Importance of wearable *Meta*Data in care orchestration

ARM

Karthik Ranjan

Director Healthcare Technology, ARM
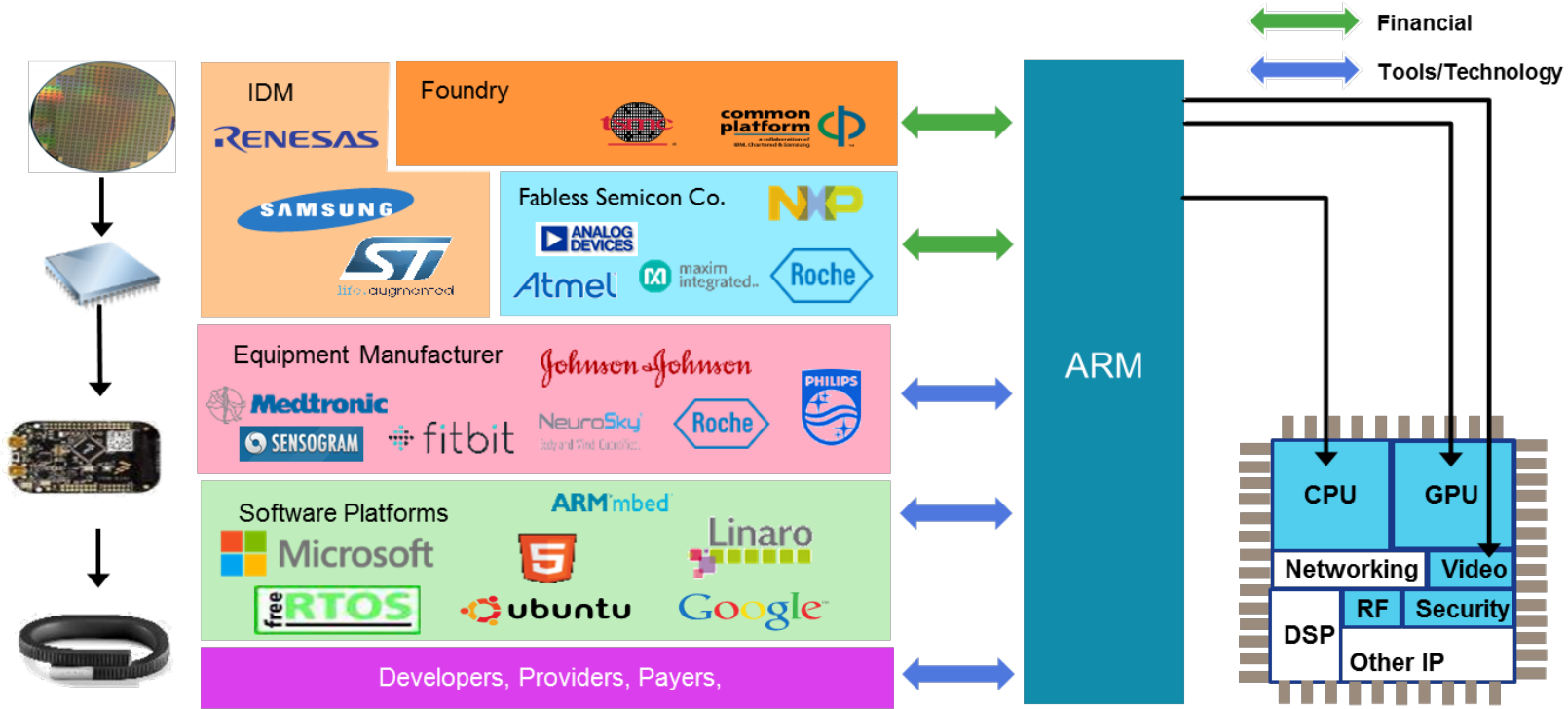
Karthik.Ranjan@arm.com | twitter: kartran
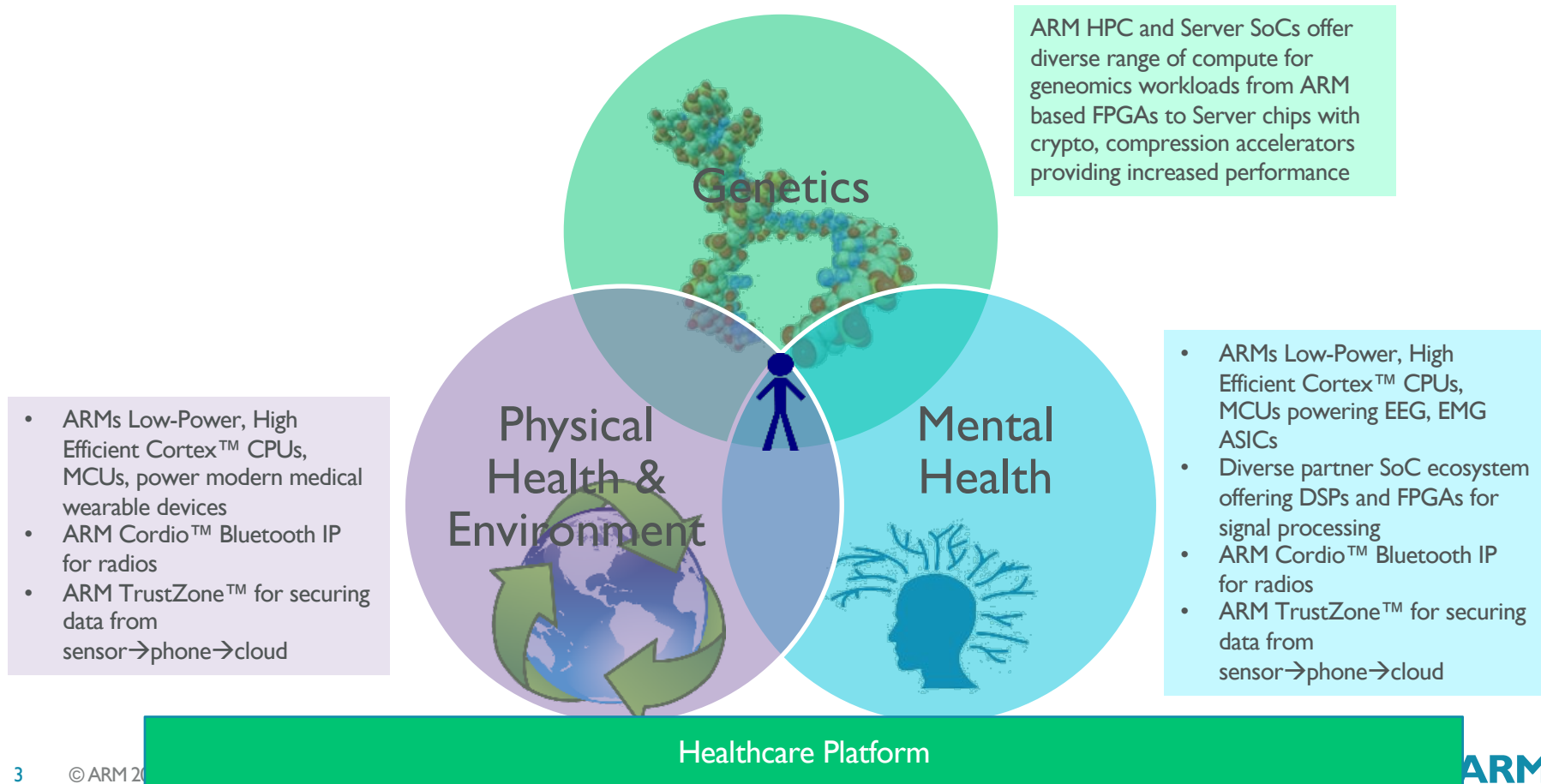
NRTC Seattle, WA
April 11th, 2017

