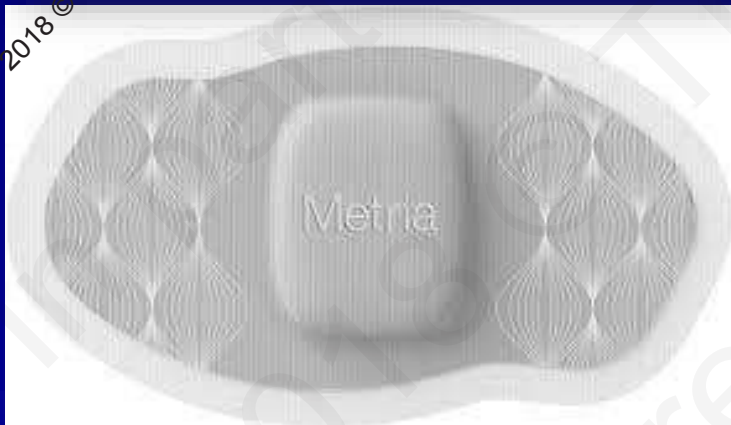
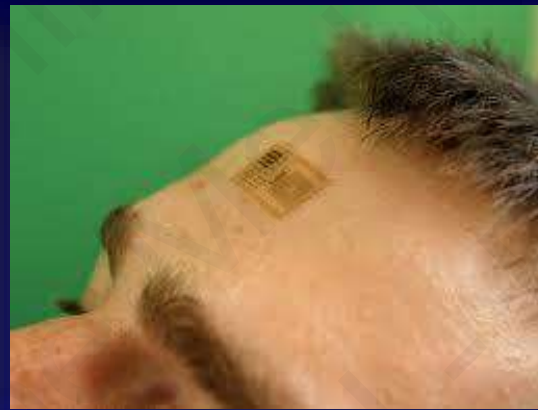


Still need doctors for sure....

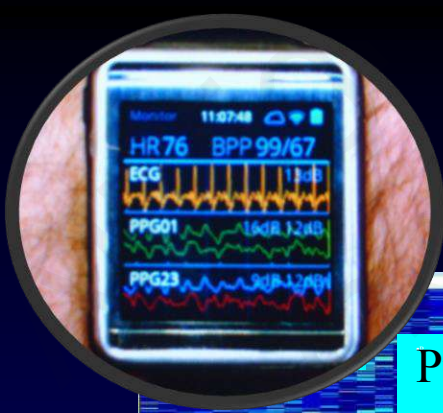
- ***Computers can determine actionable items***
- ***But Doctors need to turn those items into action***

The Wearable Decade

*...from watches, patches and
tattoo's*



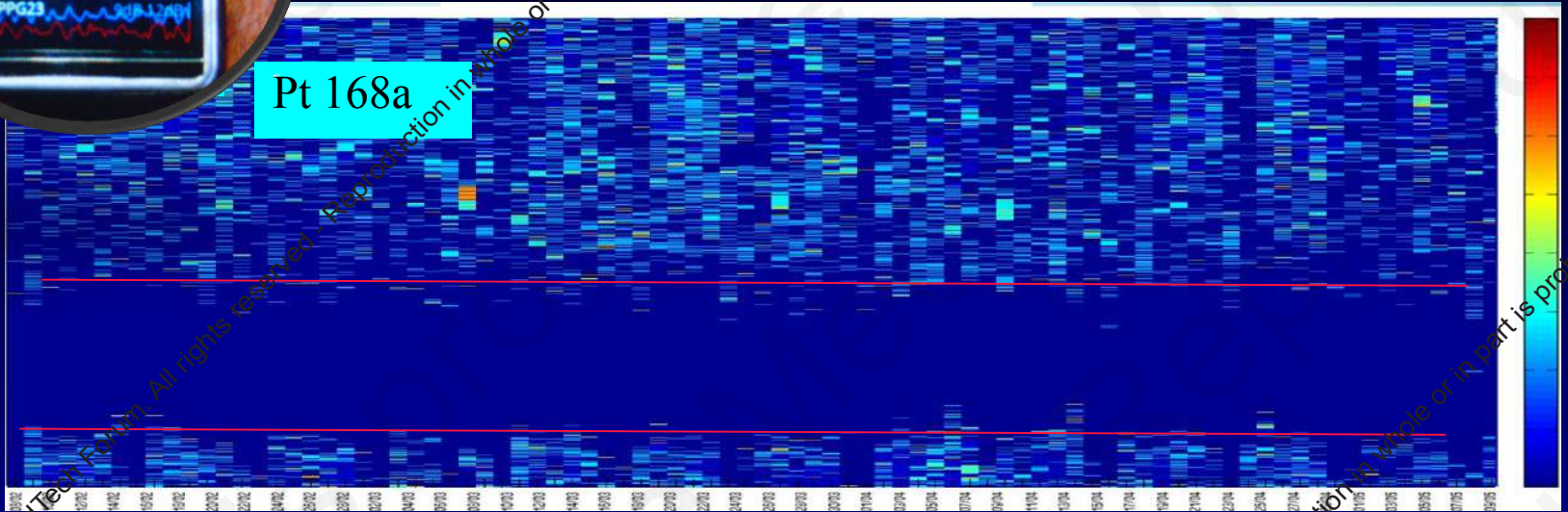
Cardiac Index “dashboard” (HRV & Blood Pressure)



