FROST & SULLIVAN

Health Tuesday: Launching Smart Life Finland program

Time: 5.3.2019, From 7:30am to 9:30am

Place: HTC Pinta (Tammasaarenkatu 3, 00180 Helsinki)

Health & Wellbeing in the Digital World –Vision 2025

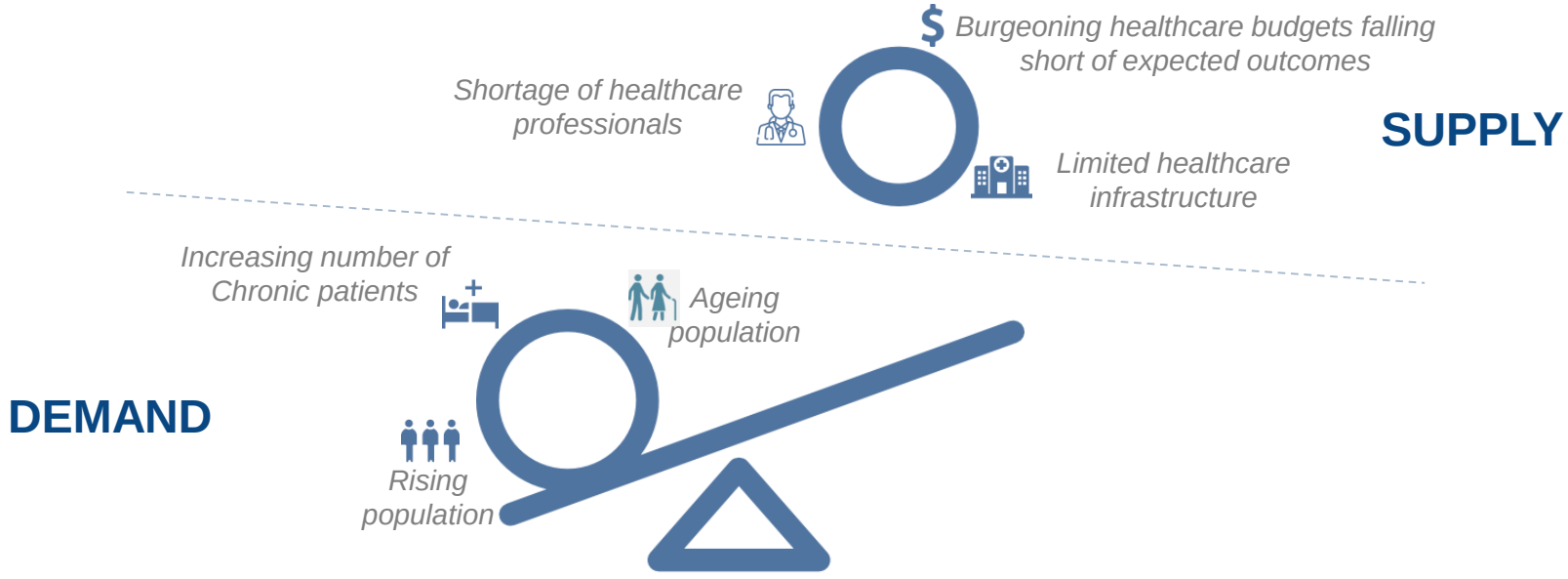
Siddharth Saha, Frost & Sullivan

The Healthcare Industry is at a Crucial Juncture

If nothing is done, these challenges are strong enough to cripple economies.

- On one hand, **rising population, aging population and more patients with chronic and multiple co-morbidities** are putting immense pressure on current healthcare systems, which is expected to rise by 2025.
- On the other hand, **governments are struggling to balance healthcare budgets** with other expenses. This is resulting in an overburdened infrastructure and healthcare workforce, which has little scope for expansion. This **imbalance in demand and supply** is expected to balloon further by 2025, presenting serious challenges for global healthcare systems.