ARM, world's leading semiconductor IP company

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Billions of chips with ARM IP shipped in 2015: **15**

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ARM IP Across the Healthcare spectrum

ARM HPC and Server SoCs offer diverse range of compute for geneomics workloads from ARM based FPGAs to Server chips with crypto, compression accelerators providing increased performance

Genetics

Physical Health & Environment

Mental Health

- ARMs Low-Power, High Efficient Cortex™ CPUs, MCUs, power modern medical wearable devices
- ARM Cordio™ Bluetooth IP for radios
- ARM TrustZone™ for securing data from sensor→phone→cloud

- ARMs Low-Power, High Efficient Cortex™ CPUs, MCUs powering EEG, EMG ASICs
- Diverse partner SoC ecosystem offering DSPs and FPGAs for signal processing
- ARM Cordio™ Bluetooth IP for radios
- ARM TrustZone™ for securing data from sensor→phone→cloud

Healthcare Platform

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Chronic Illnesses Rising + Aging population

Diabetes to grow 2.5x by 2025 to 228M people*

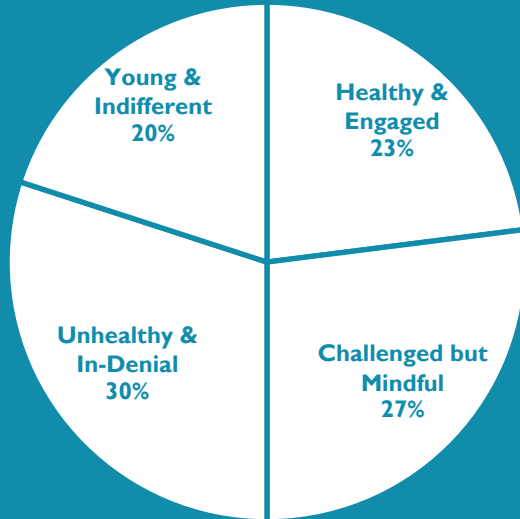2020 Chronic Diseases → ¾ of deaths*

Cancer deaths grow 8M→13M by 2030**

Projected US healthcare spend increase 3%

$3.2 Trillion spent on healthcare in US

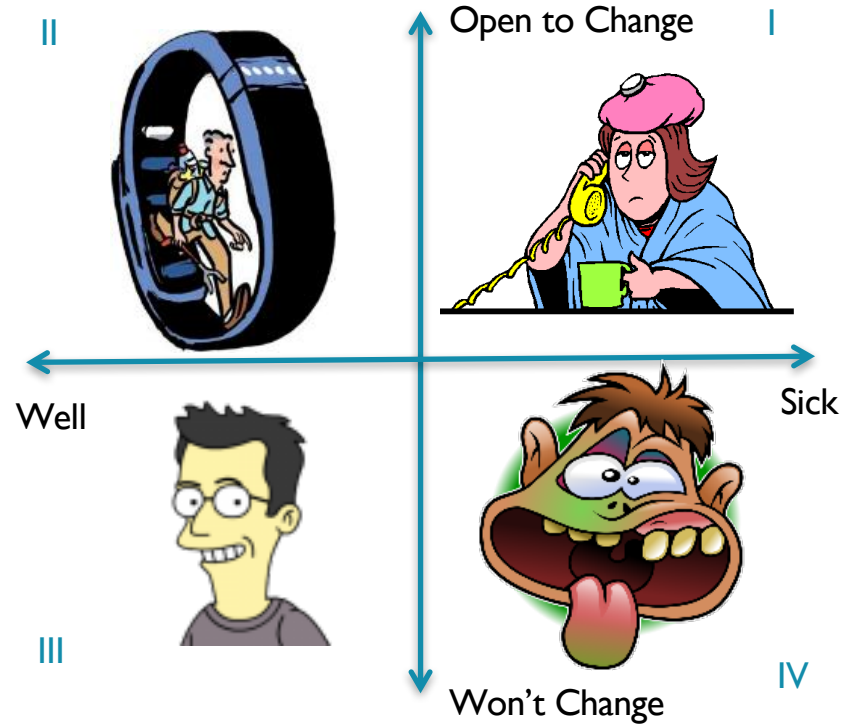~$290B → non-adherence to meds

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* Source: World health organization   ** Source: cancer.org

