

The Shape of Things to Come

Medical Devices and The Internet of Things (IoT)

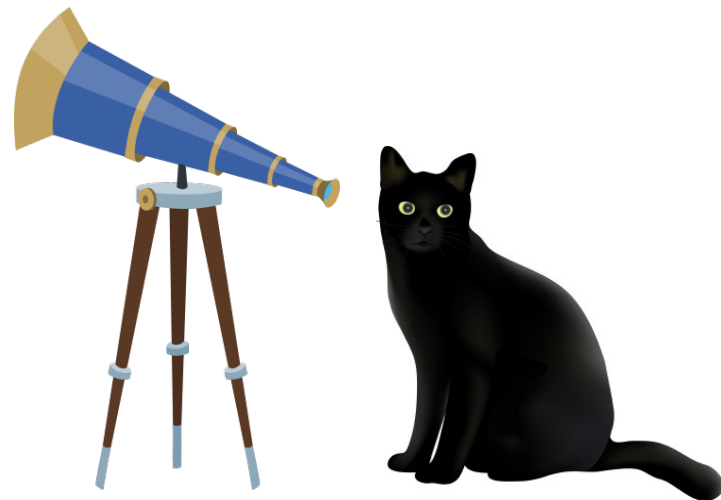
SLA Pharmaceutical & Health Technology Division
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Assumptions & Scope

- Current healthcare challenges
- Basics regarding medical devices, technology, internet
- Pharma industry focus – US focus – Information Pro focus
- Most experience is non-medical device related
- *Disclaimer:* views expressed herein are not that of my employer Teva Pharmaceuticals
- Awkward attempts at humor

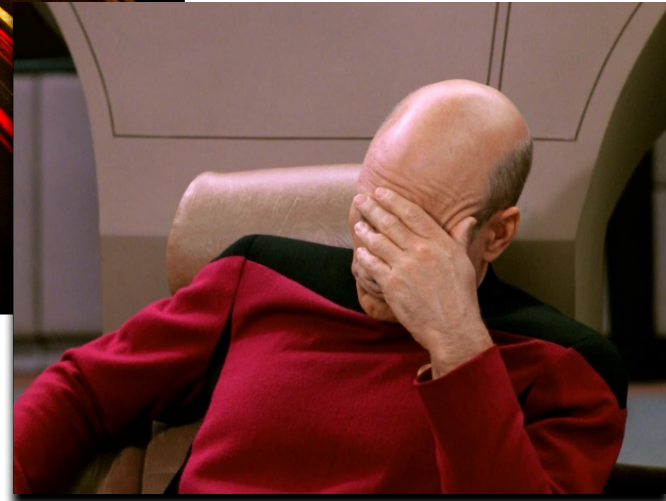
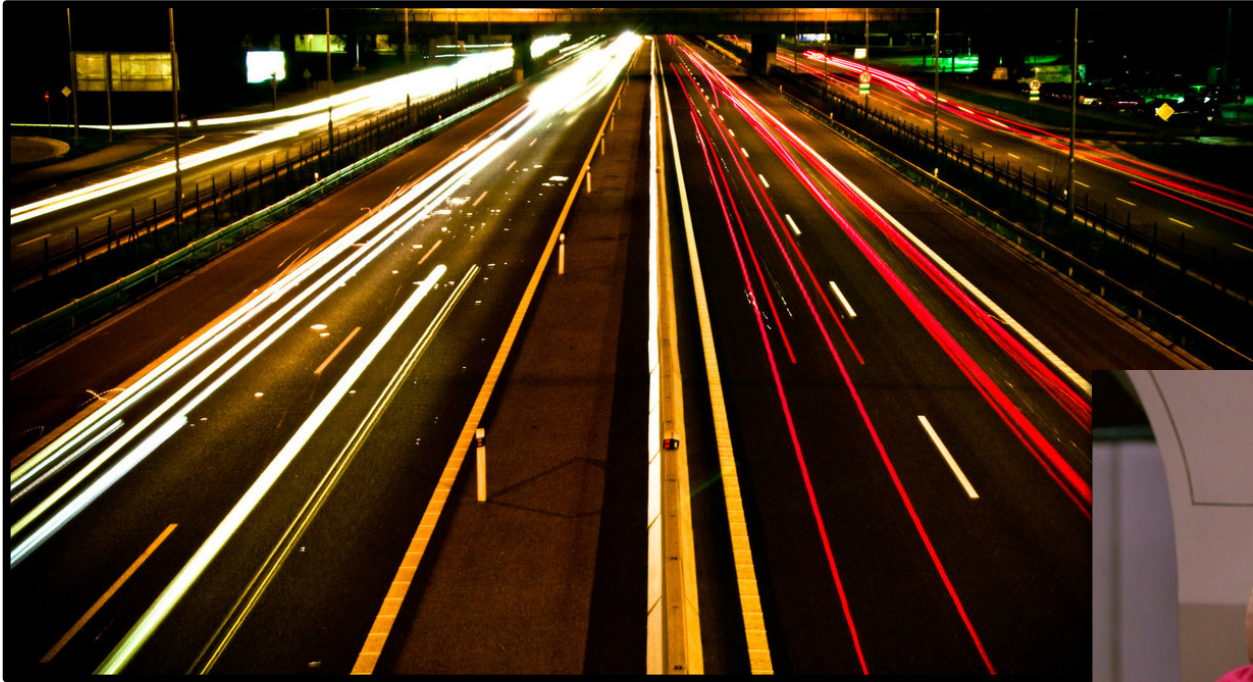