System-wide Challenges Unbalancing Healthcare Demand & Supply



Source: United Nations, World Health Organization

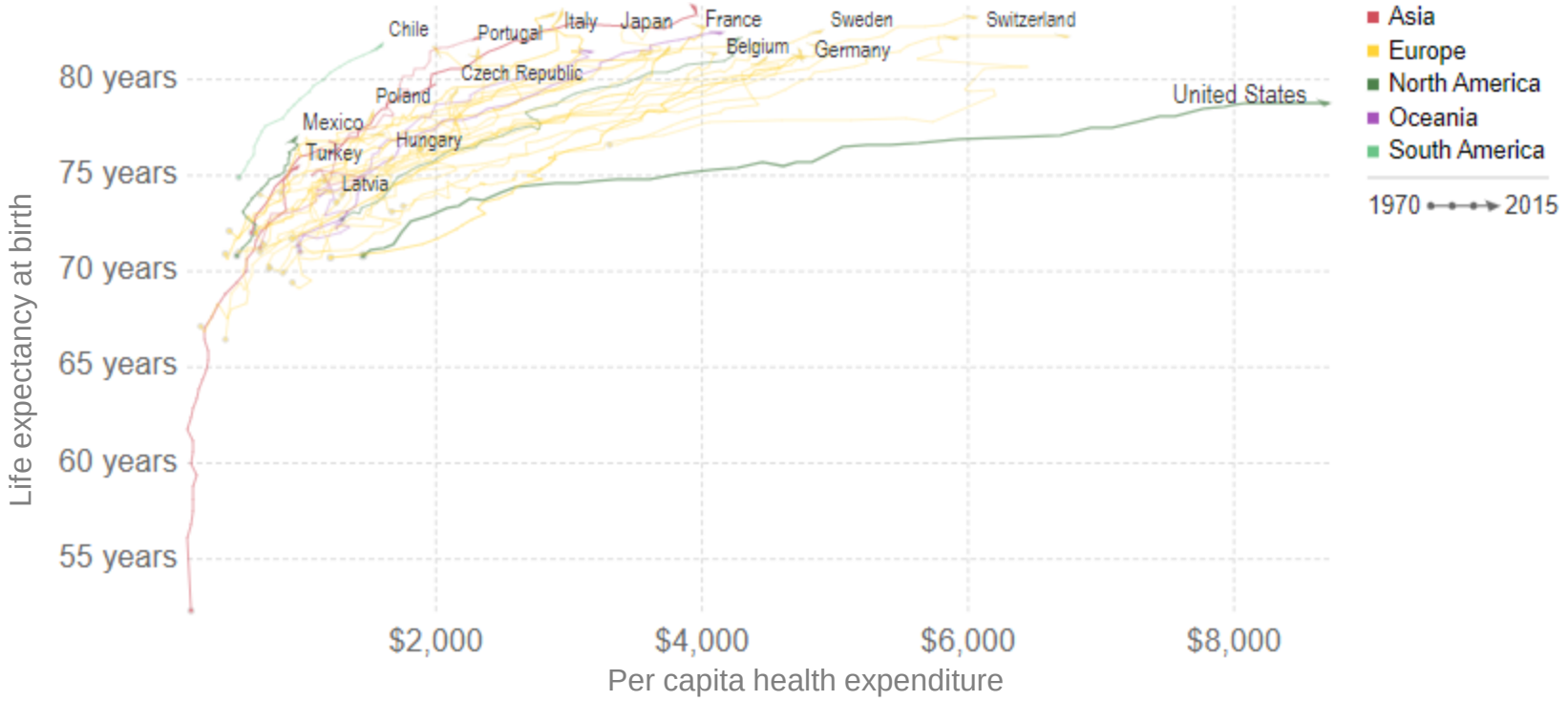
Key Global Challenge

Disconnect between healthcare spending and patient outcomes

$ Ballooning healthcare budgets yielding little gains

- The world is grappling with a significant **disconnect between health spending and actual patient outcomes**.
- Developed countries including the **US, Switzerland and Sweden**, spend higher than the rest, and yet that does not lead to a proportionate increase in life expectancy.

Life Expectance vs. health expenditure, Global, 1970 to 2015



Source: World Bank, Health Expenditure and Financing – OECDstat (2017), Our World in Data

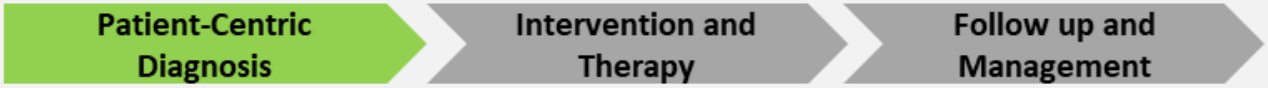
Health System Goals – Value Based Care

Focus is on improving health outcomes and overcoming regional fragmentation

The New Definition of Value Based Care

$$\text{Value-based Care} = \frac{\text{(Clinical Outcomes X Patient Outcomes)}}{\text{Burden to the System}} \times \text{Patient Experience}$$

Diagnosis is the first outcome in care delivery and an area where technologies can make a high impact

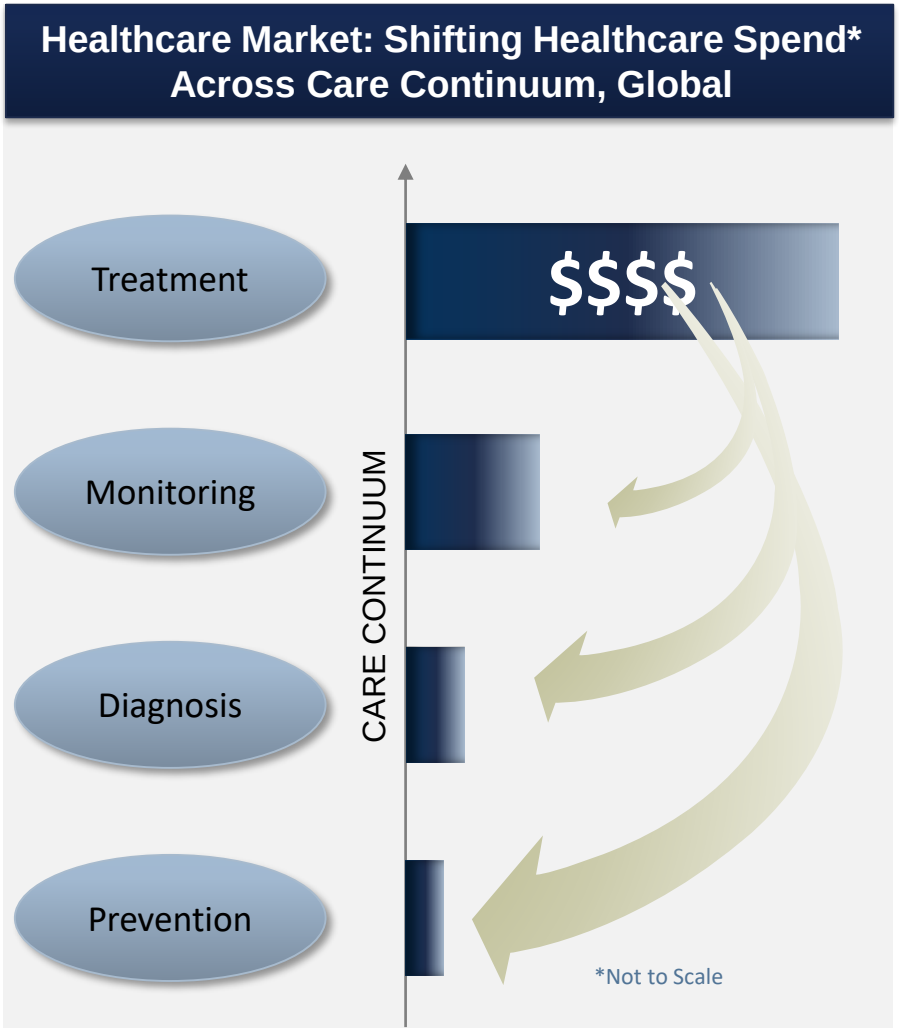


- From a patient perspective an improved overall experience contributes to clinical outcomes while supporting the reduction of the burden to the healthcare system.
- Overall, a systems approach recognizes multiple opportunities across the care continuum for enhancing outcomes, way beyond what conventional models can achieve.

Source: Frost & Sullivan

Wellness Management – Prescriptive or Ownership Based

Healthcare industry shifting ownership on patients - focusing on prevention and wellness



- Providers **continue to encourage patient engagement** and ensure that efforts are sustainable to positively impact health outcomes. Fortunately, a variety of new strategies have been developed that **encourage and motivate patients** to take **ownership** and become more involved in decisions about their care.
- These strategies **include increased deployment of a range of consumer-facing digital solutions**, including digital educational content, wearable sensors, mobile apps, and other tools.
- The future healthcare expenditure spend will evolve to **focus less on treating diseases and more on prevention, diagnosis, and monitoring**.