Not everyone sees their health in the same light

HEALTH CONSUMER SEGMENTATION

Young & Indifferent 20%

Healthy & Engaged 23%

Unhealthy & In-Denial 30%

Challenged but Mindful 27%

Source: Parks Associates

II   Open to Change   I

Well   Sick

III   Won't Change   IV

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When it comes to health we typically only see the tip

Annual Exam

Emergency Room

Illness Visit

Flu Shot @ Work

Medication Working

Sleep Quality?

BP under control

Weight Control

Glucose under control

Regular Exercise?

Resting Heartrate

Heart Function

Timing interim visits to Doctor

6

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By 2020 there will be have been 1.15 Billion connected health & fitness devices cumulatively shipped

Tsunami of connected medical devices coming

Google Medtronic Dexcom — CGM

Withings TANITA fitbit iHealth — Scale

Oral-B PHILIPS Breathometer — Oral Health

GIVEN IMAGING Intarcia Therapeutics, Inc. proteus DIGITAL HEALTH MEDIMETRICS — Smartpills

NeuroSky fitbit MI JAWBONE SENSOGRAM TECHNOLOGIES BODYMEDIA — Fitness

SENSOGRAM TECHNOLOGIES NeuroSky OMRON — CBP, HRV

Roche TANDEM DIABETES CARE cellnovo — Insulin Pump

VITALITY MedReady Inc. MedMinder — Smartpill Box

KENZEN Sandia National Laboratories — Hydration

muse the brain sensing headband EMOTIV NeuroSky — Brain Waves

SENSOGRAM TECHNOLOGIES Masimo NONIN — SpO2

uber DIAGNOSTICS AliveCor NeuroSky — ECG

DETEKT DIGITAL DIAGNOSTIC SOLUTIONS LEMAN MICRO DEVICES LMD — Blood, Sweat, Urinalysis

SPINALI DESIGN UVA+B SunFriend — Sun/UV

Biomeme NANOPORE Technologies — Genetics

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Medical device innovations also coming bottom up

CNN Money
College student 3D prints his own braces

by Hope King   @lisahopeking

March 16, 2016: 4:38 PM ET

DIY Braces On A College Student's Budget

How to make your own braces on a budget
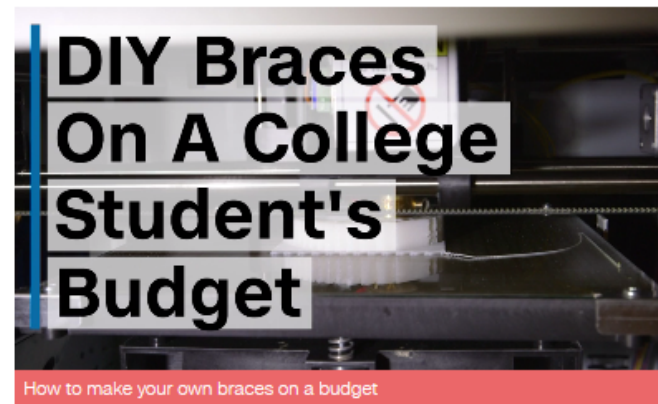
Amos Dudley wears his skills in his smile.

The digital design major has been straightening his top teeth for the past 16 weeks using clear braces he made himself.

theguardian

Health & wellbeing

Health hackers: the patients taking medical innovation into their own hands

Tired of waiting for a monitor for his diabetes, Tim Omer made his own. He is one of a growing number of patients circumventing medical companies in favour of a homemade healthcare revolution

Ara Darzi

Monday 26 October 2015 03.20 EDT

Tim Omer and part of the monitoring kit he built himself – the receiver re-using a Tic Tac box. Photograph: Linda Nylind for the Guardian

Tim Omer is a 31-year-old diabetic. Rolling up his sleeve, he reveals a small box, about half the size of a cigarette packet, taped to his upper arm. From the box, a sensor runs under his skin, delivering a readout of his blood glucose level to his mobile phone.

This is something to which few Type 1 diabetics in Britain have access - the monitors cost around £4,000 a year to buy and maintain and are too expensive for the NHS.

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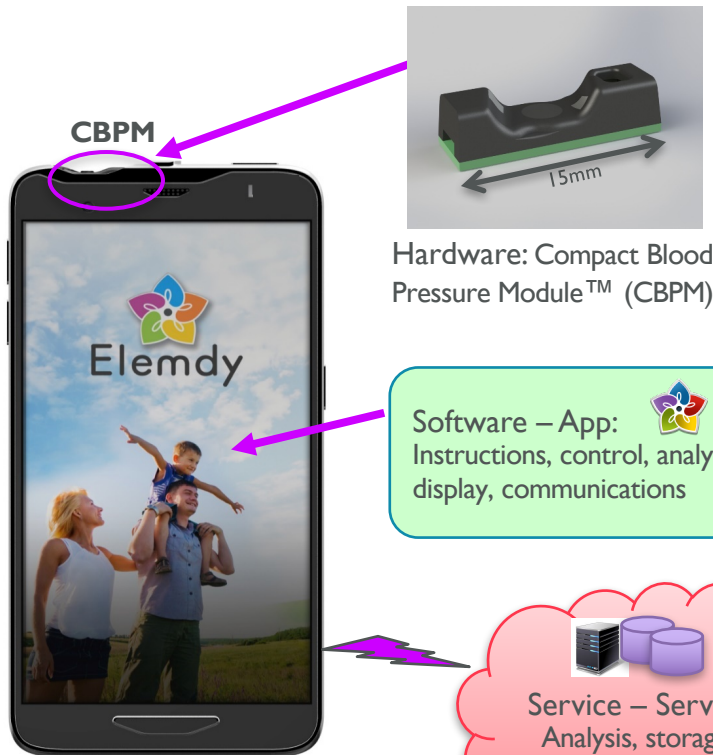# Medical Sensors are integrating directly into the Phone