HRV

Pt 168a

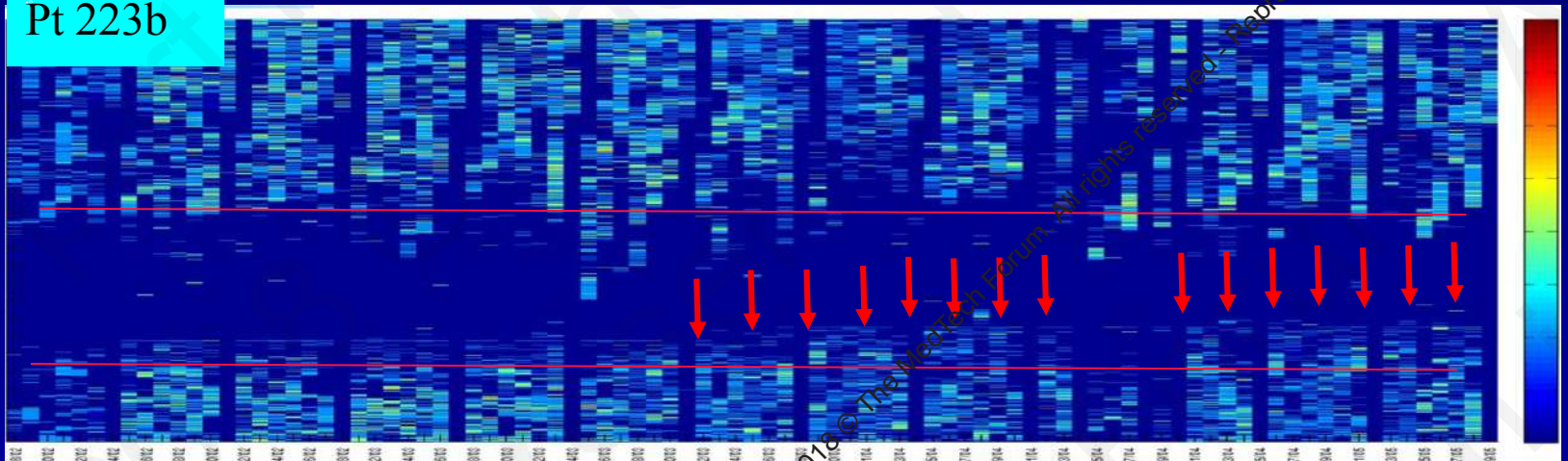
80



HRV

Pt 223b

80



Wearables will become Prescribes Healthcare

Analytics as the vortex...