What is Internet of Things (IoT)?

- Wirelessly connected objects that can transmit and receive data
 - Objects are embedded with sensors and other mobile-communication devices
- Sensors interact with aspects of the real world
 - Temperature, light levels, movement, sound
- Users control devices via mobile apps or remotely with sensors
- Data is collected and sent back to users and/or others



The Information Superhighway



IoT & Smart Things: What Can They Do?

- Improve personal daily functions, business activities, research, communities
 - Monitor, track, sense, notify, alert, answer questions, feedback
- Scaled up: smart connected cities
- So many **smart** objects- you are likely using IoT
 - Fitness Trackers (FitBit), Smart Watches (Apple Watch)
 - 25 billion internet connected devices
- IoT is expected to grow dramatically across various industry sectors



Everything Can Be Smart

HiMirror



gaze into your *smart mirror*

SAMSUNG



gather round your *smart refrigerator*

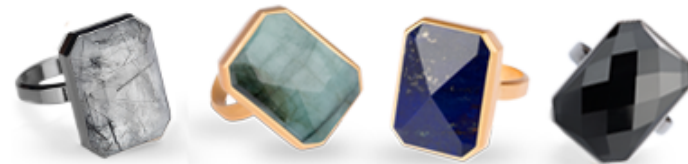


Google Home



talk to your *smart home*

"Play *Stranger Things* on Netflix"
"Set the Nest thermostat to 68 degrees"
"Tell me about my day"
"Where can I get pizza at 2 a.m.?"
"What IS the meaning of life?" *