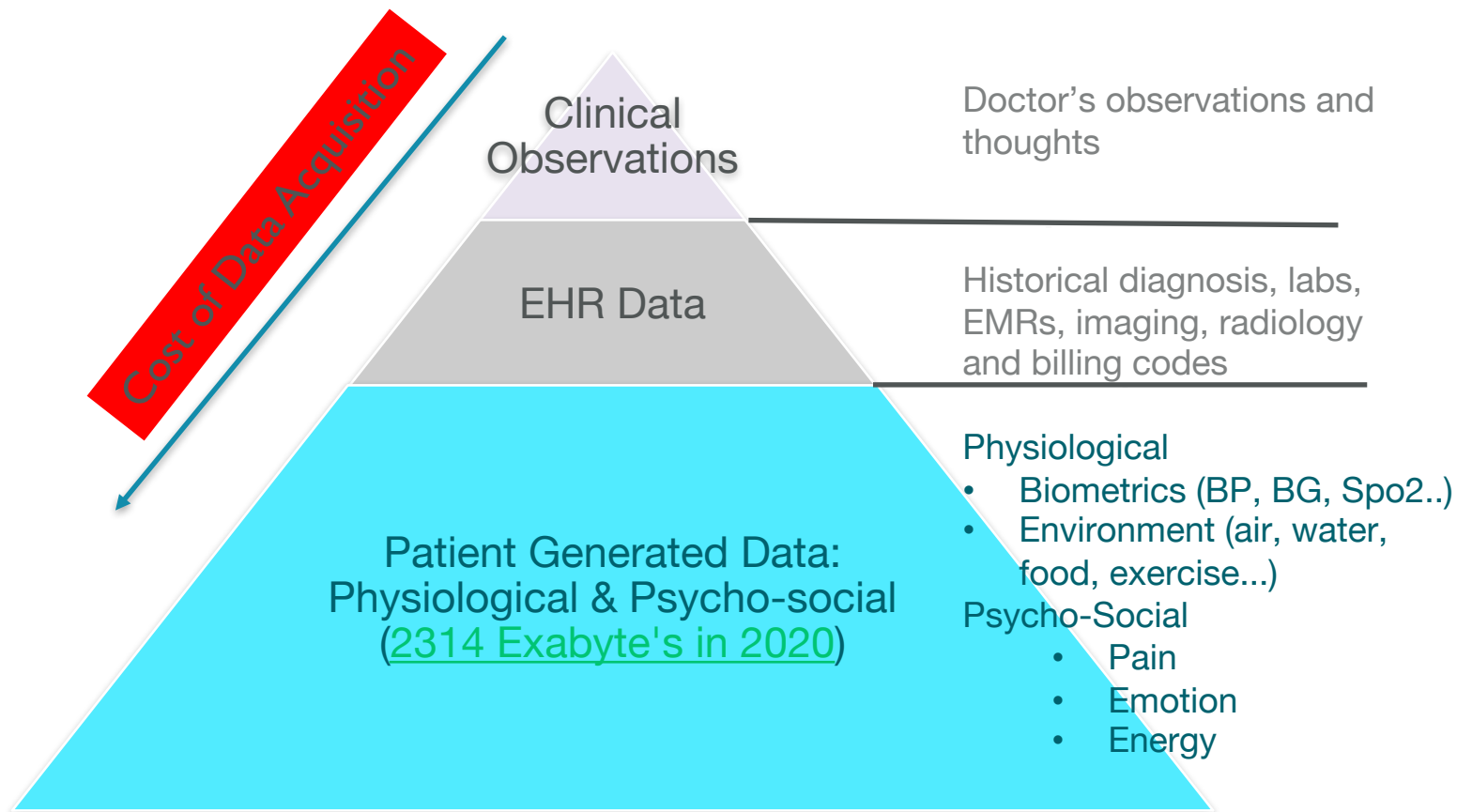**Medically-accurate** (FDA, CE etc.) Vital Signs:

Blood Pressure

+ Heart Rate

+ Respiration Rate

+ Blood Oxygen

+ Body Temperature

+ One-lead ECG

- Small and cheap enough to be incorporated in all smartphones

- Absolute: No calibration required

- SBPS is a regulated medical device. Smartphone is **not** regulated

CBPM

Hardware: Compact Blood Pressure Module™ (CBPM)

15mm

Software – App: Instructions, control, analysis, display, communications

Service – Server: Analysis, storage, sharing

LEMAN MICRO DEVICES

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In 5 years there will be more data outside EHR than in it

Cost of Data Acquisition

Clinical Observations

Doctor's observations and thoughts

EHR Data

Historical diagnosis, labs, EMRs, imaging, radiology and billing codes

Patient Generated Data: Physiological & Psycho-social (2314 Exabyte's in 2020)

Physiological
- Biometrics (BP, BG, Spo2..)
- Environment (air, water, food, exercise...)