Sensors



ML/AI algorithms



Service



Solution



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

AI/Machine learn



Head CT's



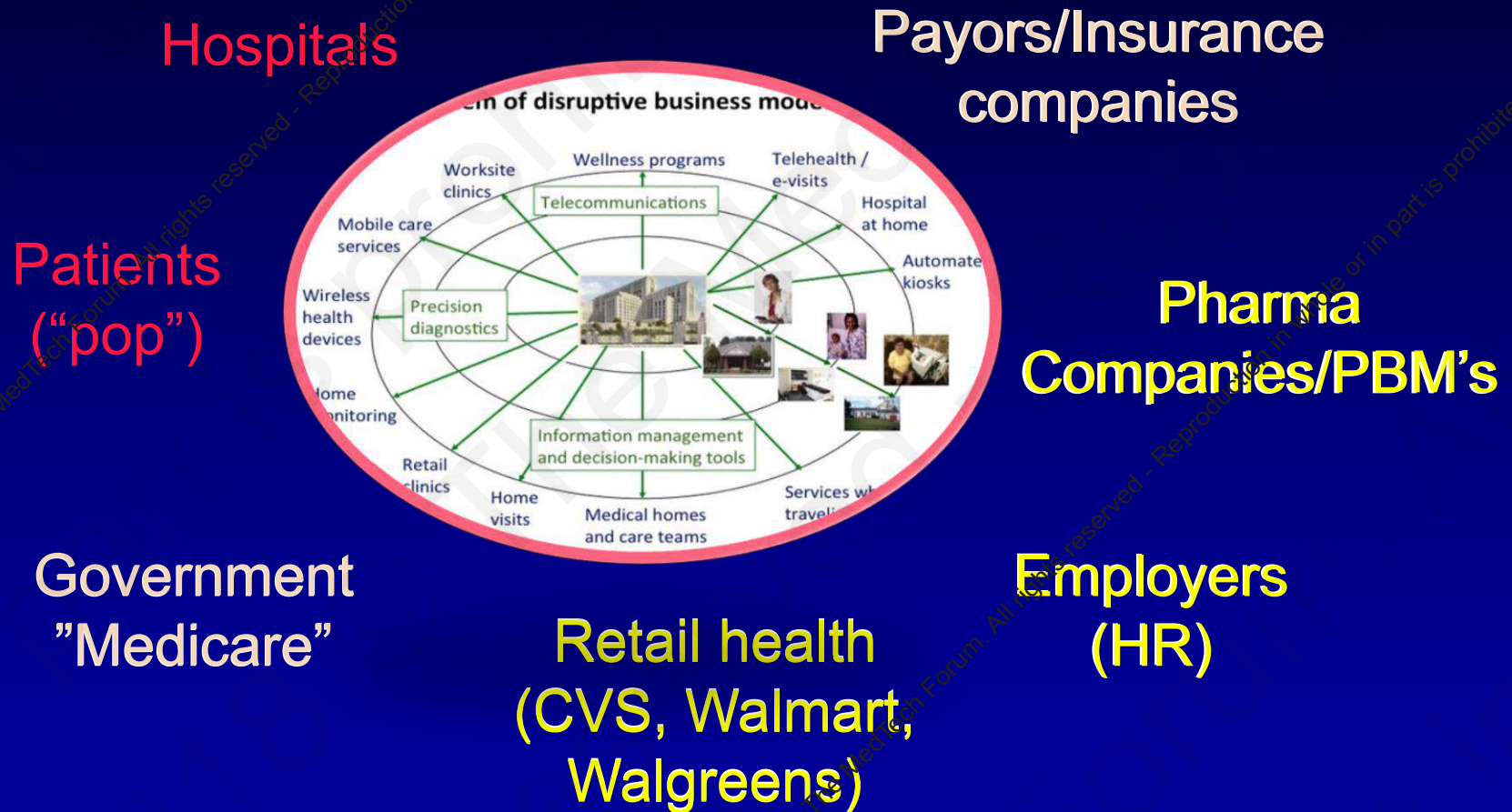
Solution



Service



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



Healthcare is undergoing an exponential transformation



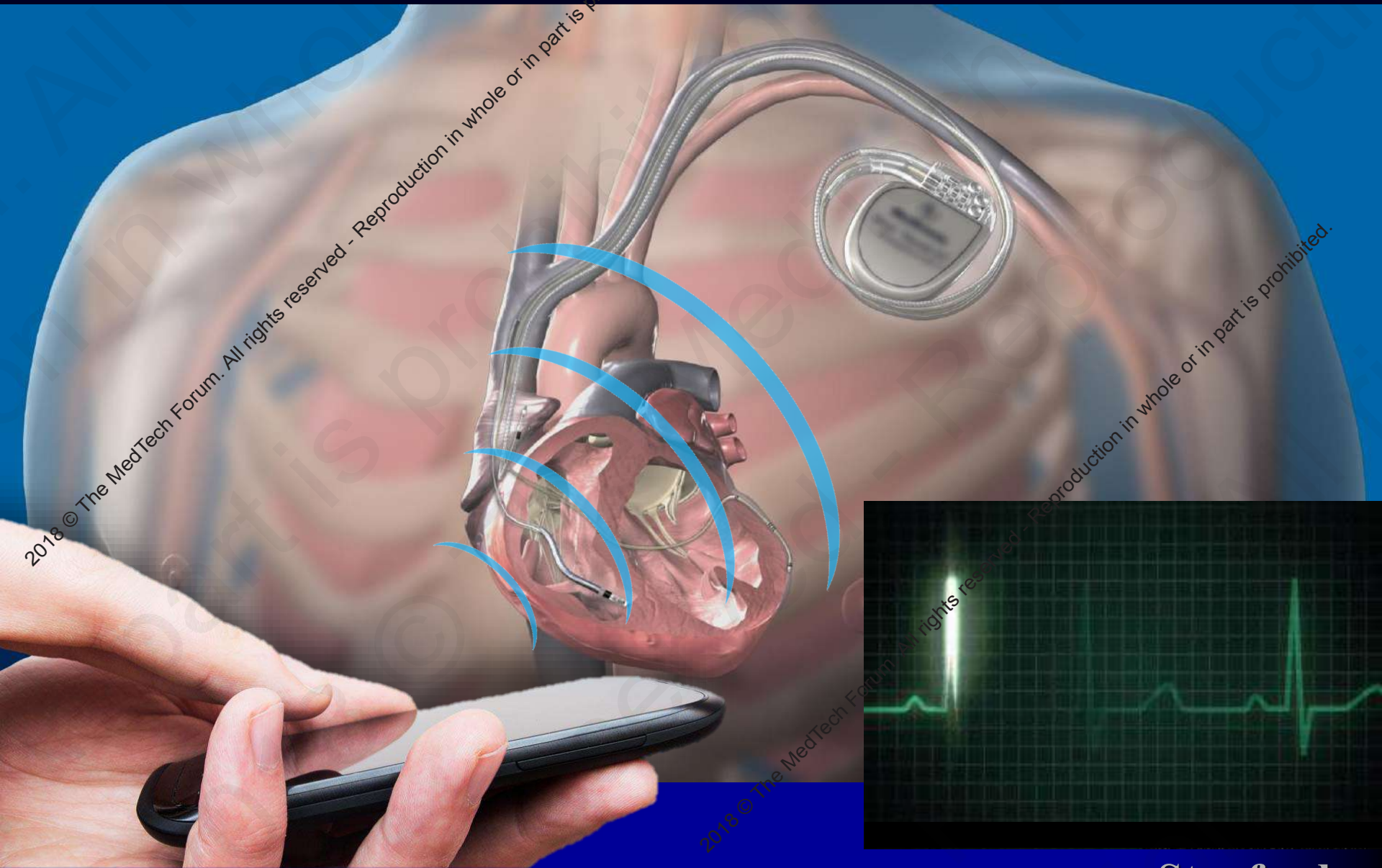
- *Alexa self diagnosis with one-hour pill delivery*
- *Chatbots to make ER's and clinics improve*
- *A.I. to aid rapid diagnosis and treatment*
- *Biosensors dash boards for care continuum*
- *POC/Liquid Bx at retail centers (CVS, Walmart)*

June 2017

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



Cybersecurity....an real emerging need



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
U.S. Individual Income Tax Return
Department of the Treasury—Internal Revenue Service
Your first name and initial
if a joint return, spouse's first name and initial
Label
See instructions on page 14J
Use the name on the return

