FROST & SULLIVAN

Role of IOT and Wearables in Healthcare

Jan 19th, 2018

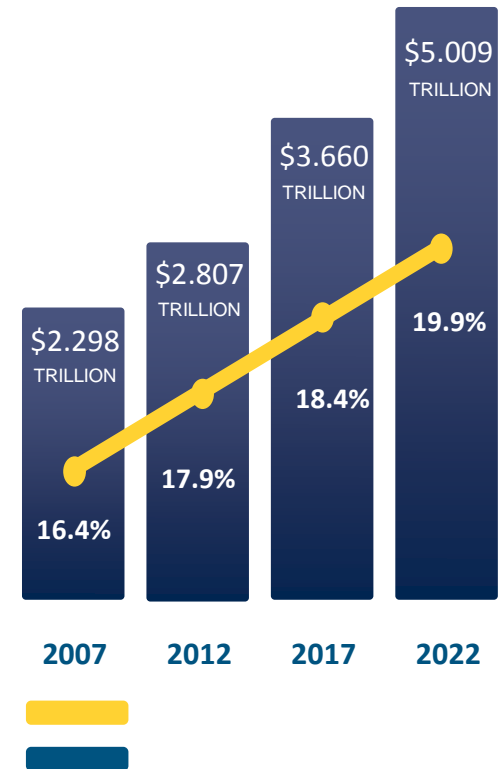# A Global Healthcare Crisis

Chronic Diseases

- **40 of the 56 million annual deaths** globally occur from preventable chronic conditions such as cardiovascular disease, cancer, and chronic respiratory conditions

- 80% of all **heart disease, diabetes, and stroke**, and 40% of **cancers** can be prevented by optimizing risk factors including **obesity, hypertension, sedentary activities, poor nutrition, and tobacco and alcohol use**

Aging Population

- In the US, more than **3.5 million seniors** are turning **65 every year**, with **90%** having at least one chronic condition

- **80%** of Medicare costs result from **20% of the patients,** who are **elderly,** with **multiple comorbidities** such as diabetes, COPD, or congestive heart failure

*US Healthcare Costs**

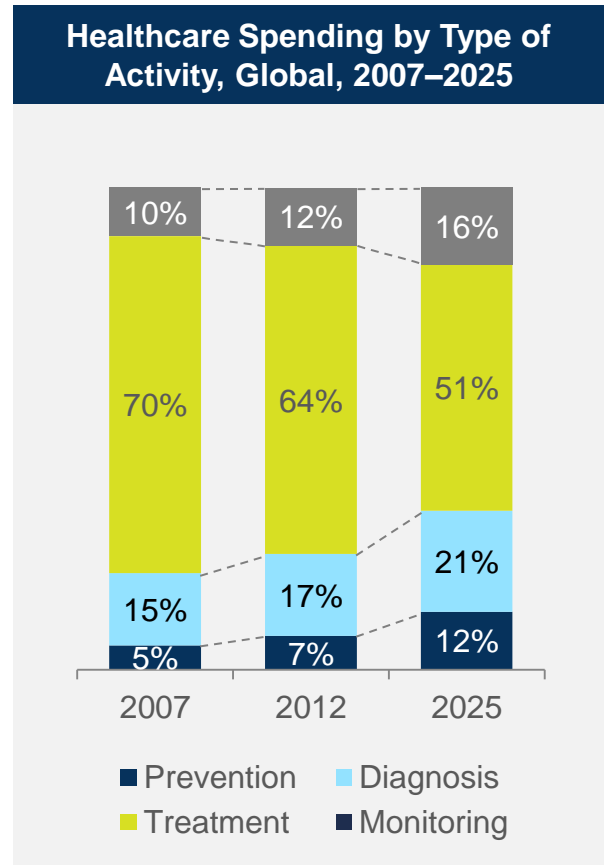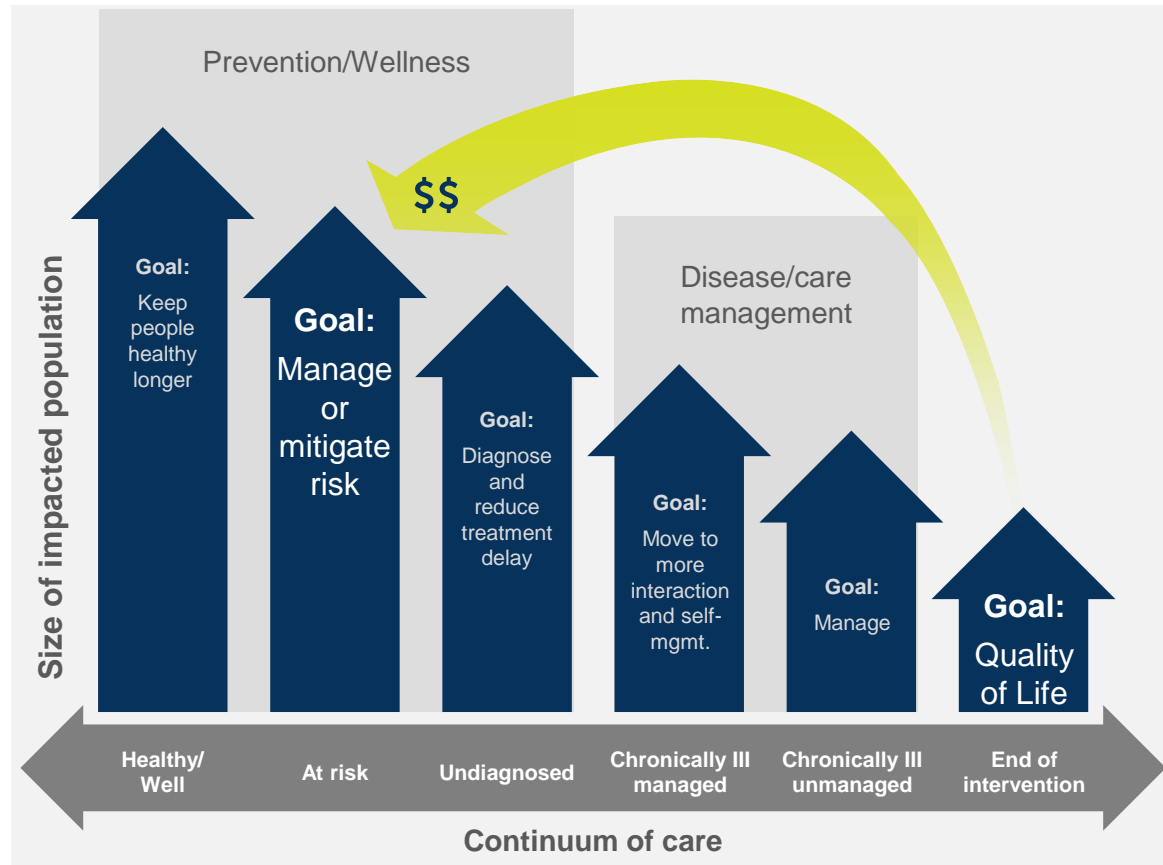| Year	Cost	Percentage
2007	$2.298 TRILLION	16.4%
2012	$2.807 TRILLION	17.9%
2017	$3.660 TRILLION	18.4%
2022	$5.009 TRILLION	19.9%

*CMS--National Health Expenditure Projections 2012-2022 / Lancet Global Burden of Disease 2015 / World Health Organization / CDC

Changing the Cost Curve: People want Health, not Healthcare

Shift of Focus–and Investments–from Acute Care to Prevention

Prevention/Wellness

Disease/care management

$$

Size of impacted population

Goal: Keep people healthy longer

Goal: Manage or mitigate risk

Goal: Diagnose and reduce treatment delay

Goal: Move to more interaction and self-mgmt.