Psycho-Social
- Pain
- Emotion
- Energy

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Telemedicine to the rescue

Traditional – FTF Care

TAM: $32.4B → $305B SAVINGS
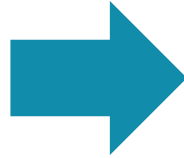
Telehealth via video & phone → 80% efficacy for common ailments*
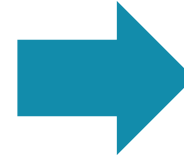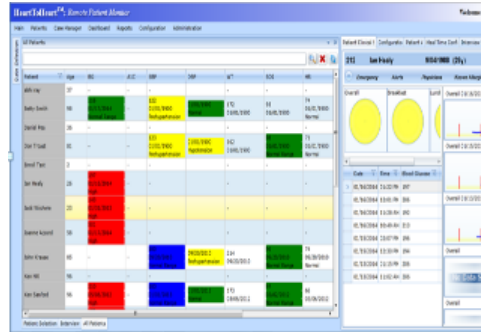
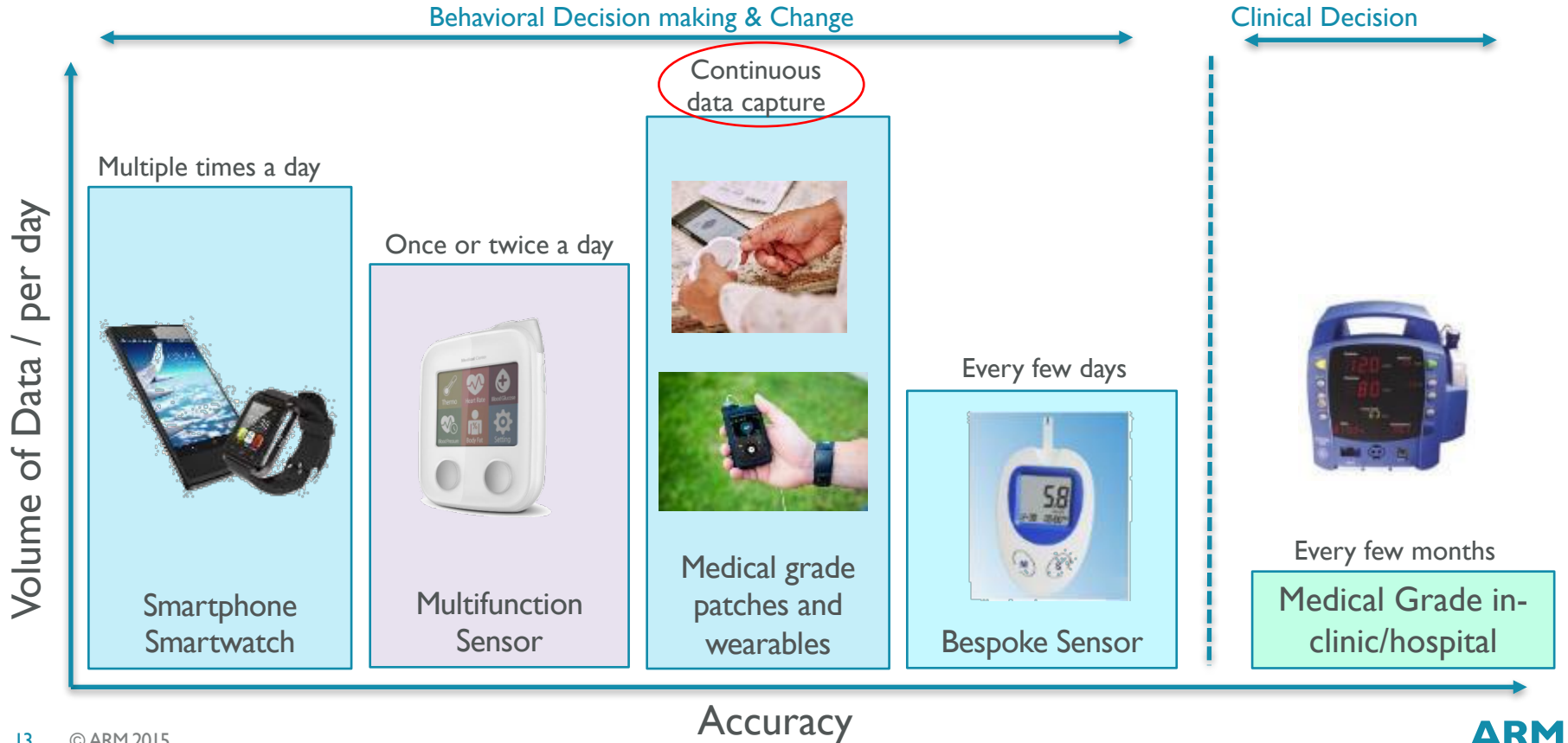Add Remote Monitoring & Diagnostics → 95%+ efficacy for common ailments*