Form 8812
Application for Automatic Extension of Time To File U.S. Individual Income Tax Return
Department of the Treasury—Internal Revenue Service
Name(s) shown on return
All Filers
Enter the amount from line 1 of your return on line 38 of the Form 1040A
enter the amount from line 1 of your return on line 38 of the Form 1040A

Form 8868
Application for Extension of Time To File U.S. Individual Income Tax Return
Department of the Treasury—Internal Revenue Service
Name(s) shown on return
All Filers
Enter the amount from line 1 of your return on line 38 of the Form 1040A
enter the amount from line 1 of your return on line 38 of the Form 1040A

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

Full name, address, & phone number (if under 12, give age)
John R. Doe, HM3, USN

U.S.S. Neverforgotten (DD 178)

MEDICAL FACILITY
U.S.S. Neverforgotten (DD 178)

DATE
23 JAN 99

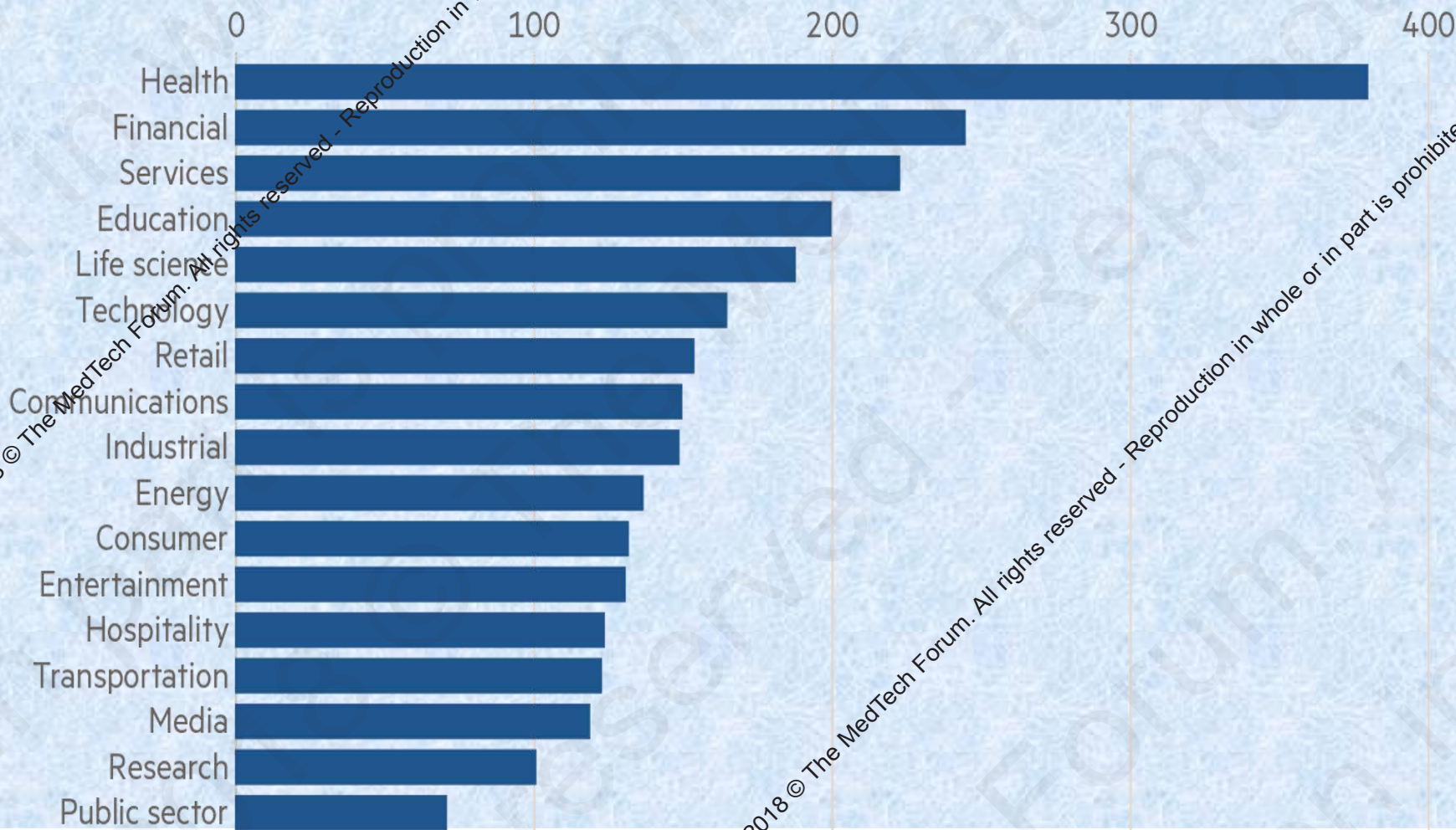
R (Superscription)
(Inscription)
Tr. Belladonna