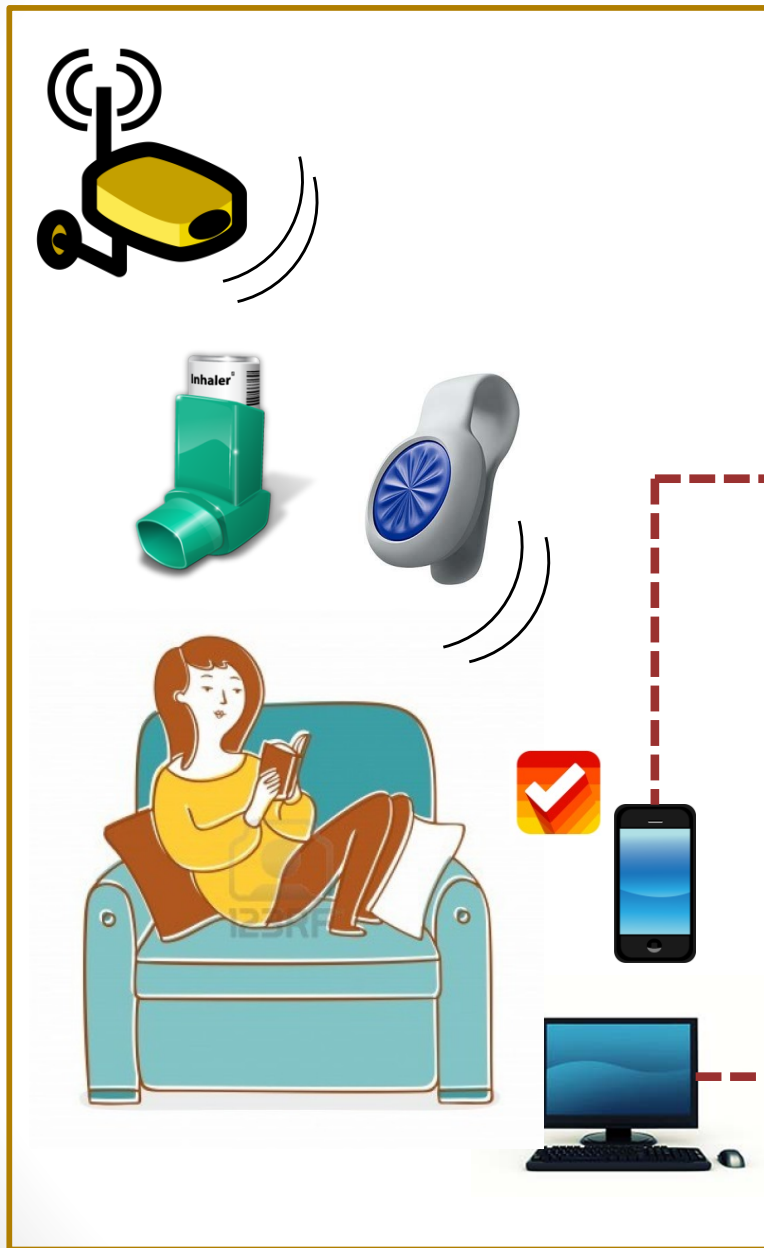


RINGLY
next gen *activity trackers*

Healthcare & IoT

- Network of connected health technologies
 - Monitoring, tracking, collecting *real-time* bio data
- Market estimated to double by 2019
 - larger than the smartphone, PC, tablet, connected car and the wearable device market **combined**. *
- Potential benefits for pharma industry, hospitals and patients
- “Everyone is doing it”
- **TL;DR** saves money, healthier people— because mobile device technology

Patient at Home

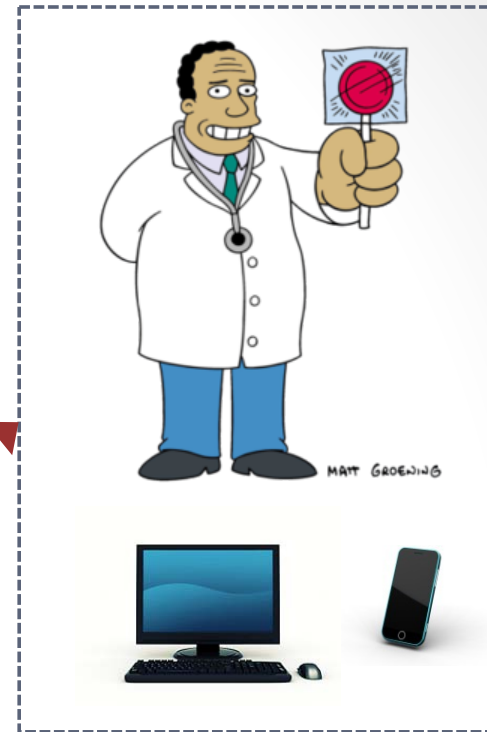


The Cloud

NET

Cell Tower

Healthcare Pros



Caregiver (s)

Potential to Change Healthcare

- Moving away from traditional office-based care model
 - Healthcare ecosystem with patient at the center
 - Care for remote patients, patients with limited mobility
 - Tracking/monitoring real-time (pulse, glucose levels, brain activity)
- Real time chronic disease management
 - Senior citizens may have 3-4 chronic conditions by 85
- Lowered cost of care
- “Personalized healthcare” can drive better outcomes for individuals
 - Patient generated health data (PGHD) incorporated into EHR (electronic health records)
- Analytics of large data sets (Big Data) can lead to better treatments, predictions



Technology is Driving H-IoT

- Mobile device revolution
- Evolution of wearable devices
 - Evolving from activity trackers
 - Half billion by 2019
- Cloud computing of business services
- Sensors becoming smaller, faster, more efficient
- Analytical capabilities for massive data sets (Big Data)



Pharma & eHealth

- IoT: aligns with pharma industry goals and challenges
 - Demonstrating patient value
 - Push toward personalized medicine
 - Clinical trial improvement, efficiency, accuracy
 - HEOR benefits from data analytics, improve patient outcomes
- Partnerships: pharma, IT, nonprofit, gov't, hospital networks
 - Teva Pharmaceuticals + IBM Watson
 - Develop cognitive technologies and systematic approach to drug repurposing and new drug discovery – CNS and Respiratory
 - Medtronic + IBM Watson + International Diabetes Foundation (SugarWise app)

Development Platforms

- **Apple's *ResearchKit* and *CareKit***
 - iPhone/iPad/Apple Watch app development frameworks
 - *ResearchKit* is for medical researchers development