■ Remote Monitoring ■ Telehealth ■ Behavioral Modification

18%
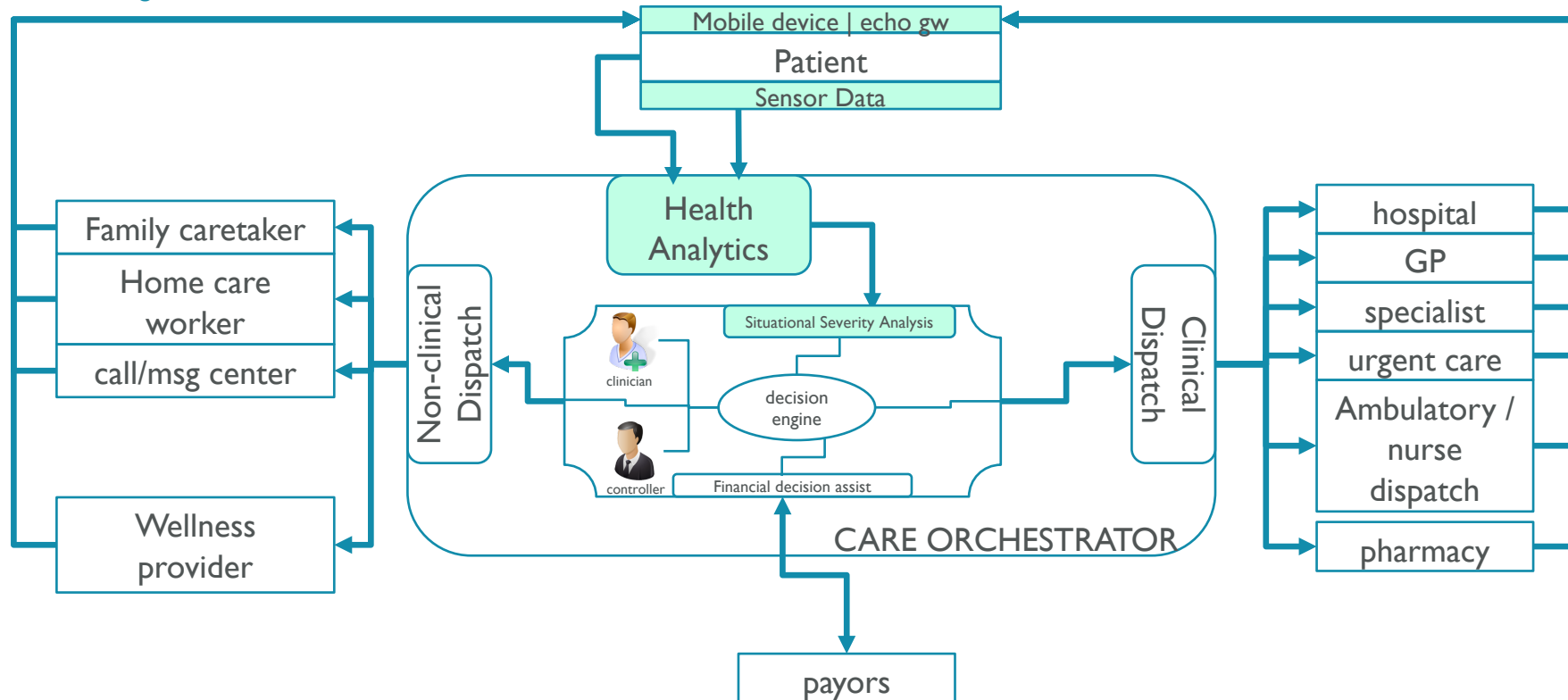
45%

37%
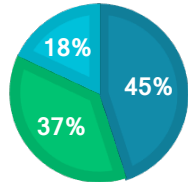
Clinical Dash boarding for managing patient populations

Dr. John Smith

© ARM 2015

** Source: Goldman Sachs

*Source: Dr. Dan Davis, CEO Healthcare Interactive Care technologies

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Medical data: Quantity vs. Quality

Behavioral Decision making & Change — Clinical Decision

Volume of Data / per day

Multiple times a day

Once or twice a day

Continuous data capture

Every few days

Every few months

Smartphone Smartwatch

Multifunction Sensor

Medical grade patches and wearables

Bespoke Sensor

Medical Grade in-clinic/hospital
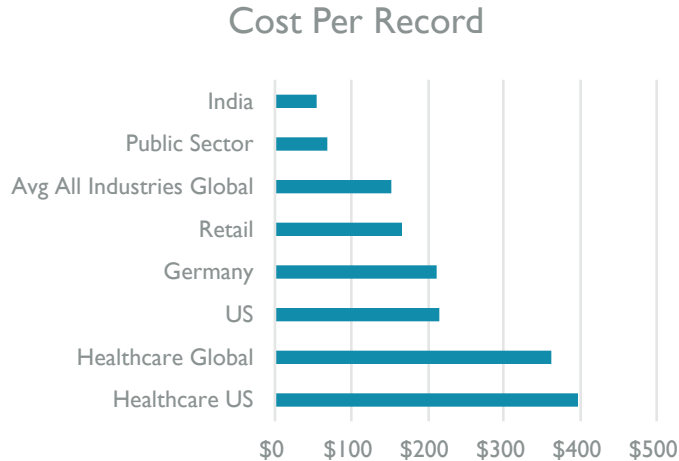
Accuracy

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Care orchestration & workflow automation

driving towards better health outcomes at a lower cost

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Why should we care about security & health?

Matter of Life and Death

Cost Per Record

Category	Cost
India	~$50
Public Sector	~$70
Avg All Industries Global	~$150
Retail	~$170
Germany	~$210
US	~$215
Healthcare Global	~$360
Healthcare US	~$400

$0 $100 $200 $300 $400 $500
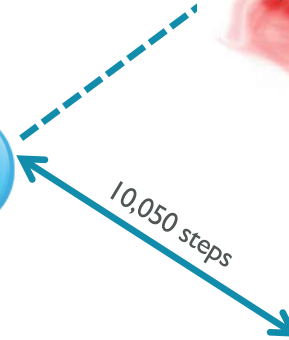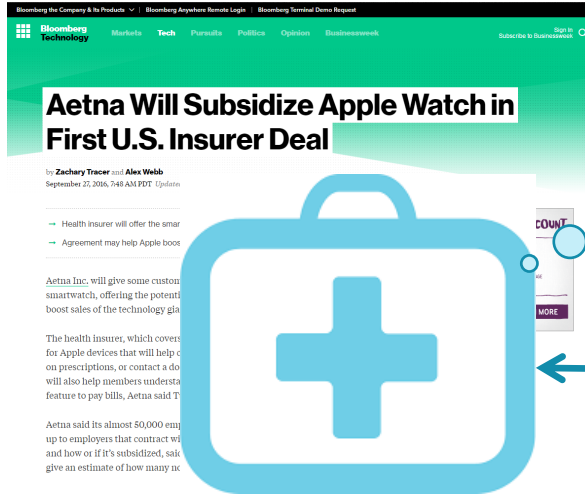
* Source: Ponemon Institute Sponsored by IBM