gm or ml.
15 ml

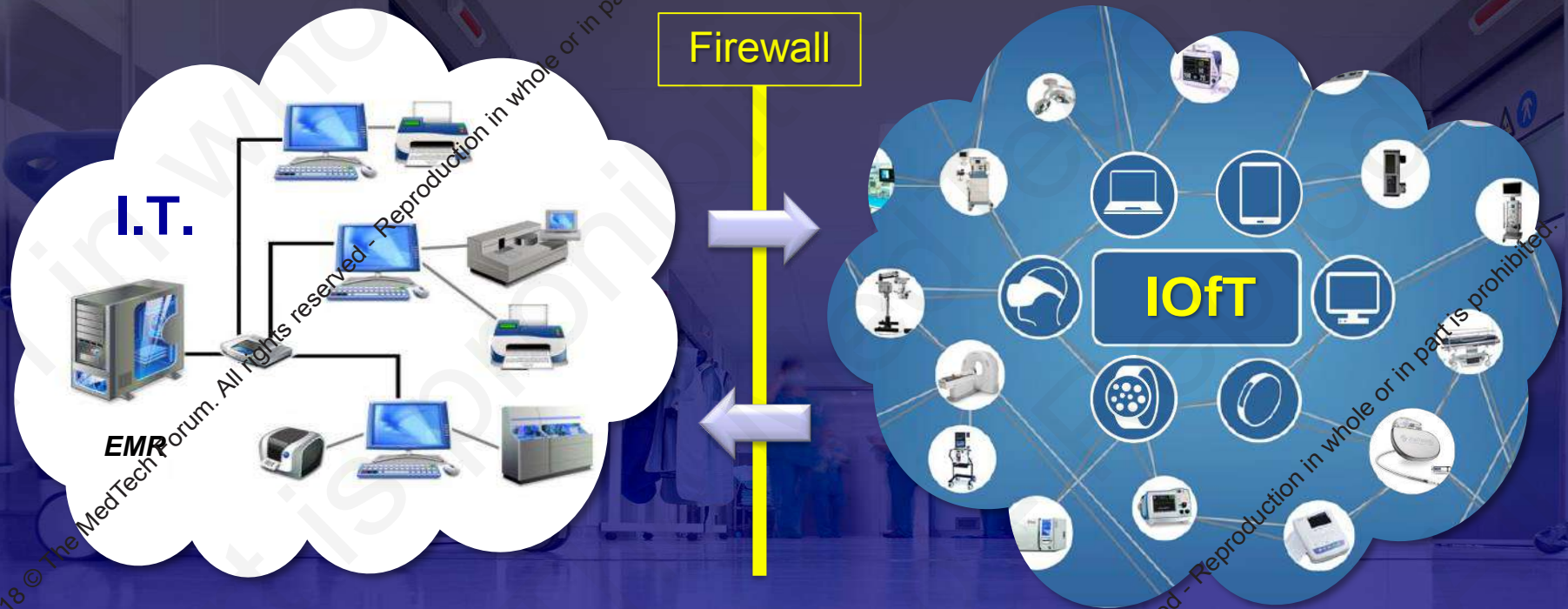


Data breach cost per capita

By industry classification, 2017 (\$)