Goal: Manage

Goal: Quality of Life

Healthy/Well | At risk | Undiagnosed | Chronically Ill managed | Chronically Ill unmanaged | End of intervention

Continuum of care

Healthcare Spending by Type of Activity, Global, 2007–2025

	2007	2012	2025
Monitoring	10%	12%	16%
Treatment	70%	64%	51%
Diagnosis	15%	17%	21%
Prevention	5%	7%	12%

- Prevention
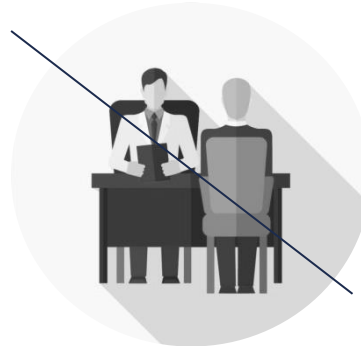- Diagnosis
- Treatment
- Monitoring

Source: Frost & Sullivan

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Access to Healthcare Today–Inefficient and Expensive

John has light fever with a sore throat; he suspects it is strep throat.

He realizes that his primary care physician is not available now–it is a Saturday evening. Besides, he first needs to make an appointment on Monday.

He needs to attend an important meeting on Monday. Reluctantly, with no other option, he heads for the ER.

7.45 p.m.
Doctor's Office Closed
ER Open

5 miles
Distance from Home

2 hours
Time in ER
+ 20 min for prescription

$350
Cost incurred

Note: Illustrative distance, time, and costs. Representative example for the US region. Source: Frost & Sullivan

What it Could be–Anytime, Anywhere, and Cheaper

INSTANT HEALTHCARE

Virtual office visits reduce wait time

CONTINUOUS HEALTHCARE

Information is transmitted and shared in real-time between individuals and caregivers

ERROR FREE HEALTHCARE

Sensors, real-time analytics improve diagnoses, reduce procedural errors, and errors in medication administration

MY HEALTHCARE

Care will increasingly be customized to fine-tune the approach to the individual and their family

COST-EFFECTIVE HEALTHCARE

The most innovative companies improve quality while collapsing extraneous outdated processes and cost

COMMUNITY CARE

SPECIALTY TREATMENT CENTERS

HEALTHCARE EVERYWHERE

WELLNESS SUPPORT

AGING IN PLACE

SPECIALITY CLINICS

RETAIL/COMMERCE

TECHNOLOGY AUTOMATION

Can IoT Tackle Some of Healthcare's Biggest Challenges?

ACCESS

- **31,000** Current shortage of primary care physicans
- **40%** Individuals who do not schedule annual well checkups
- **29 days** Average wait time to schedule appointment with a specialist
- **27%** Individuals who experienced medical records coordination problems

QUALITY

- **400,000** Number of annual deaths due to preventable medical errors
- **5%** Outpatient encounters that are misdiagnosed
- **10%-20%** surgeries performed yearly, and later deemed medically unnecessary
- **17%** patient discharges which result in readmissions

COST

- **2 M** Number of Americans filing bankruptcy each year due to medical bills
- **$1,200** Average in network deductible
- **$750 B** Approximate annual healthcare spend on needless or avoidable care
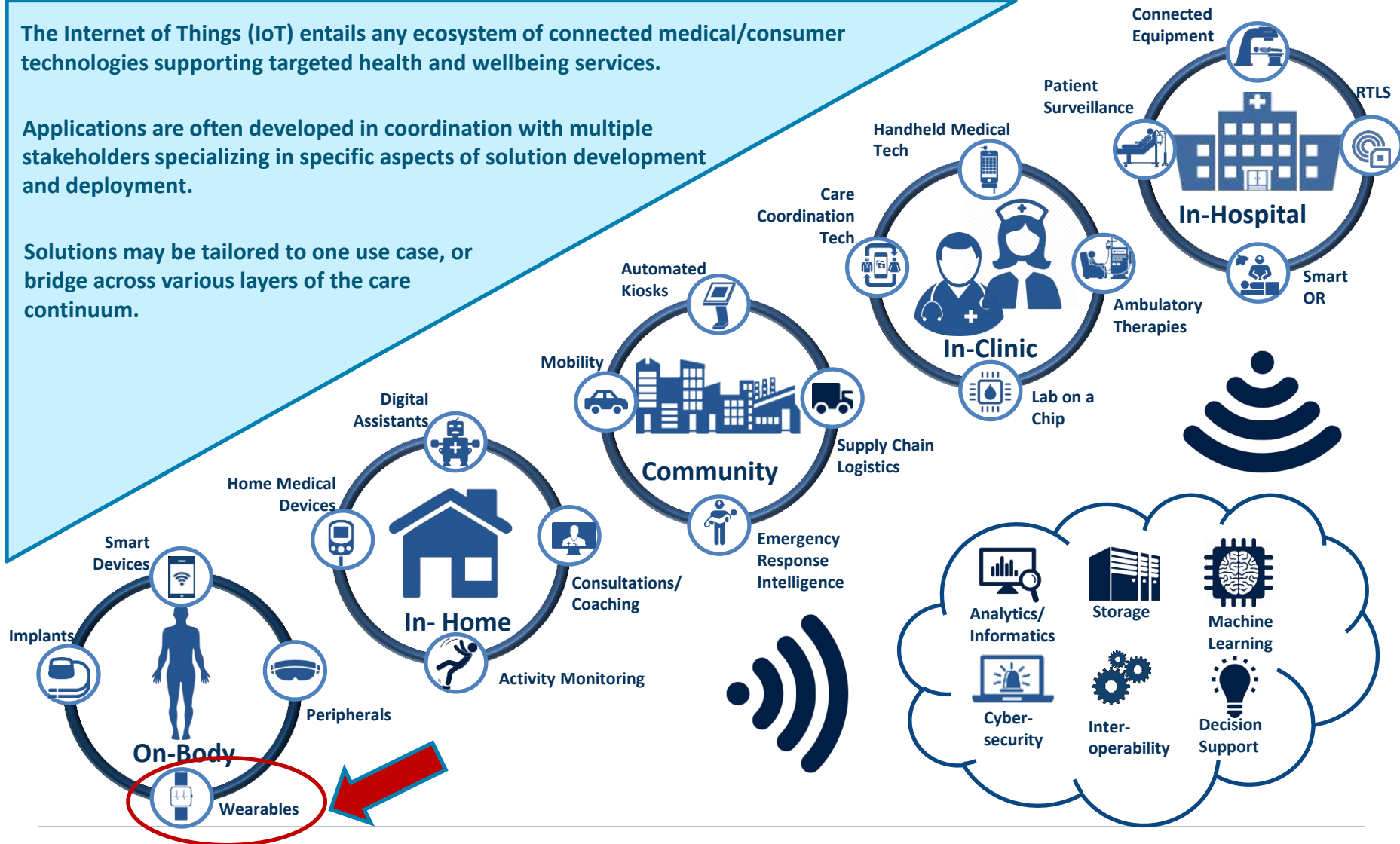- **5%** Patients who account for 50% of Medicaid program spend

Cost, quality, and access issues continue to plague the current care system, with the most recently enacted initiatives (reimbursement cuts, PPAC, etc.) failing to significantly reverse trend lines.

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The Internet of Things Ecosystem

The Internet of Things (IoT) entails any ecosystem of connected medical/consumer technologies supporting targeted health and wellbeing services.