Source: Frost & Sullivan

Settings for Care Provision

Care delivery moving beyond the hospital

D	**Specialist** **Specialist care centres** **Serving population of 250K, 500K and 1,000K on central city sites**	**Diagnostic** **Treatment centres** **Secondary care** **Tertiary care**	Planned interventions Emergency care Complex diagnostic treatment & inpatient care
C	**Community** **Community care centres** **Serving populations of 100K** **In the heart of the community**	**Resource centres** **Community hospitals**	Basic Diagnostic Services Day interventions Minor injuries Nurse-led inpatient care Intensive rehabilitation Chronic care management
B	**Health and Social** **Health and social care centres** **Close to home, serving populations** **Of up to 10K**	**Surgeries** **Drop in centres** **Healthy living centres**	Social care Primary care Outreach care Information and advice
A	**Home**	**Home** **Nursing home** **Pharmacy** **Cyber café** **Health kiosk**	Self care Monitoring Automated treatment Information and advice NHS Direct

Alternate Care Locations

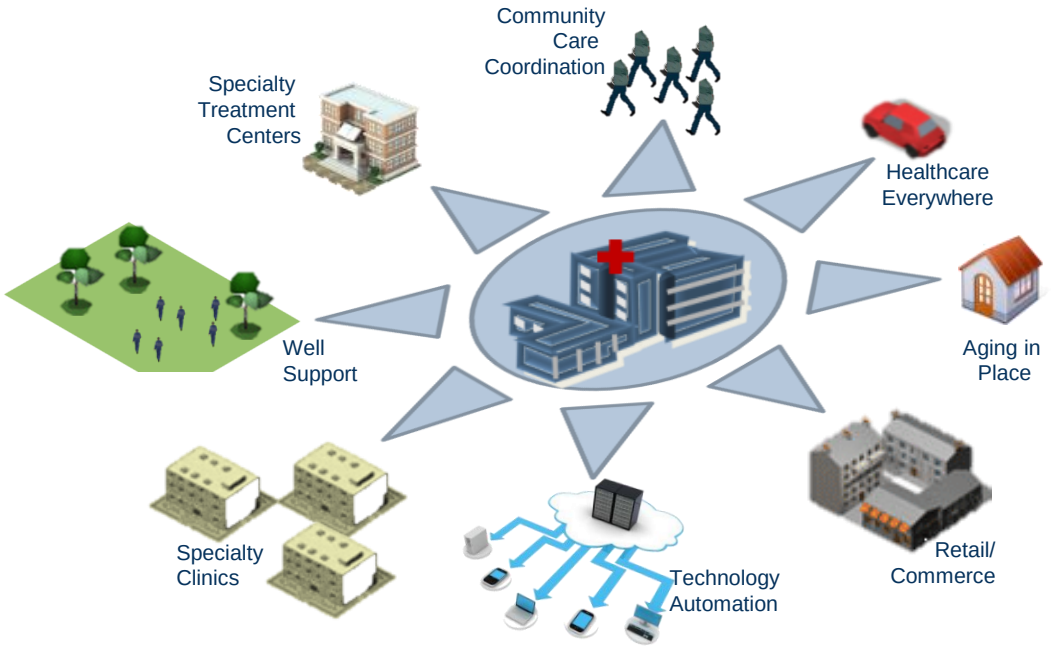
Care delivery moving beyond the hospital

Depending on location, wait times to a see a clinician can range from days to weeks, or even months. Through virtualization, the majority of routine care can happen within seconds or minutes.

Instant Healthcare

As opposed to discrete interactions, the provision of healthcare is moving to a model where information is being transmitted and shared in real time between individuals and caregivers.

Continuous Healthcare



Errors resulting from to misdiagnosis of issue, procedural errors, and errors in medication administration are all easily avoidable with IT and sensor based tools to provide guidance and support.

Error Free Healthcare

Rather than the one-size fits all approach, care will increasingly be customized in an infinite variations to best tune the approach to the individual and their family.

My Healthcare

The most innovative companies in healthcare are improving quality of treatment while simultaneously collapsing extraneous tasks and costs tied to legacy processes.

Cost Effective Healthcare

Source: Vision 2025 – Healthcare in the Smart Home, Frost & Sullivan, HealthCatalyst

Alternate Care Locations

Smart home provides multiple healthcare services

Common Healthcare Services in a Smart Home

- Wearables/Contactless Vitals Monitoring
- Activity, Exercise, Rest & Sleep Monitoring
- Diet & Nutrition Monitoring
- Smart Toilets for Waste Monitoring

- Vaccination and Medication Management
- Virtual Home Assistants
- Diagnostic Devices
- Telehealth Services

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

Source: Vision 2025 – Healthcare in the Smart Home, Frost & Sullivan

Alternate Care Locations

Smart home caters to care needs of all resident profiles

Physically/Intellectually Disabled
Enabling independent living or vitals tracking to ensure wellbeing

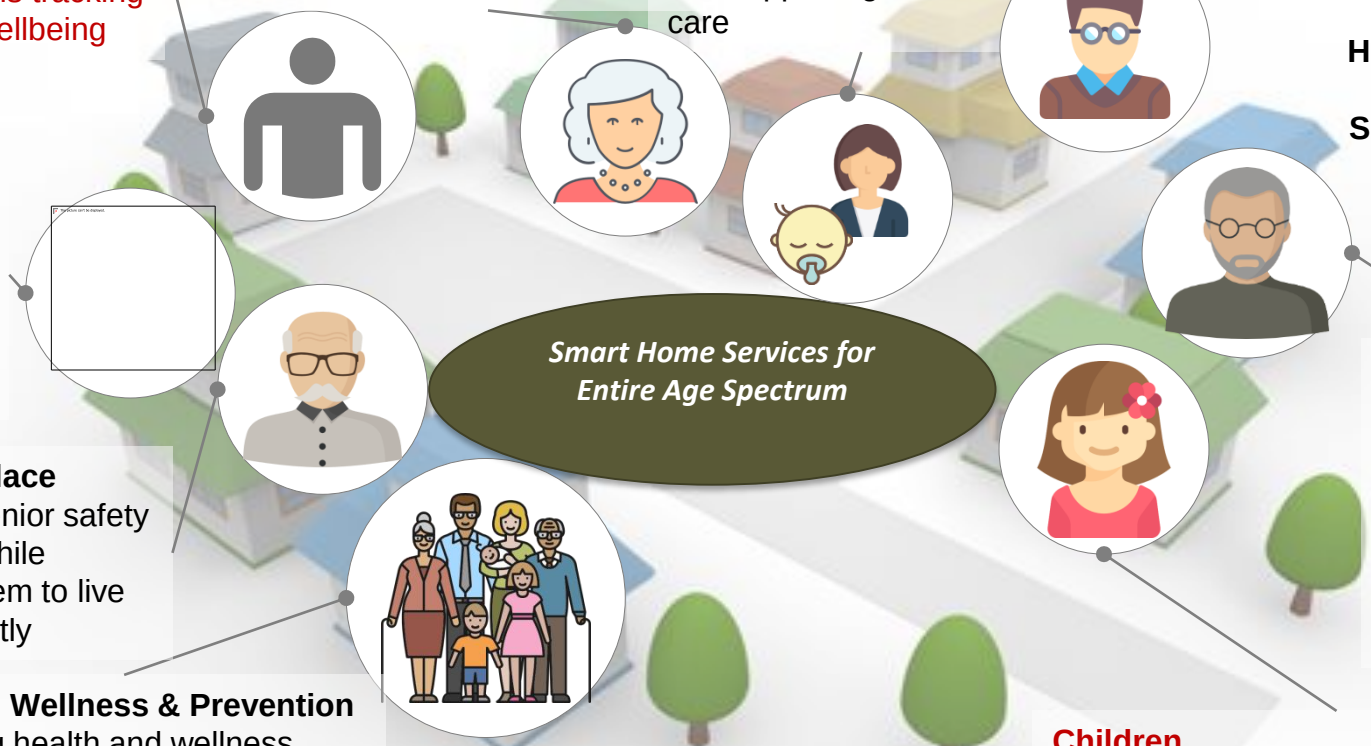
Chronic Disease Management
Medication reminders, coaching and education