Hospital Networks: A True Security Vulnerability



IoT

...Needs cyber protection

Hospital Networks: A True Security Vulnerability

Contextual Machine learning of each IP address

CT-1	001111110000001111100100110001101110010100111111111111101
PM-2	1110111111000011101011111101100011110111111010101100110
CT-3	1101111100001110001101010010111010011111000110001000110
CT-4	110001110111101111110111111111111101000111111011101111110
MRI-1	111110011011101111000111101110101110100011111101111110
MRI-2	1100110111111101100010010000001011101110111011111111111
MRI-3	111110001111110001111111111111111001111001111110010111111
ECG-1	011111101100111011111011111110101111101111111101100111010
ECG-2	1111111110001111111001010010100011111011110110100111101
ECG-3	00011111111111011000101000011110010000000111100100100011
ECG-4	10111110011111111101010111111000101110111000001001111110
ECG-5	01110000111101110111110011111100111111111111001100000110111
Pump-1	1011101101000010011001100011101110000110010000001100111
Pump-2	1101100110001010111101101000111110100011010111110010111
Pump-3	1111111110011000111100111101010000110100111000100100010
Pump-4	11101000010111001111111000001111101111111111110101111100
EMR-N	11100100110101111111111001111111111111111111001010111111
EMR-E	00000000011111111100001100111101100100011011011010110001
EMR-S	0100010011111111001111111111111110011111000111110011110101
EMR-W	010001111001001111111100001011110111001101111110110011111