Applications are often developed in coordination with multiple stakeholders specializing in specific aspects of solution development and deployment.

Solutions may be tailored to one use case, or bridge across various layers of the care continuum.
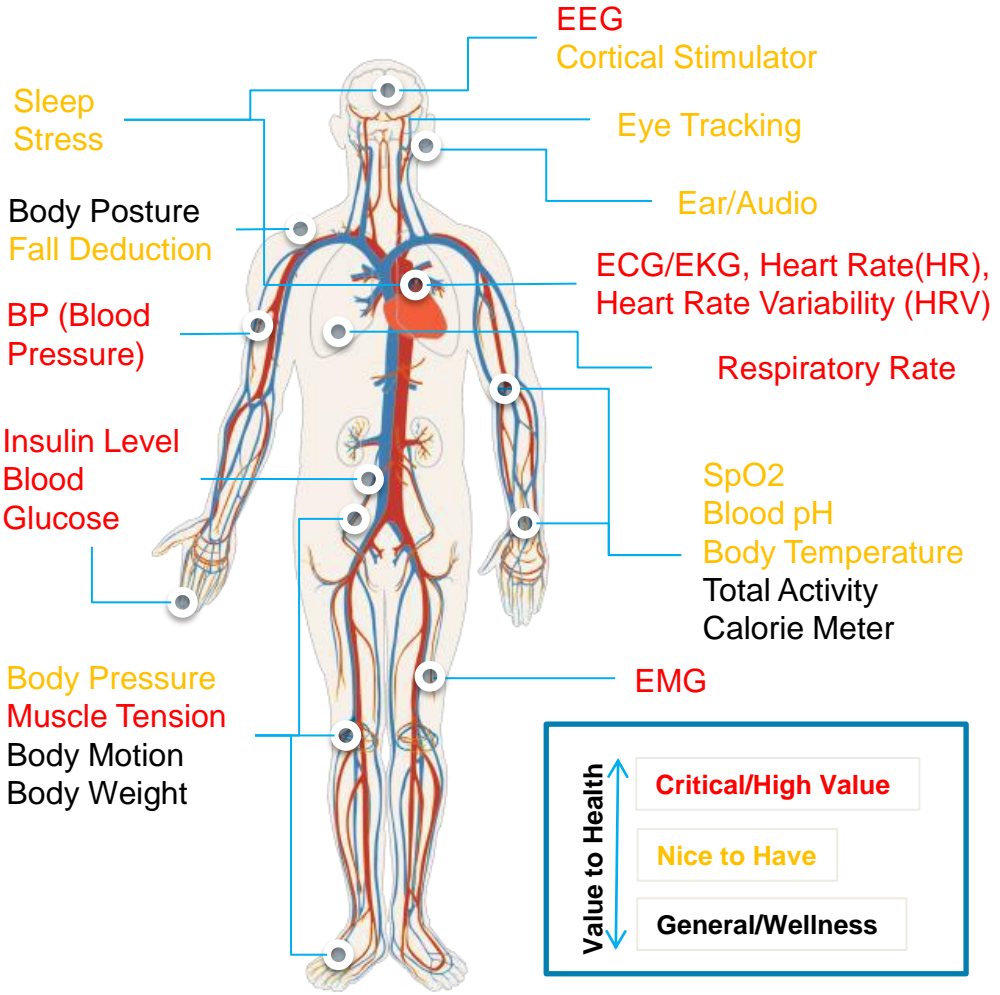
Connected Equipment

Patient Surveillance

Handheld Medical Tech

RTLS

In-Hospital

Care Coordination Tech

In-Clinic

Smart OR

Ambulatory Therapies

Lab on a Chip

Automated Kiosks

Mobility

Community

Supply Chain Logistics

Digital Assistants

Home Medical Devices

In- Home

Consultations/ Coaching

Emergency Response Intelligence

Activity Monitoring

Smart Devices

Implants

On-Body

Peripherals

Wearables

Analytics/ Informatics

Storage

Machine Learning

Cyber-security

Inter-operability

Decision Support

Role of Wearables in Healthcare
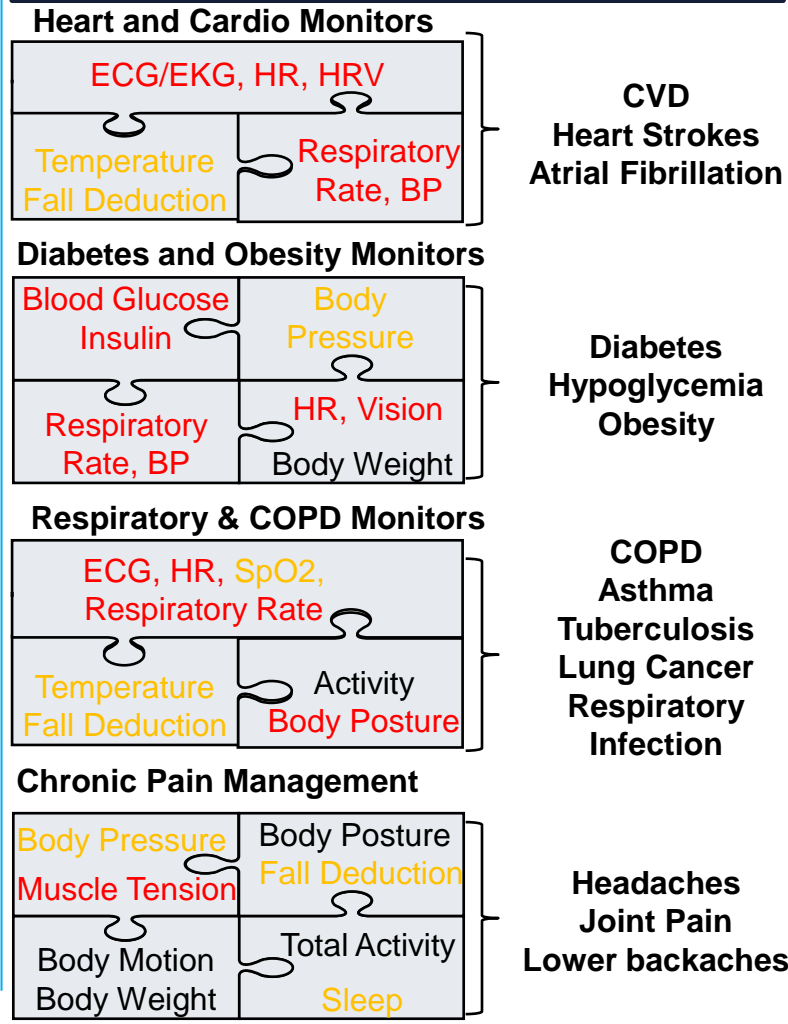
What do we Track? When, Where, and How?