Infant and Maternal Health
Monitoring of infant needs and supporting maternal care

Sleep
Tracking sleep, supporting better quality of life

Smart Home Healthcare Market: Healthcare Services for Smart Home Users, Global, 2017

Teenagers
Preventing mental health issues and substance abuse



Aging-In-Place
Ensuring senior safety remotely, while enabling them to live independently

Post-acute Care Monitoring
Monitoring for faster recovery and preventing readmissions

General Wellness & Prevention
Tracking health and wellness vitals (such as, weight, temperature, blood pressure); prevent development of chronic conditions

Children
Tracking vitals and taking doctor advice at home (telehealth) as part of after-hour diagnosis of seasonal flu

Key:
Health, Safety & Wellness
Medical Support

Source: Vision 2025 – Healthcare in the Smart Home, Frost & Sullivan

Alternate Care Locations

Health and Wellbeing in the car

- In-car companion diagnostic tests to calibrate drug dosages.
- Multimodal infectious disease analyzer
  - Breath or spit tests.
  - Skin swabs
- Remote in-car diagnosis of conditions by qualified provider supported by requisite sensors.

- Chronic disease monitoring from sensors, wearables, tattoos, ingestible sensors.
- In cabin passenger surveillance.
- Health dashboard, capturing current trends, proactive guidance.
- Nutrient (minerals, proteins, vitamins) level monitoring; food/ medicine suggestions for meeting daily requirements.
- Anonymized data collection and analysis supporting research and population health analytics.

- Omnichannel health supply purchasing, telematics can interact with a pharmacy or an automated dispenser.
- Specialized support for disability (eyesight, hearing, loss of limb, paralysis, dementia, etc).
- Virtual nurse avatar support for disease management and healthcare queries.
- Augmented reality for purchase decision making, answering questions like quality ratings and expected costs for services.

- Electrostimulation for chronic pain or other (electroceuticals).
- Counter pulsation for deep vein thrombosis.
- Emergency wound kits.
- 3D printer for custom drug/ devices. (Pill dosage/shape, wound dressings, etc) .
- Gamification for mental health therapy (ADHD, improve concentration), physical therapy (limb movement).
- Nanorobot-therapy for on-the-go cancer treatment.
- In-vehicle fitness capabilities.

Alternate Care Locations - Applications

Requirements for chronic disease management, ageing, wellness etc. in the smart home

On-Body Wearables

- ➢ Smart biomarker monitoring devices
- ➢ Vitals measurement devices and apparel
- ➢ Chronic pain management

Bathroom

- ❖ Smart pill dispensers
- ❖ Diagnostic devices
- ➢ Smart mirrors
- ➢ Smart weighing scale
- ➢ Smart toilets

Bedroom

- ❖ Sleep apnea support for diagnosis & therapy
- ➢ Sleep quality monitoring

Entire Home

- ❖ Voice assistants to
  - ❖ Answer basic questions on managing disease or to connect with care providers to seek answers from experts
  - ❖ Remind taking medicines
  - ❖ Motivate users to exercise and follow prescribed regimen of diet and activity
- ➢ Contactless monitoring sensors and devices for vitals monitoring
- • Prepare analytics-based reports on overall progress, share (if consented) with family and friends, and with care providers

Smartphone Apps

- ❖ Medication adherence tools
- ➢ Personal disease management diaries or logs
- • Disease management information tools

Voice Interactive Diagnosis & Control Tools

Artificial Intelligence + Data Analytics = Insights

Living Room

- ❖ Telehealth visits
- ❖ Peer support forums (video)

Kitchen

- ❖ Connect with nutritionist for diet and meal suggestions
- ➢ Smart bin to track used food and check compliance with treatment regimen
- • Smart refrigerator that keeps track of expired items and suggests recipes on the basis of available ingredients and diet recommendations

Legend

❖ Active Care | ➢ Monitoring | • Support

Source: Vision 2025 – Healthcare in the Smart Home, Frost & Sullivan

Going Back to the Core – Smart hospitals

The popular notion of Digital = Smart is incorrect; going digital is only the first step.

Frost & Sullivan Defines Smart Hospitals as:

Smart Hospitals

Optimize / Redesign / Build New

Clinical Processes | **Management Systems** | **Infrastructure**

Digitized, networking infrastructure of interconnected assets

The '*Smart Component*' → For providing a valuable service or insight, not possible or available earlier