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



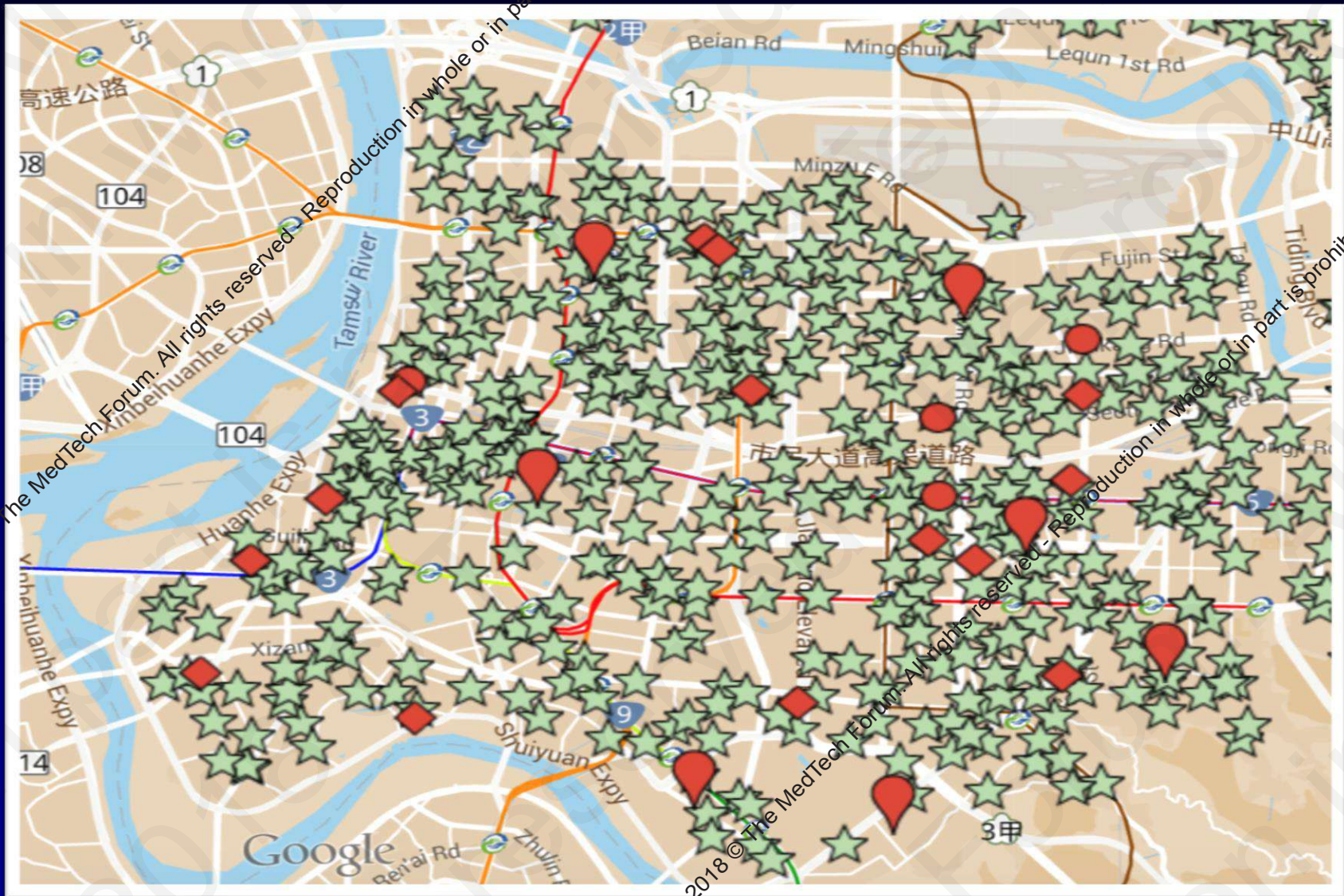
22 Million Members

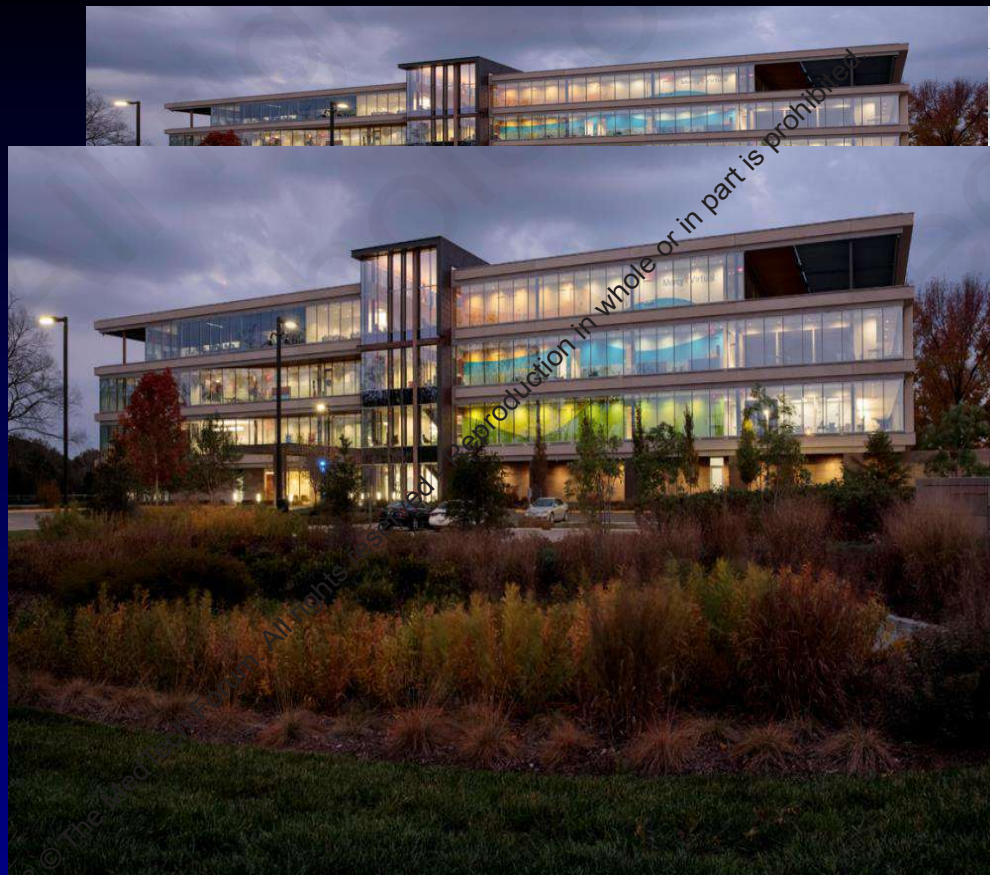
10,000 locations

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.....