The human body is a tremendous source for a variety of vital signs–a biological data generating System.
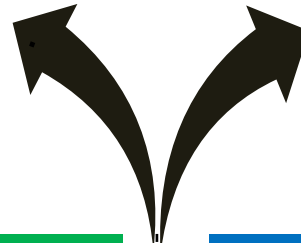
Harnessing Human Body Data/Biometrics

EEG
Cortical Stimulator

Eye Tracking

Ear/Audio

Sleep
Stress

Body Posture
Fall Deduction

ECG/EKG, Heart Rate(HR),
Heart Rate Variability (HRV)

BP (Blood Pressure)

Respiratory Rate

Insulin Level
Blood
Glucose

SpO2
Blood pH
Body Temperature
Total Activity
Calorie Meter

Body Pressure
Muscle Tension
Body Motion
Body Weight

EMG

Value to Health (↑↓)
- Critical/High Value
- Nice to Have
- General/Wellness

Major Therapeutic Focus

Heart and Cardio Monitors

ECG/EKG, HR, HRV	
Temperature Fall Deduction	Respiratory Rate, BP

**CVD
Heart Strokes
Atrial Fibrillation**

Diabetes and Obesity Monitors

Blood Glucose Insulin	Body Pressure
Respiratory Rate, BP	HR, Vision Body Weight

**Diabetes
Hypoglycemia
Obesity**

Respiratory & COPD Monitors

ECG, HR, SpO2, Respiratory Rate	
Temperature Fall Deduction	Activity Body Posture

**COPD
Asthma
Tuberculosis
Lung Cancer
Respiratory
Infection**

Chronic Pain Management

Body Pressure Muscle Tension	Body Posture Fall Deduction
Body Motion Body Weight	Total Activity Sleep

**Headaches
Joint Pain
Lower backaches**

Wearables–Shifting Focus to Clinical Over Consumer Health

Consumer Health Applications

- Intended for maintaining or encouraging a general state of wellness or healthy activity

- Considerably large market with a large number of players

- Less regulated market, facilitating easier entry; but very competitive

- Due to a large variety of solutions, it is very tough to make consumers stick to a particular device

- Newer technologies with consumer-centric and secure interfaces expected to easily overtake existing players in the ecosystem

Medical or Clinical Use Applications

- Useful for a medical professional to diagnose or influence course of care decisions

- The market is new and slow moving with a limited number of players

- Considerable regulations and stringent norms; difficult to enter

- Once entered with apps providing accurate medical information, secure user interfaces, and private health data securities, players can gain significant market share in a shorter period of time

- Fees can be paid by insurers and thus expected to be more regularly used by users

Source: Frost & Sullivan

Wearables Targeting Specific Health Needs

Brain Health and Neuro Monitoring
- halo neuroscience
- Thync — How good feels
- muse — the brain sensing headband
- evena MEDICAL Eyes-On
- FiT FORCE IMPACT TECHNOLOGIES
- Cerora

Respiratory/Sleep Monitoring
- Kokoon
- sleep image
- Airing
- adamm — Health Care Originals
- SUNSPRITE — GoodLux Technology

Mother and Infant Care
- iSono Health
- PregSense — Nuvo Group
- Ultra Stan
- Modoo
- bloom TECHNOLOGIES
- OWLET BABY MONITORS
- SMART DIAPER Pixie Scientific
- Sensible Baby
- Sproutling
- CYRCADIA HEALTH
- mimo

Cardio and Multi-Parameter Monitoring
- VITALITI CLOUD DX
- HealthPatch MD
- vitalconnect
- ViSi Mobile
- Sotera WIRELESS
- ezon
- B.O.L.T One-touch wireless health tracker
- infra
- biovotion bodymanagement
- echolabs
- Withings Inspire health
- SCANADU

Pain Management & Wound Care
- Quell
- ViMove dorsaVi
- valedo
- PulseRelief
- SURROSENSE RX ORPYX
- Ulcer Sensor Leaf Healthcare

Aging in Place (Elderly Care)
- BALANSENS BioSensics
- GoSafe
- Simple
- Tempo
- activeprotective
- UnaliWear — Extending independence with dignity
- TZOA ENVIRO-TRACKER
- vega gps bracelet
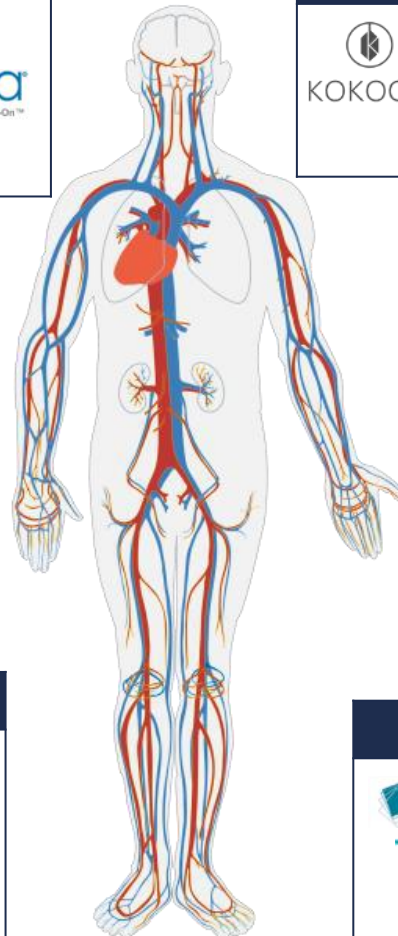
Top 10 Segments for Medical-Grade Wearables

Multi-Parameter RPM

Chronic Pain Management

Heart & CVD

Sleep Disorders

Diabetes and Obesity

Top 10 Clinical Wearable Categories

Neurological & Mental Health

Respiratory & COPD

Women's Health

Aging in Place

Pediatric Health
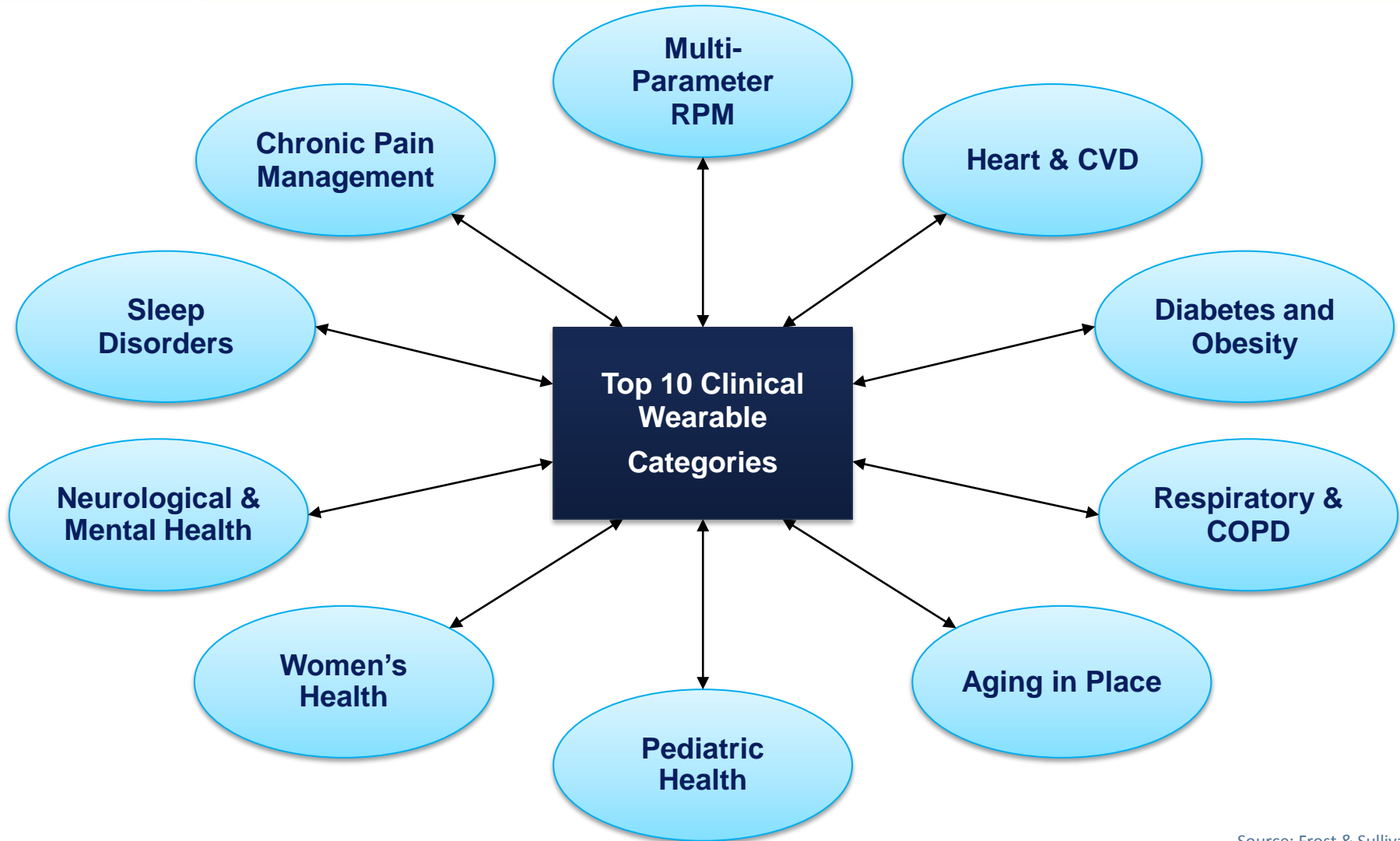
# Consumer Perception–Wearables for Health and Wellness