Achieve better patient care, experience and operational efficiency

Smart Hospital implementations involve strategy, not a to-do list

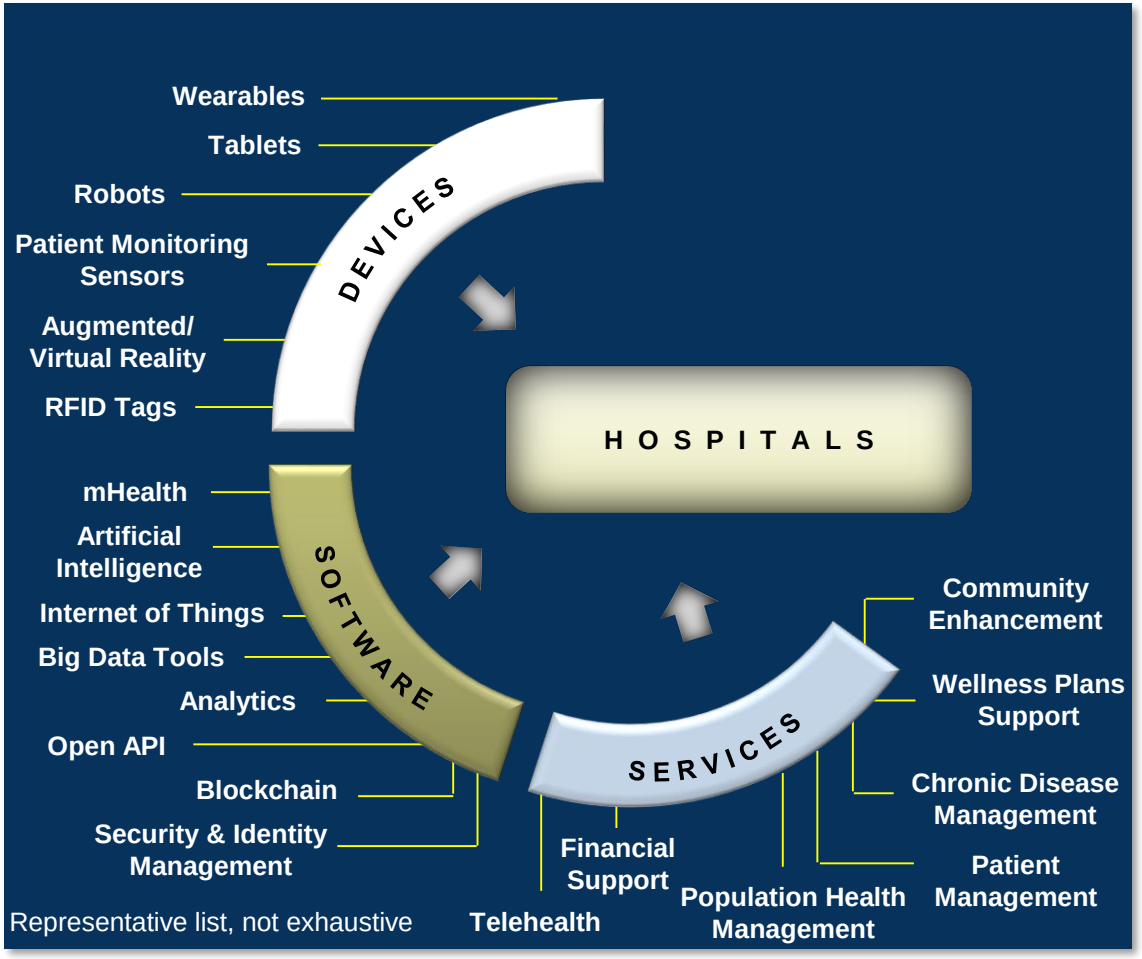
Smart hospitals are those that optimize, redesign, or build new clinical processes, management systems and potentially even infrastructure, enabled by underlying digitized networking infrastructure of interconnected assets, to provide a valuable service or insight, which was not possible or available earlier, to achieve better patient care, experience, and operational efficiency.

Source: Future of Smart Hospitals, Frost & Sullivan

Patient Management – Smart hospitals

Smart hospitals are utilizing a myriad of digital technologies to deliver on patient-centric care.

Smart Hospitals: Digital Technologies and Services Landscape



Current State of Implementation

- Currently implemented as singular efforts
- Technologies lie in disparate systems
- Unplanned applications lead to significant manual coordination efforts
- Reduced workflow efficiency: opposite of what is actually expected

Source: Future of Smart Hospitals, Frost & Sullivan

Smart hospitals – An Example

Digital health has long-term healthcare implications.

Capacity Command Center

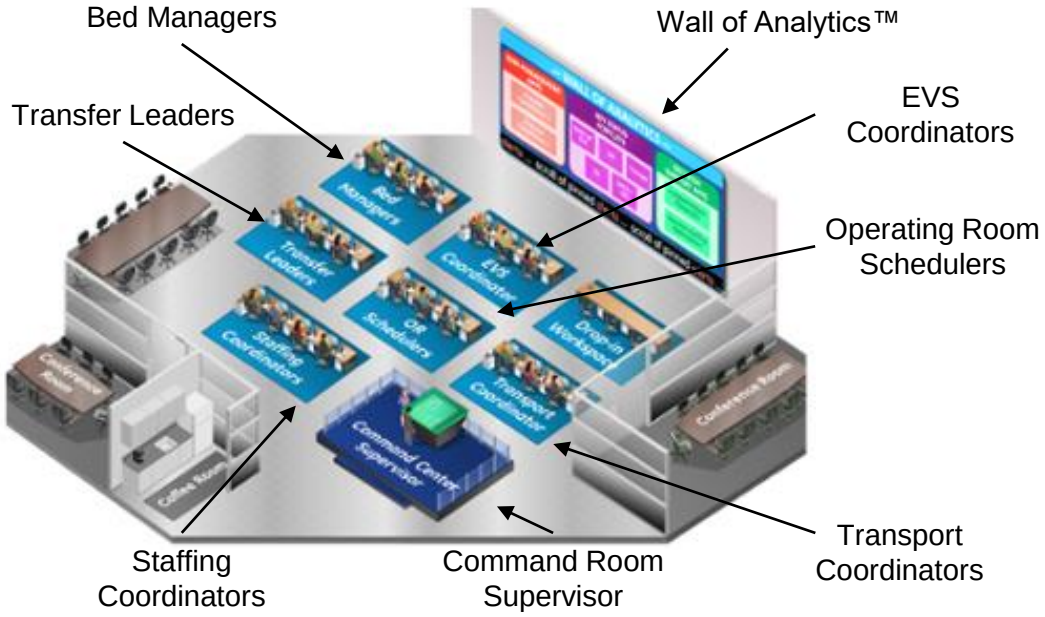
GE Healthcare

JOHNS HOPKINS MEDICINE
THE JOHNS HOPKINS HOSPITAL

Features

- 4,500 square feet
- Tech from aviation, aerospace, and power industries – predictive analytics and systems engineering principles
- 24 staff members
- 22 information screens – Wall of Analytics
- Data from 14 sources, ~500 messages/minute
- GE consultation services

Capacity Command Center Layout at Johns Hopkins Hospital



Objectives	Benefits	Current Progress
• GE to provide real-time data on patient movement in the facility and predictive data on future capacity • GE to assist the hospital to manage growing demand for emergency services; ambulance, operating rooms, and in-patient units • GE consulting group to help the hospital to manage operating room schedules and admission.	• 60% improvement in patient transfers from other hospitals (serious medical conditions). • 63 minutes sooner ambulance dispatch to patients. • 30% faster in bed assignment and 26% faster in bed transfer processes at the ED. • 70% reduction in transfer delay from the operating room • 21% increase in early discharge of patients.	1. Oregon Health Sciences University, Adventist Florida Hospital, Tampa General Hospital, CHI Franciscan Health, Thomas Jefferson University Health, Florida Hospital health system, and Tampa General Hospital. 2. United Kingdom, Finland, the Middle East, and Australia