Black Hat hacker details lethal wireless attack on insulin pumps

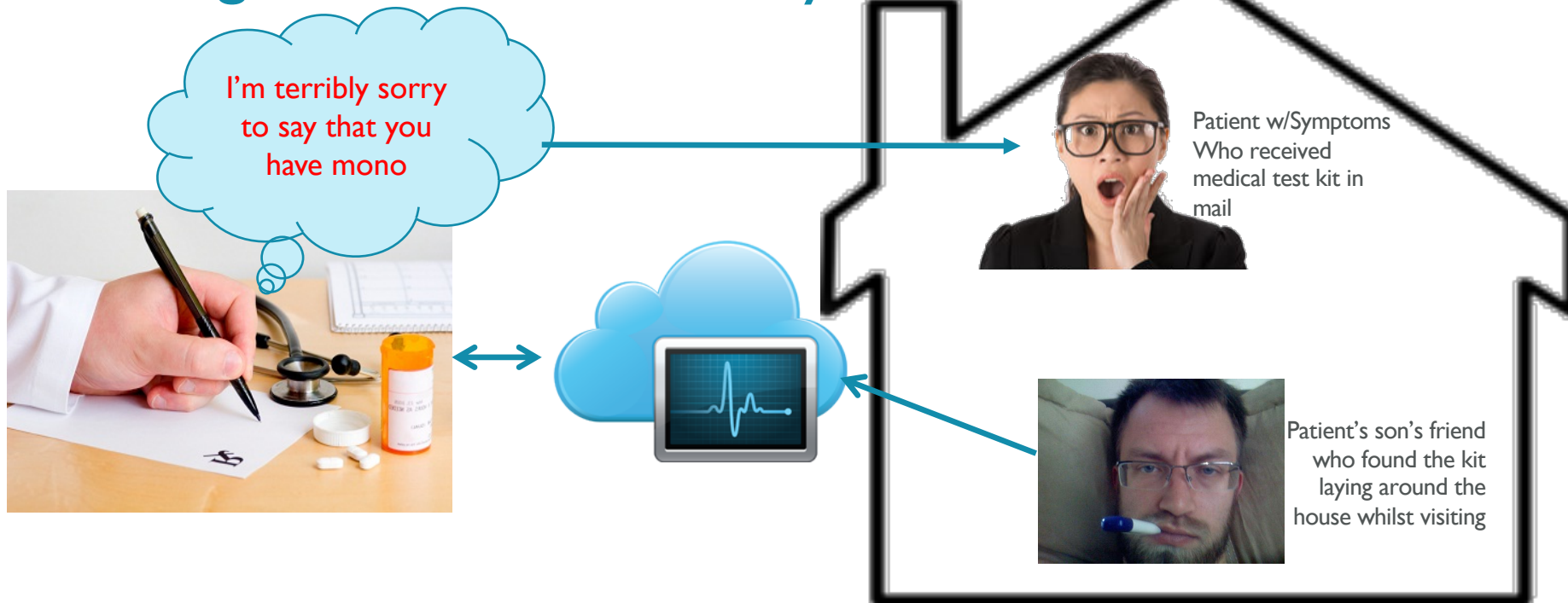[Researchers hack pacemaker, kill a man(nequin)](#)

Hacking the Heart

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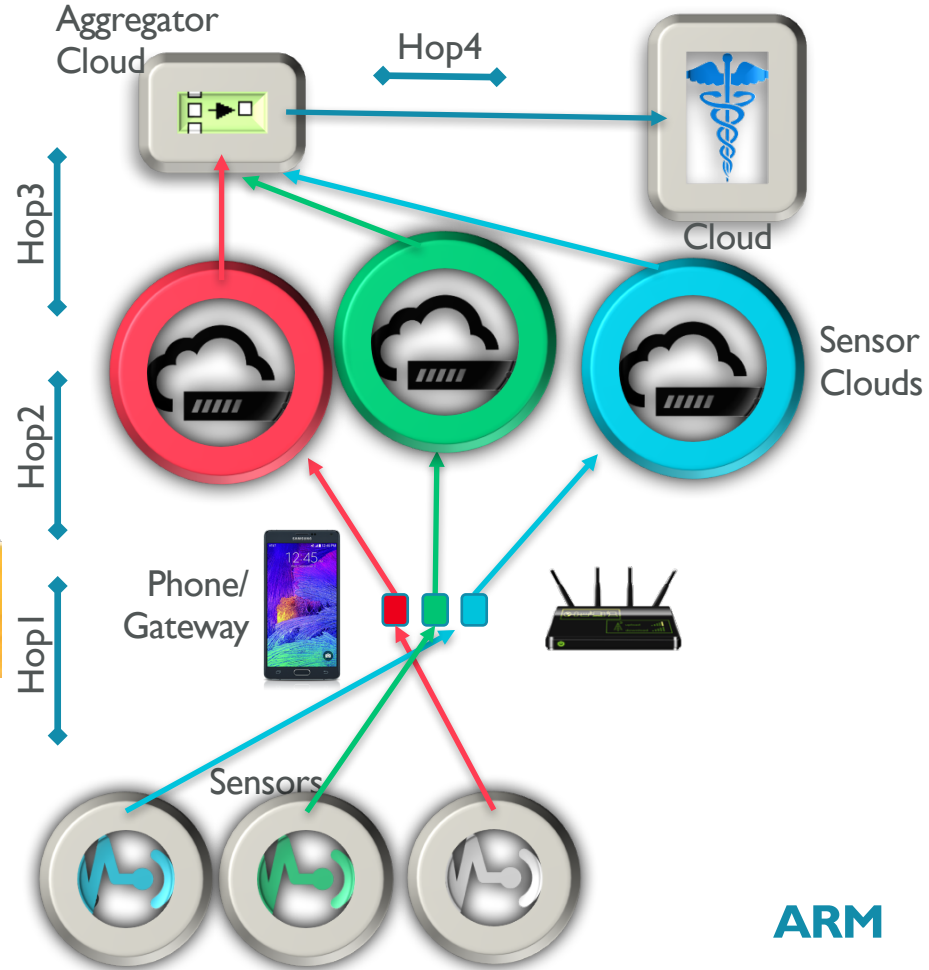# Fraud Prevention: Insurers require data + identity