- **IBM Watson's Health Cloud**
 - Cognitive health data platform captures individual insights, total health picture

Mobile Apps

- **mPower** – Parkinson's study
- **EpiWatch** – epileptic seizure prediction
- **Diabetes Care**
- **genieMD**
- **SugarWise**

H-IoT Examples

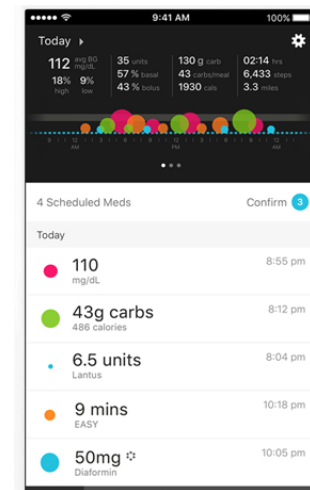


- **VitalPatch** “bionic band-aid”
- biosensor that monitors 8 vital signs
- Patients, doctors, hospital staff can access real-time data
- Hospital use, home use



ONE DROP

- Diabetes management for iPhone, Android
- Blood glucose monitoring
- Apple CareKit
- Version with HCP remote patient monitoring platform



Challenges

- Regulations and Standards
 - Numerous IT, data, communication standards
 - Geography, devices themselves
- Security
 - HIPPA, privacy, anonymity, hacking
 - Who owns the data? Patient consent
- Data accuracy
- Interoperability: foundation, structure, semantics
 - Incompatible technology platforms
 - Many ontologies – difficult to map
- Patients need mobile devices and soft tech skills
 - Only 15% of smartphone users over 65 have downloaded an app
 - Economic status
- Must demonstrate **real value**
 - Beyond “lifestyle activity” measurements
 - Most critical therapy areas
 - Integrate, sustainable, empower human health
- ROI will take time

IoT Information Support

News Sources

- **FirstWord MedTech Plus** (FirstWord)
 - Top Stories, Trends, Conferences
- **MedTech Insight**(Informa)
 - formerly *The Gray Sheet*
- **mHealthIntelligence** (Xtelligent Media Network)
 - Mobile-and-telehealth focus
 - Network includes Health IT, Health Analytics, Security, EHRs
 - Whitepapers and webcasts
- **MD + DI: Medical Device and Diagnostic Industry** (UBM Cannon)
 - Mobile Health channel
- **SmartBrief newsletters**
 - Health IT, MMA for Apps, MTC SmartBrief (Big Data, digital IT)



More Sources

- **FDA** – Center for Devices & Radiological Health
 - Efforts to clarify regulatory strategy and policy of FDA approved devices with sensors
 - [FDA: Medical Devices & Digital Health](#)
 - FTC's Mobile Health Interactive Tool
- **Journals** (non-exhaustive)
 - The Internet Journal of Medical Technology
 - The Journal of Mobile Technology in Medicine
 - Journal of Medical Science and Technology
 - Journal of Medical Internet Research
 - Big Data
 - Artificial Intelligence in Medicine

Literature Searching

- Medline/PubMed: MeSH
 - Fitness Trackers (under Diagnostic Equipment)
 - Electronic Health Records
 - Internet – Utilization
 - Mobile Applications
 - Telemetry
 - Wireless Technology
- Multidisciplinary databases
 - Scopus, Web of Science
 - Coverage in Engineering, Materials Science, Technology
- Embase: Emtree
 - Accelerometry
 - Activity Tracker (under Sports Equipment)
 - Biosensor
 - Cloud Computing
 - Internet
 - Mobile Application
 - Sensor
 - Smart Phone
 - Telemonitoring
 - Wireless Communication

References

- [Hi Mirror](#) *smart mirror*
- [Google Home](#)
- [Wearable Biosensor Can Flag Illness](#)
- [Teva Pharmaceuticals and IBM Expand Global Partnership](#) (Press Release Oct 2016)
- [Medtronic Leveraging IBM Watson's in Diabetes App](#)
- [Study Find the Best Medical Adherence Apps](#)
- [List of all ResearchKit Apps](#)
- [genieMD](#)
- [VitalPatch](#)
- [One Drop](#)
- [Apple Watch for Corporate Wellness](#)
- [MedTech Insight](#) *Pharma & MedTech Business Intelligence*
- [FirstWord MedTech](#) *FirstWord*
- [Xtelligent Media Network](#)
- [MD + DI](#)
- [SmartBrief industry newsletters](#)
- [FDA: Medical Devices & Digital Health](#)