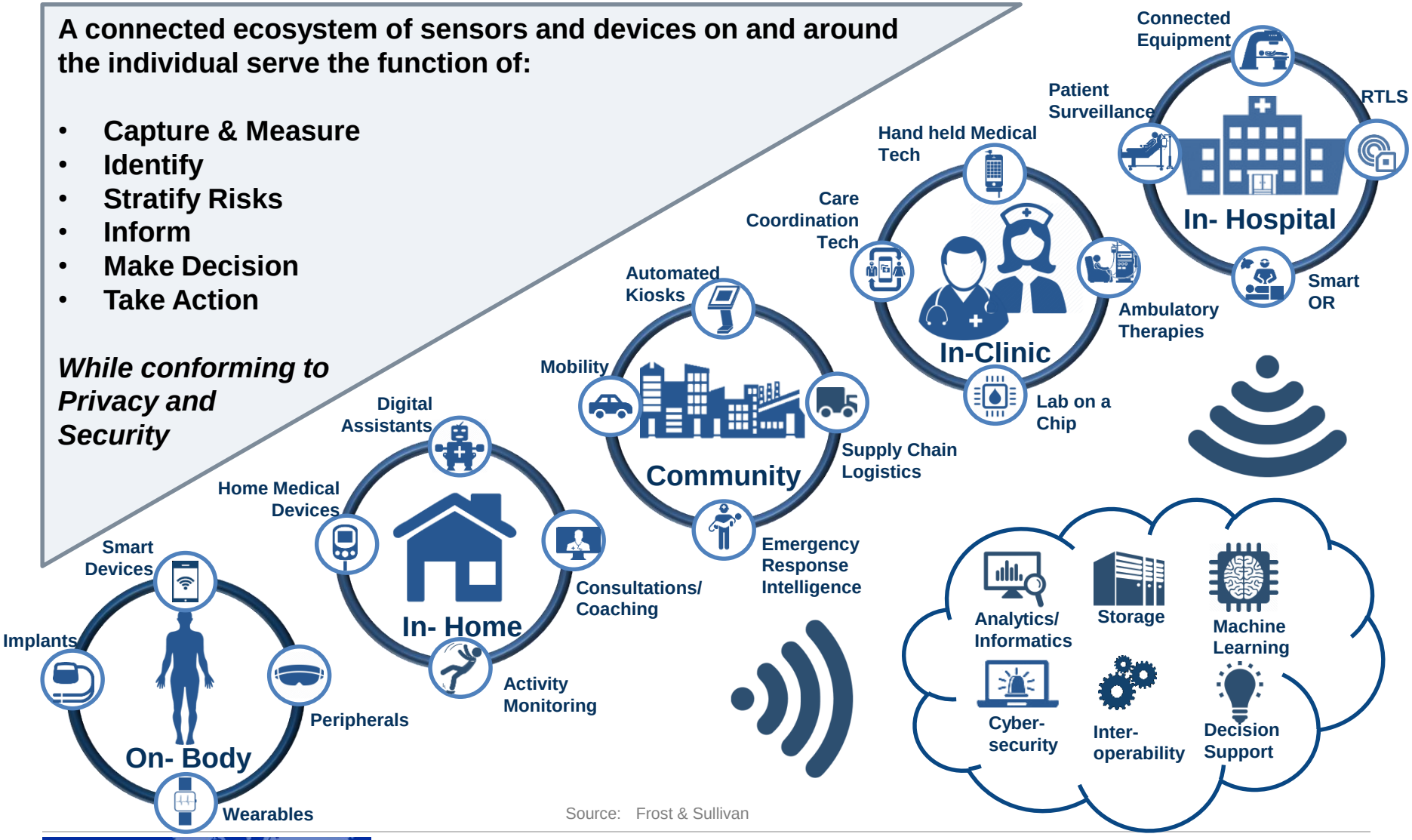
The Digital Health Ecosystem in 2025

Digital health will encompass solutions across the care continuum

A connected ecosystem of sensors and devices on and around the individual serve the function of:

- **Capture & Measure**
- **Identify**
- **Stratify Risks**
- **Inform**
- **Make Decision**
- **Take Action**

While conforming to Privacy and Security

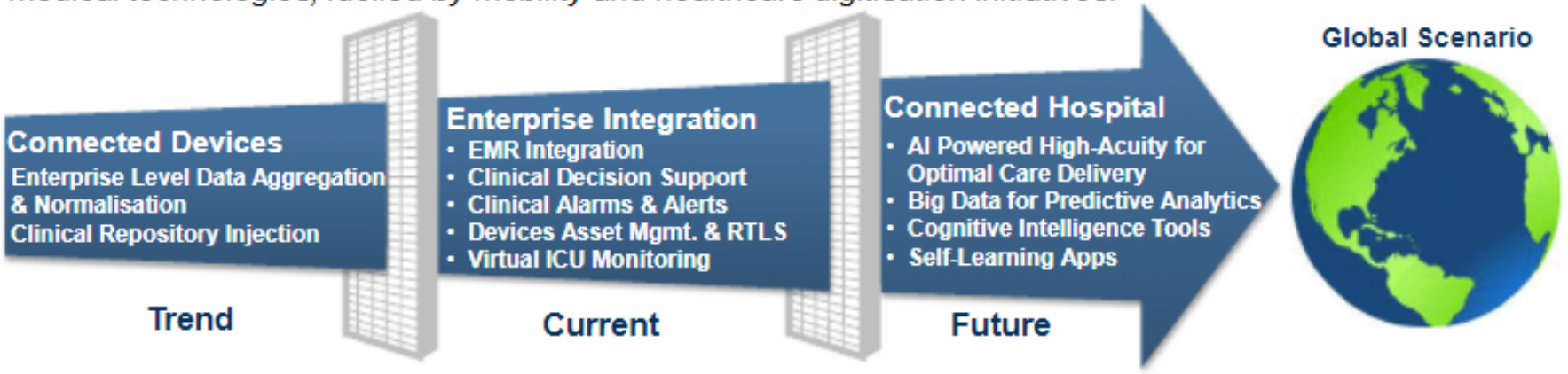


Source: Frost & Sullivan

eHealth

Strategic imperatives for device connectivity vendors and healthcare systems integrators.

Global Healthcare Systems Strategy: *Connected hospital is the vision for every health system around the world. This vision stems from the progression of an increasing number of connected devices and wireless medical technologies, fuelled by mobility and healthcare digitisation initiatives.*



Connected Medical Devices	Data Integration & Analysis	AI & Deep Learning Tools for Clinical Process Optimisation
Networked medical devices are capable of acquiring and transmitting vital sign data from patients to centralised clinical data repositories. High-acuity medical devices in operating rooms, ICUs and EDs are integrated with enterprise clinical IT systems for harnessing real-time patient insights and key parameters.	Data integration entails integrating patient-generated device data with an EMR and other critical health IT systems in hospitals or clinics. Device data analysis begins after the appropriate data has been captured and pulled into a single clinical repository to explore and look for meaningful oddities and trends.	AI-powered systems with machine learning capabilities learn and acquire knowledge from the enormous amount of data fed into them. By integrating enterprise-level refined patient data, the system offers the possibility to explore clinical patterns, trends and inferences from diverse data sets and assist doctors in diagnosis and decision-making.