Increasing millennial adoption of digital health will shift the value proposition of wearables from complex products to simple consumer-centric information services, empowering individuals for self-health management.

Healthcare Wearables Segment: Consumer Adoption by Age and Gender, US, 2016

Male
- 19%
- 36%
- 45%

Female
- 13%
- 37%
- 50%

Overall (n=1,500)
- 16%
- 36%
- 48%
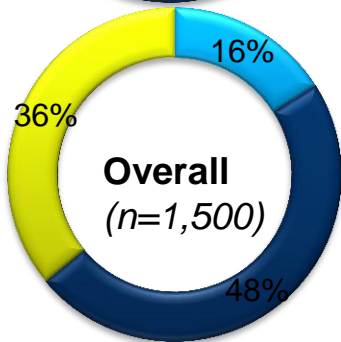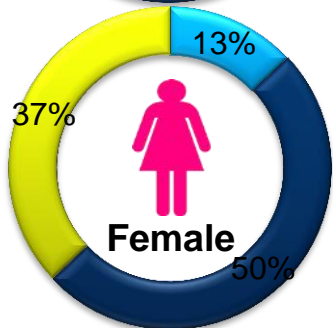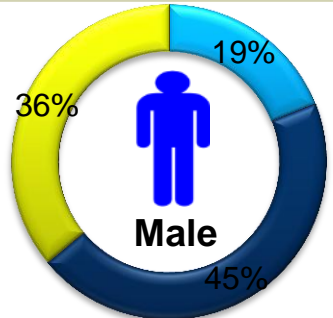
> Interest in using wearable sensors in the future is strong among both men and women. The younger age groups report the highest use and future interest in wearable sensors.
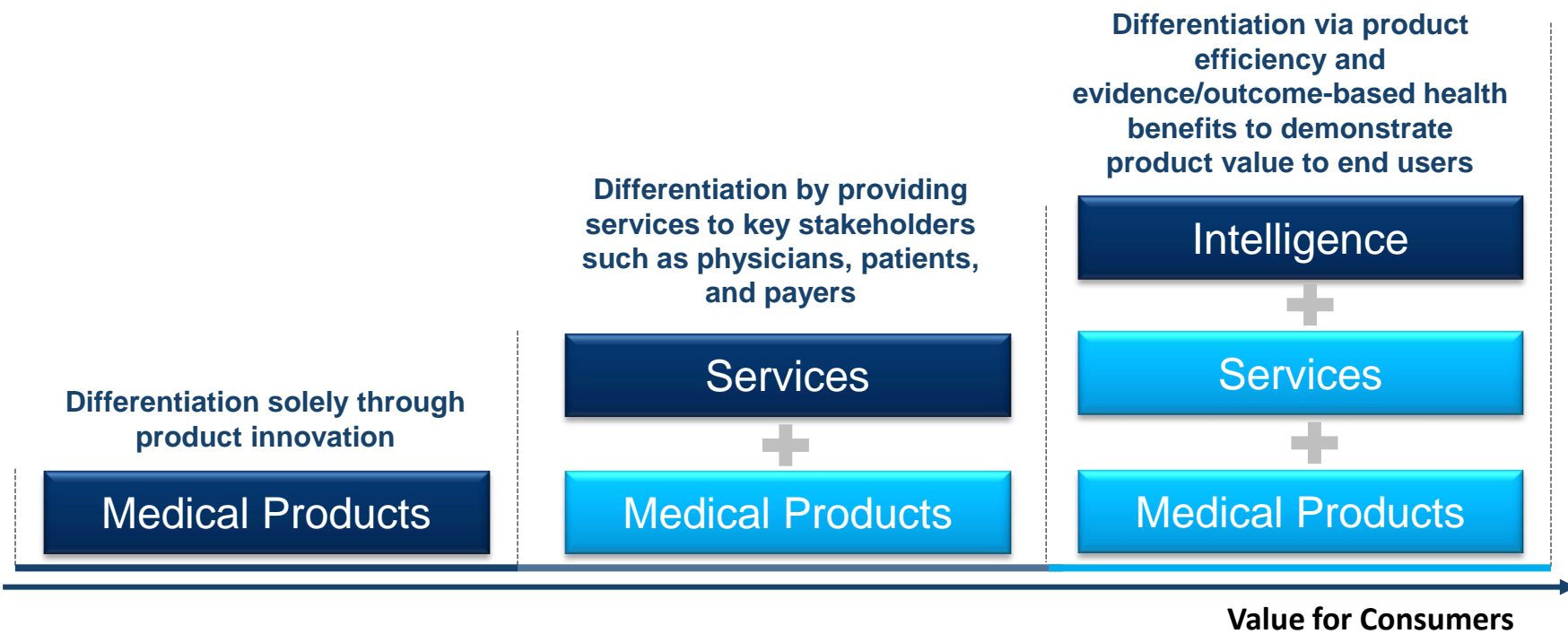
> Overall, 16% of the consumers report using wearable sensors to track health, with the highest use (28%) among consumers aged 18–35.

18–35
- 18%
- 54%
- 28%

36–55
- 35%
- 50%
- 15%

55+
- 58%
- 36%
- 6%
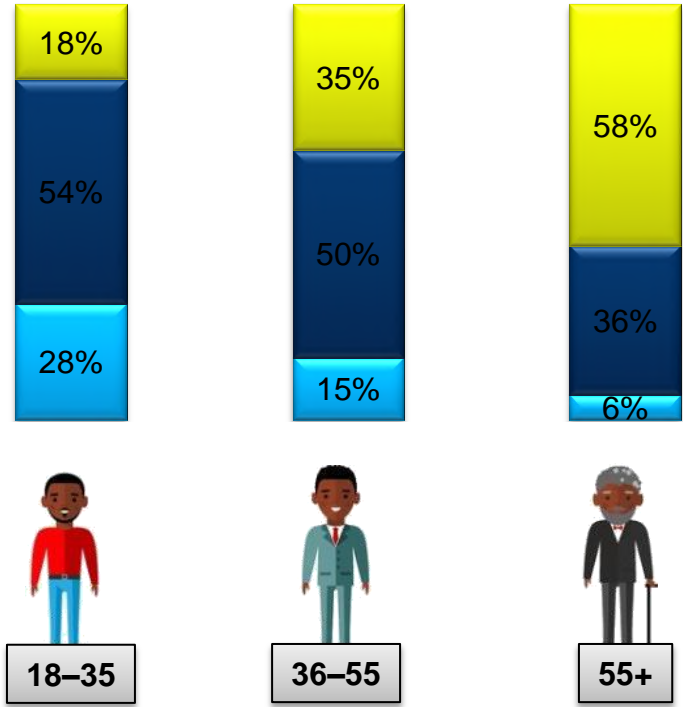
■ **Currently Use**   ■ **Consider Using in Future**   ■ **Would Not Use**