© ARM 2015

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Misdiagnosis: data + identity are critical

I'm terribly sorry to say that you have mono

Patient w/Symptoms Who received medical test kit in mail

Patient's son's friend who found the kit laying around the house whilst visiting

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Convenience: From diagnosis to treatment in minutes

© ARM 2015

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Today's model for health data acquisition..........

Aggregator Cloud

Hop4

Cloud

Hop3

Sensor Clouds

Hop2

Phone/ Gateway

Hop1

Sensors

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Pre-Requisites for acquiring remote medical data

Elderly Monitoring

Wellness

Care Giver

2. Patient Identity

3. Consent to share

Phone

Gateway

1. Device attestation & application layer encryption

Sensors

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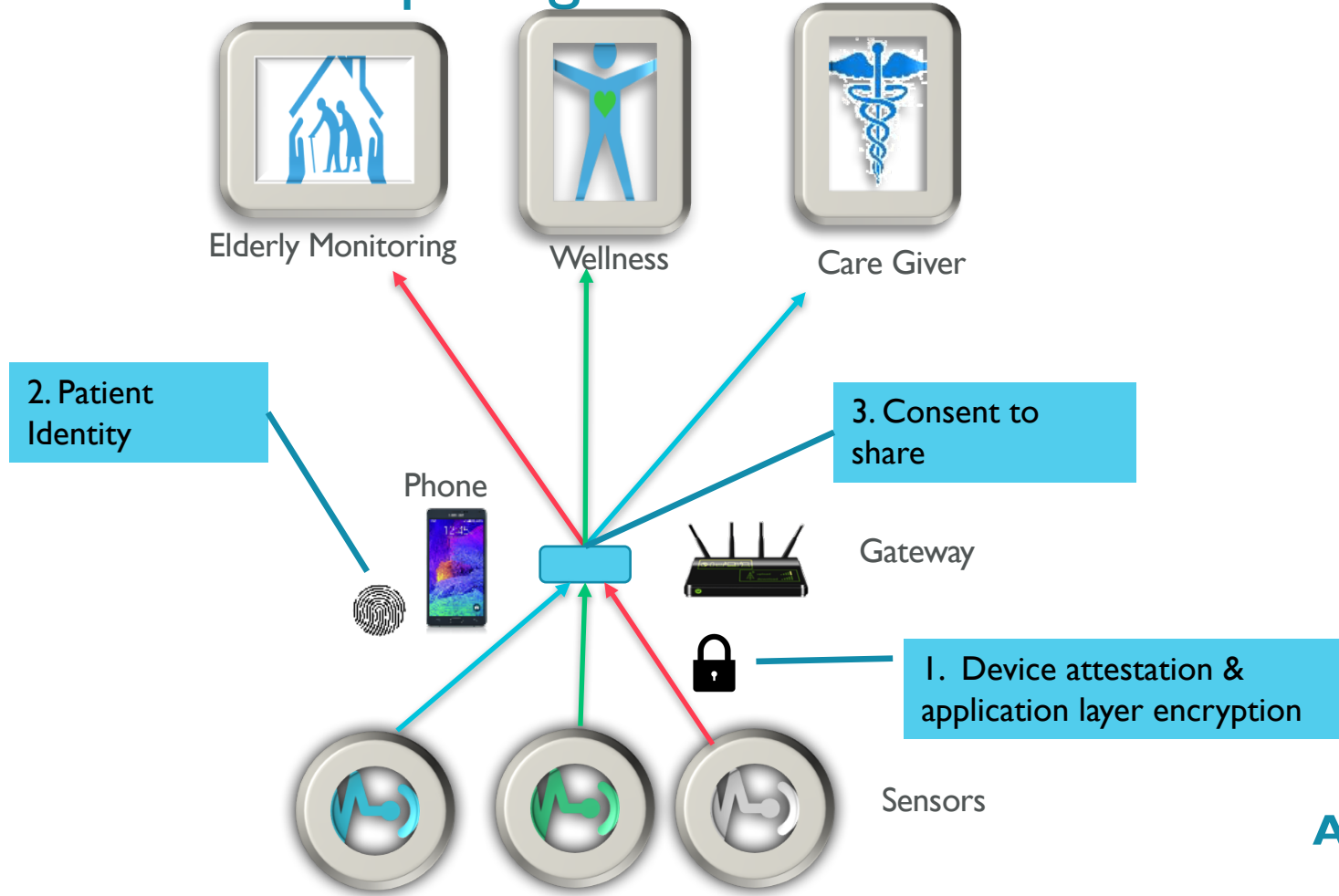
THANK YOU!

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