Source: Global Hospital-based Medical Device Connectivity Market, Frost & Sullivan

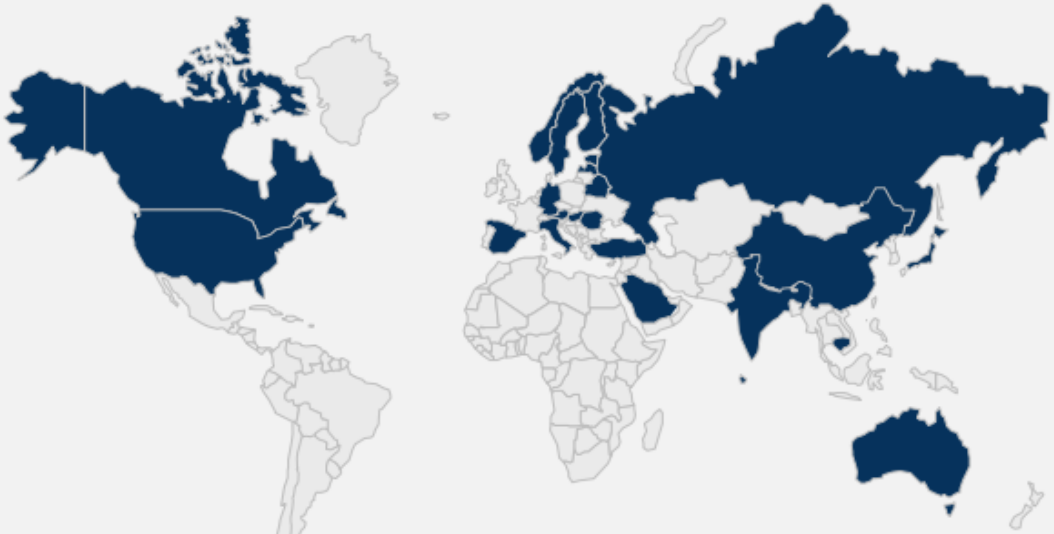
5G

5G technology to enable IoT and continuous monitoring in healthcare

By 2025, faster and stable 5G internet will promote data exchange between patients and providers, significantly accelerating telemedicine

TODAY

5G trials are underway using various spectrum bands



Potential 5G bands US	Potential 5G bands EU	Potential 5G bands CJK
600 MHZ 2.6 GHZ (sprint) 3.55-3.7 GHZ 20, 37, 39 GHZ 57-71 GHZ (<_____>)	700 MHZ 2.6 GHZ (sprint) 3.4-3.8 GHZ 26 GHZ	3.3-4.2 GHZ 4.4-4.9 GHZ 28-39 GHZ

2035

$1.1 TRILLION

5G Enabled Output in Healthcare

Source: Global Mobile Suppliers Association; Qualcomm, Frost & Sullivan

Artificial Intelligence in Healthcare

AI for Healthcare IT application market to cross **1.7 billion** by end of 2019.

WHAT'S DRIVING IT?

AI-based Healthcare Workflow optimization; Digital Assistance; Risk Predictions

Machine Learning become pervasive across clinical and operational outcomes

AI-powered IT tools that manage payers' and providers' business risks (clinical, operational, financial and regulatory) continue to be important for the industry.

WHAT DOES IT MEAN FOR YOU?

Medical Imaging

Operationalizing AI platforms would result 15–20% gain in productivity for Radiologist in 12-18 months

Digital Pathology

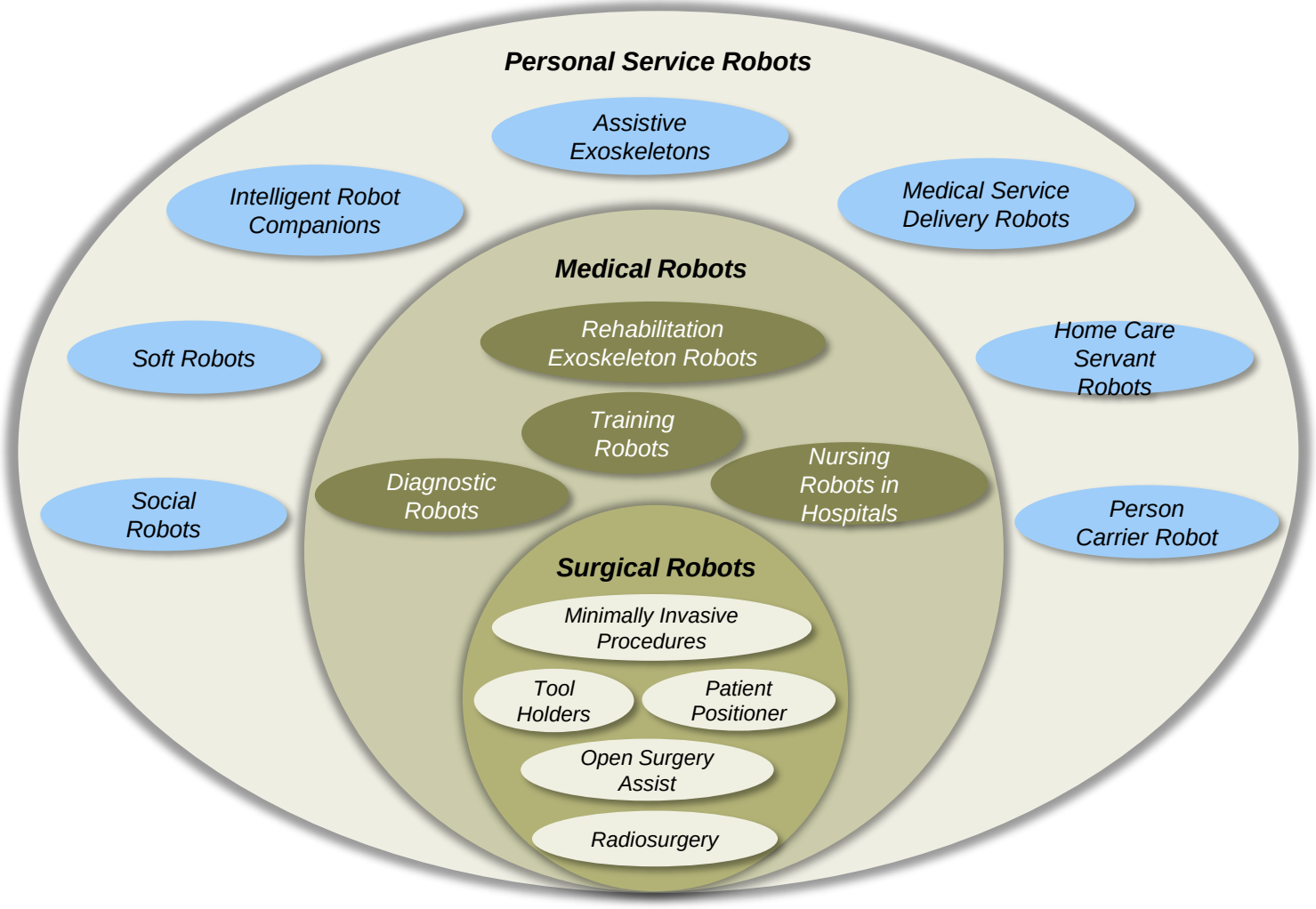
AI will make its way into pathology as far as clinical diagnostic spectrum is concerned

Drug Discovery

For pharma AI and real-time analytics will make 'adaptive clinical trial' a reality than a concept.