Source: Frost & Sullivan

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Value Creation for Wearables to be Driven by 'Intelligence'

Differentiation via product efficiency and evidence/outcome-based health benefits to demonstrate product value to end users

Differentiation by providing services to key stakeholders such as physicians, patients, and payers

Intelligence
+

Differentiation solely through product innovation

Services
+

Services
+

Medical Products

Medical Products

Medical Products

Value for Consumers

Apple–HealthKit has a Higher Impact than Apple Watch on Healthcare

HealthKit

Apple Inc.

WATCH

Source: Roland Berger, Frost & Sullivan Analysis

Partnering to Innovate–Beyond Conventional Boundaries

Retail

Walgreens

Use cloud-based 2net platform to collect device data during **home-based clinical trials**

Pharma

NOVARTIS

Collaborated to develop a series of next-generation CGM products designed to be smaller and less expensive than existing technologies

CGM Device Company

Dexcom

Next-generation wireless technologies to power device **connectivity in remote patient monitoring**, transitional care support, and chronic care management

QUALCOMM®

Technology & Connectivity

Smart contact lens technology that monitors health vitals, measures blood glucose level non-invasively, and offers **early detection of chronic health conditions**

Google

Technology & Data Science

Health Insurance

oscar

Insured people submit their Fitbit data, and if they reach the daily fitness goals, they get $1 every day.

fitbit

Wearable Technology

Consumer Technology

SAMSUNG

Connecting patients implanted with neuromodulation therapies via consumer electronics and allowing physicians to more quickly make informed, data-driven treatment decisions

Medtronic

Medical Device

Clinical Trail Cloud Tech

medidata

Collaborated to use mHealth wristband *vivofi* in clinical studies

GARMIN.

Wearable Technology

Cosmetics & Beauty

L'ORÉAL

L'Oreal is funding MIT's research on a wearable skin patch that monitors blood flow 24/7, expected to be used to study skin health
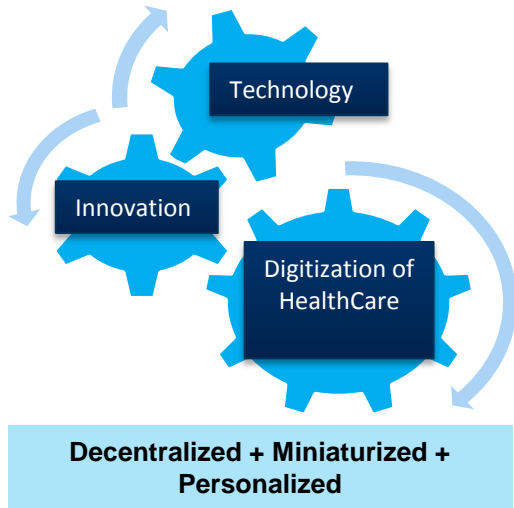
MIT Massachusetts Institute of Technology

Academia

Wearables Potential to Transform Healthcare

Wearables are poised to play a critical role in broader transformations in healthcare delivery.

Technology-driven Paradigm Shift in Future Healthcare System

Technology

Innovation

Digitization of HealthCare

Decentralized + Miniaturized + Personalized

Factors Transforming Healthcare	From Today As-is-State (2015)	**Shift**	Future To-be-State (2025)
Focus	Process/provider-centric		Patient-centric and participatory
Objective	Symptomatic, curative		Predictive and preventive
Access/ Location	Limited in-hospital care (centralized)		Any time, any place-homecare (decentralized)
Technology	Isolated systems		Integrated systems (digital medicine)
Treatment Methods	Episodic care (invasive)		Holistic care (minimum/non-invasive)
Medication	Blockbuster medication		Personalized medication

Decentralization of Care Delivery Model
(Home & Virtual Care; eVisits)

Customer Centric Care
(Data-driven, engaging, Social, Outcome-based Care)

Role of Wearables in Transforming the Future of Health and Wellness

Cost Containment
(Promoting ACO and value-based care)

Preventive & Wellness Focused
(Personalized Medication/Care)

Source: Frost & Sullivan

Wearables–Enabling Care Decentralization

Benefits to Different Stakeholders

Hospital
Reduces readmission, patient process time, and test duplication

Physician
Can access comprehensive patient data and history for improved decision making and diagnosis
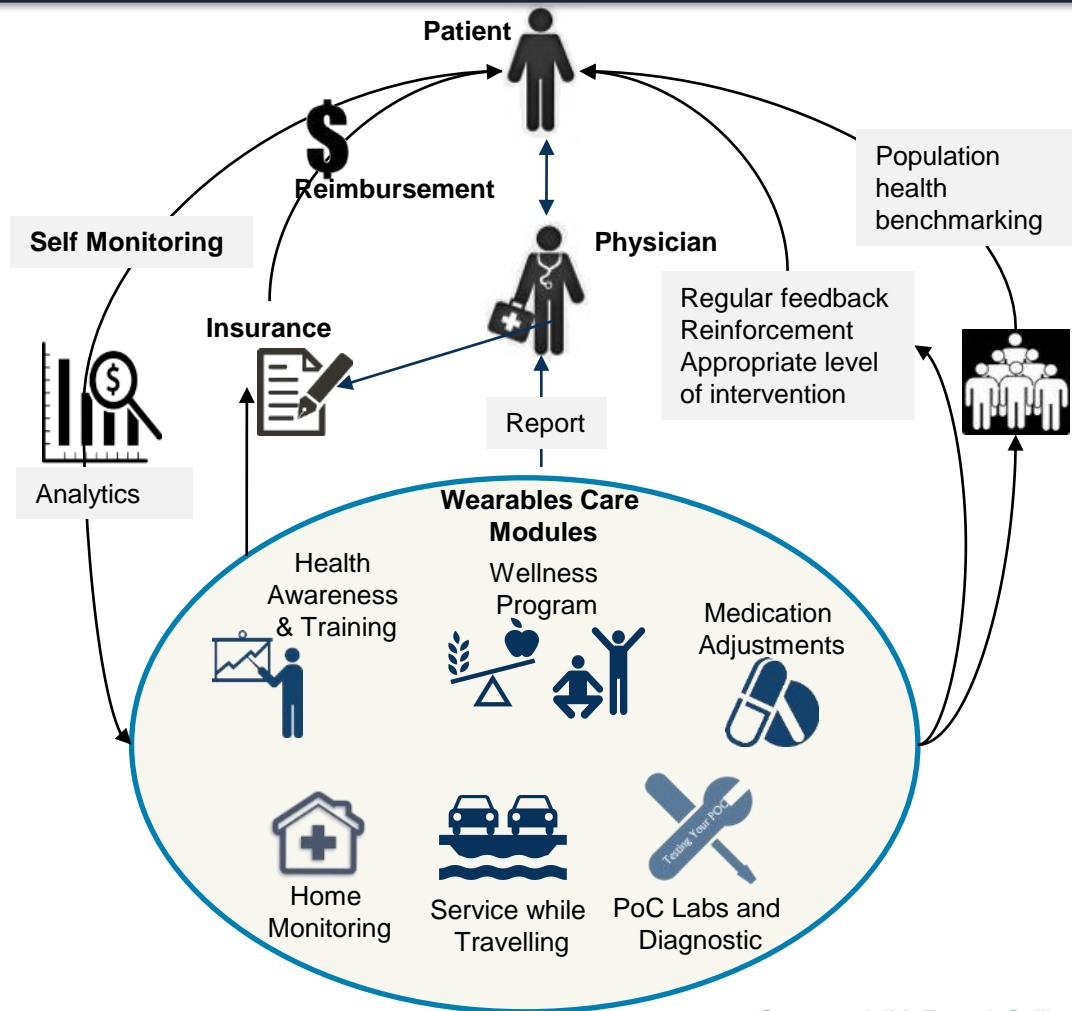
Patient
Can stay more informed about personal health and wellness, and benefit from reduced treatment time

Payer
Reduced treatment cost and hospital stay, and overall process efficiency

Wearable-enabled Decentralized Care Model

Patient

$ Reimbursement

Self Monitoring

Physician

Population health benchmarking

Insurance

Regular feedback
Reinforcement
Appropriate level of intervention

Report

Analytics

Wearables Care Modules

Health Awareness & Training

Wellness Program

Medication Adjustments

Home Monitoring

Service while Travelling

PoC Labs and Diagnostic

Wearable-enabled Business Models to Promote Preventive Care

Business Model	Sub-type	Target Use Case	Example
Service-based Models	Product as a Service, Data as a Service, App driven Platform Services	Hospitals/Institutional, Occupational Health, Population Health Management	UHC UnitedHealthcare + Qualcomm — *UnitedHealthcare Motion Program*; HealthPatch® MD vitalconnect — *Prescribed by Physicians*
Fee-based Models	Subscription, Pay-as-you-go, Transaction Fees, Renting, Leasing, Licensing,	Clinical Trials, Rehabilitation Program, Wellness and Fitness Programs	HealthKit WATCH — *Research and Clinical Trials*; fitbit — *Corporate-Wellness Programs*; MISFIT — *Incentivized by Insurance Payers*
Product Alone Model	Direct Sales	Most General Purposes Consumer and Infotainment Wearable Devices	Xiaomi, Samsung, fitbit, SONY — *Supported by Consumers*

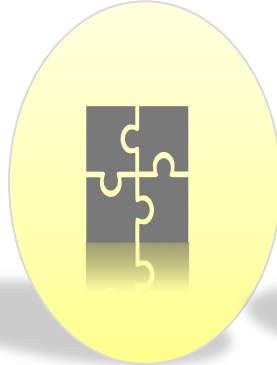*Evolution–Product- to Service-Oriented Business Model*

Challenges for this Vision

Technical

Physical Security, Cybersecurity

Lack of Interoperability

Data Source Verification

Standardized Data Capture, Accuracy
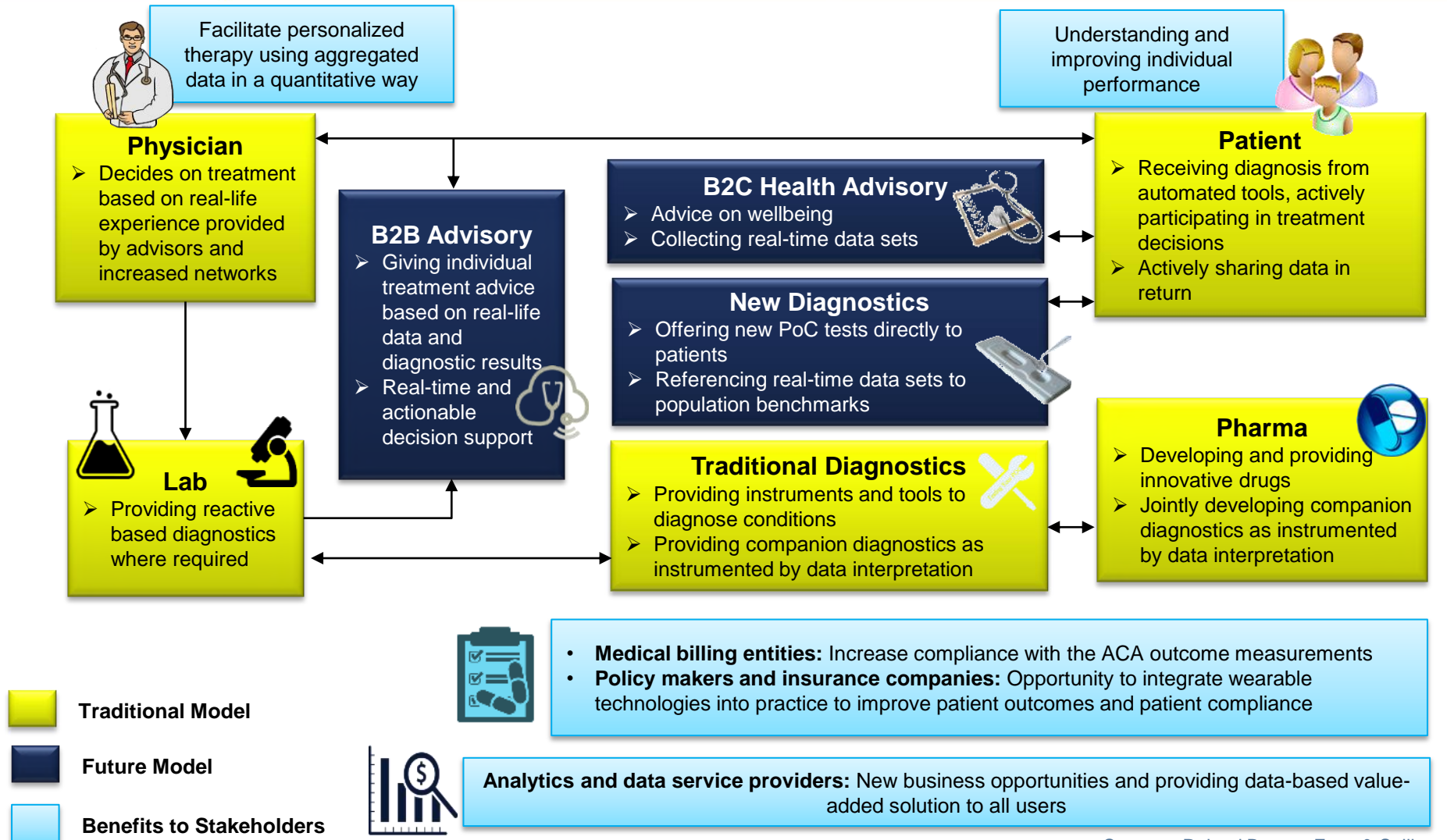
Unique Identifiers

Debatable

Data Ownership

Privacy

High Costs

Wearable and Data-driven Healthcare Models 2020

Facilitate personalized therapy using aggregated data in a quantitative way

Understanding and improving individual performance

Physician
- Decides on treatment based on real-life experience provided by advisors and increased networks

Patient
- Receiving diagnosis from automated tools, actively participating in treatment decisions
- Actively sharing data in return

B2B Advisory
- Giving individual treatment advice based on real-life data and diagnostic results
- Real-time and actionable decision support

B2C Health Advisory
- Advice on wellbeing
- Collecting real-time data sets

New Diagnostics
- Offering new PoC tests directly to patients
- Referencing real-time data sets to population benchmarks

Lab
- Providing reactive based diagnostics where required

Traditional Diagnostics
- Providing instruments and tools to diagnose conditions
- Providing companion diagnostics as instrumented by data interpretation

Pharma
- Developing and providing innovative drugs
- Jointly developing companion diagnostics as instrumented by data interpretation

- **Medical billing entities:** Increase compliance with the ACA outcome measurements
- **Policy makers and insurance companies:** Opportunity to integrate wearable technologies into practice to improve patient outcomes and patient compliance

Analytics and data service providers: New business opportunities and providing data-based value-added solution to all users

Traditional Model
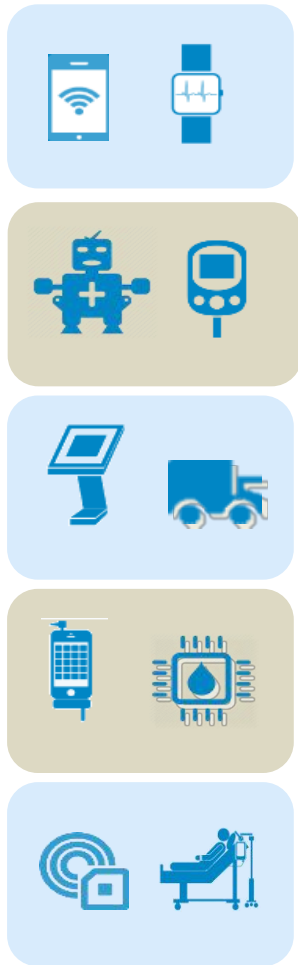
Future Model

Benefits to Stakeholders

Sources: Roland Berger; Frost & Sullivan

Envision: Connected Health Ecosystem 2025

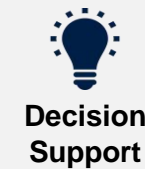IoT Ecosystem (Smart Medical Objects)

Network Infrastructure

Encryption & Digital Sign

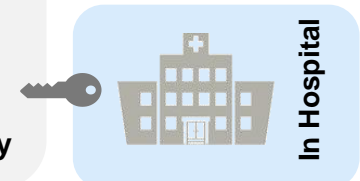Data Lakes

Indexing Device Registries

Blockchain

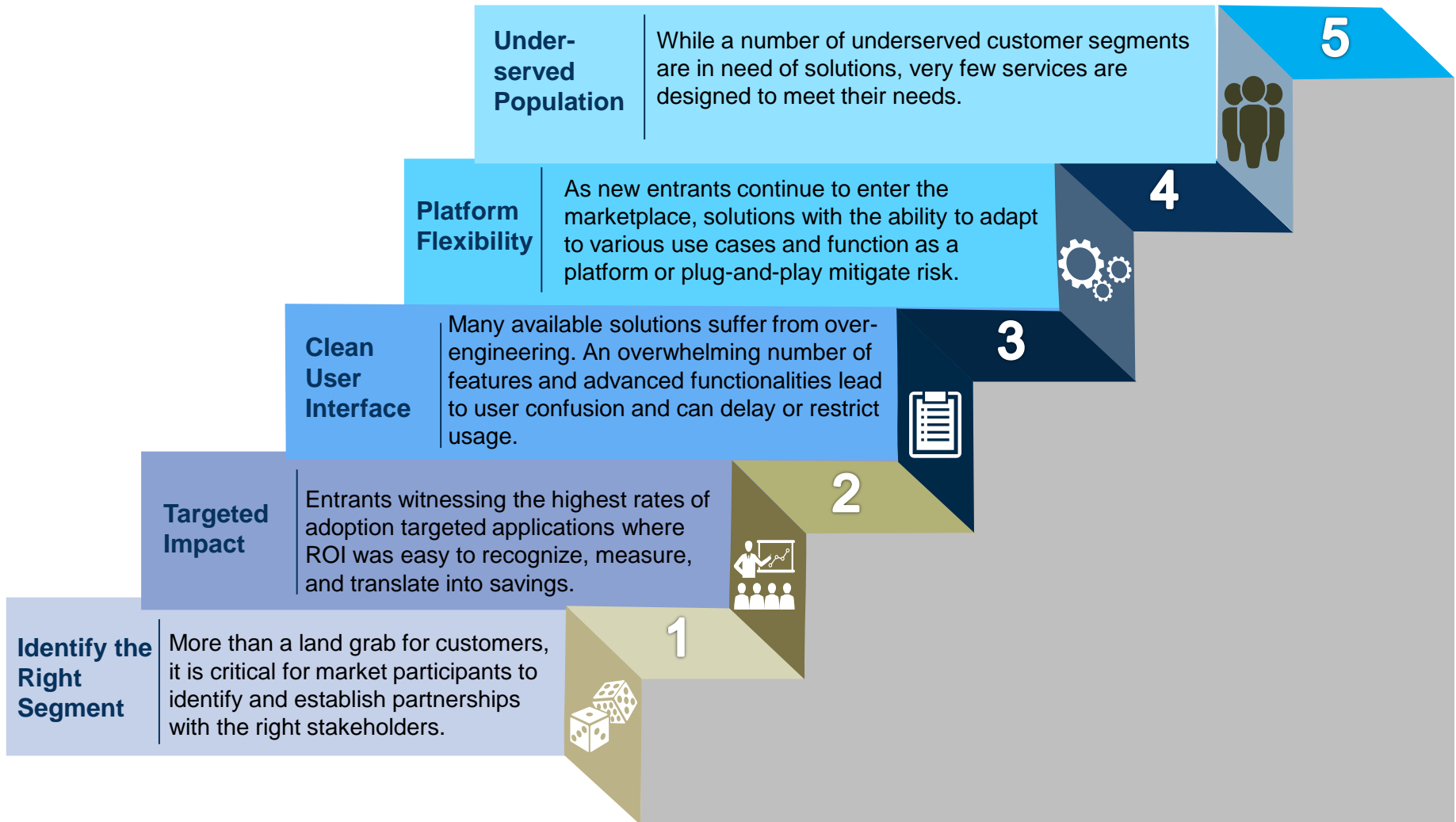Decryption & Authenticate Digital Sign

Converging Technologies

- Cybersecurity
- Machine Learning
- Analytics/Informatics
- Decision Support
- Interoperability

Trusted Applications (by Segment)

- On Body
- In Home
- Community
- In Clinic
- In Hospital
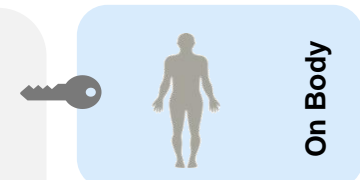
5 Competitive Keys for Success in Wearables

5 — **Under-served Population**: While a number of underserved customer segments are in need of solutions, very few services are designed to meet their needs.

4 — **Platform Flexibility**: As new entrants continue to enter the marketplace, solutions with the ability to adapt to various use cases and function as a platform or plug-and-play mitigate risk.

3 — **Clean User Interface**: Many available solutions suffer from over-engineering. An overwhelming number of features and advanced functionalities lead to user confusion and can delay or restrict usage.

2 — **Targeted Impact**: Entrants witnessing the highest rates of adoption targeted applications where ROI was easy to recognize, measure, and translate into savings.

1 — **Identify the Right Segment**: More than a land grab for customers, it is critical for market participants to identify and establish partnerships with the right stakeholders.

Source: Frost & Sullivan

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  - ➤ Wearable Technologies in Clinical and Consumer Health, Forecast to 2020

- **Complimentary Frost Prospective:**
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