Robotics and Automation Supporting Care Assistance

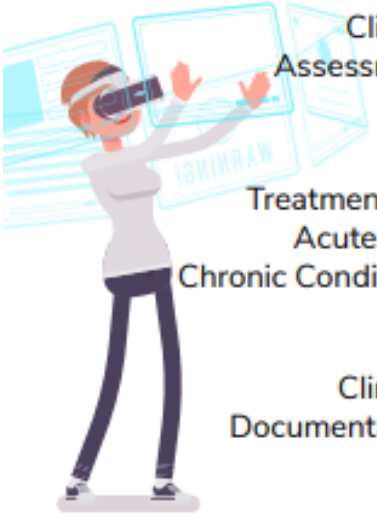
Categorization of Robots Used in Healthcare



Source: Care Assistance and Pharma Automation Robots,, Frost & Sullivan

Virtual Reality

Applications

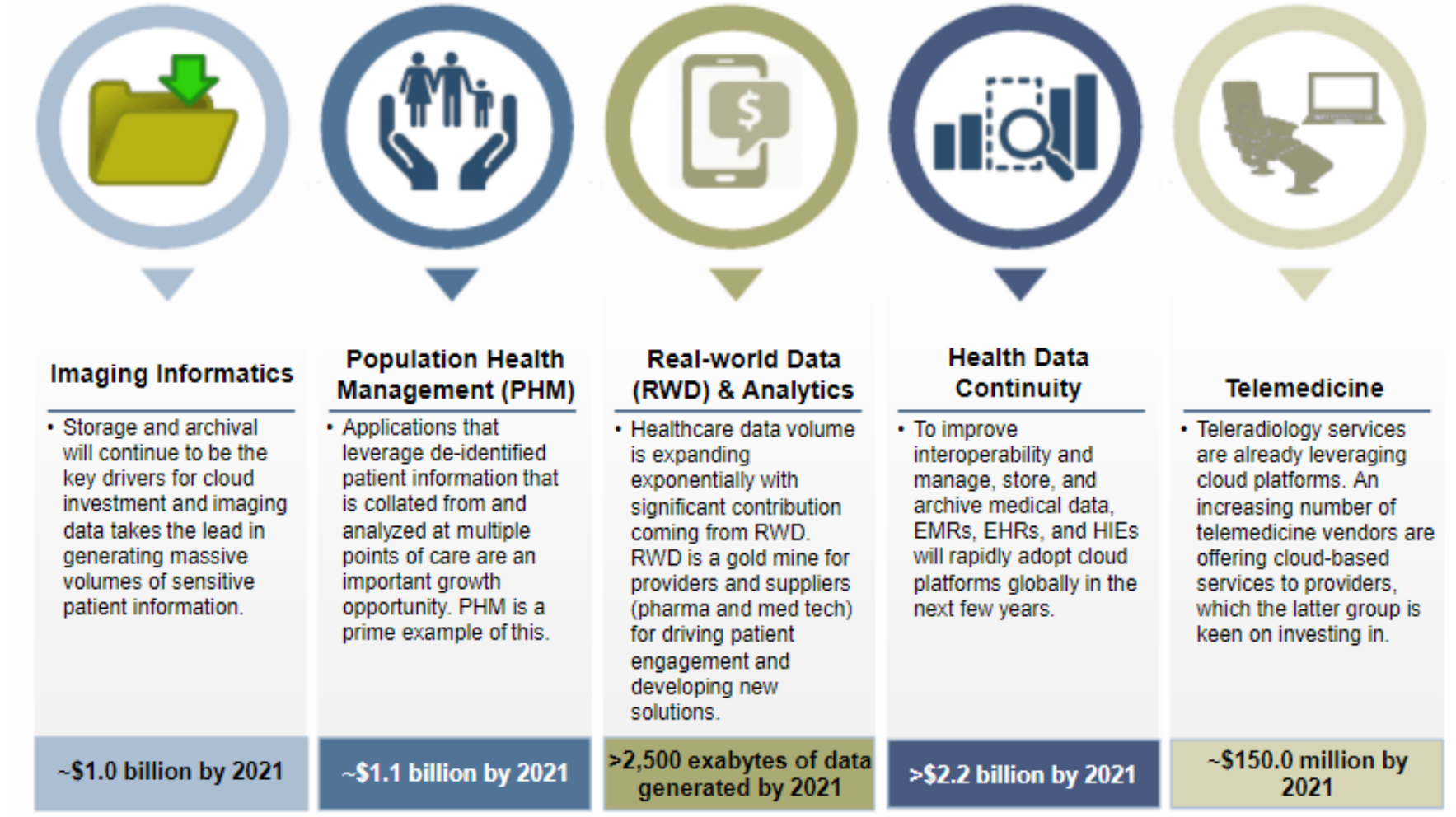


USERS AND USE CASES	
Education/ Training	Surgeons - Medical Students - Human Resources - Emergency Responders/Disaster Preparedness - Global/Remote Team Exercises – Product Sales & Marketing - Patient Education /Patient Experience
Behavioral Modification/ Mental Health/Wellness	PTSD - Autism – Schizophrenia – ADHD - Medication/Treatment Compliance - Substance Abuse - Fitness/Wellness/Weight Management - Phobias — Smoking Cessation – Sleep Disorders - Stress
Clinical Assessment	Physical Assessments - Behavioral and Psychological Assessments – Cognitive Function Assessment
Treatment for Acute and Chronic Conditions	Pain Management - Vision Disorders - Physical Therapy/Rehab - Speech Therapy – Telemedicine - Brain Injury-Alzheimer's/Dementia
Clinical Documentation	Remote Scribes - Interactive Medical Records - Data Visualization & Display

Source: Virtual Reality in Healthcare A Look at Growth Opportunities, Leading Vendors, and Market Dynamics as Healthcare Braces for the Fourth Digital Wave, Frost & Sullivan

Cloud Infrastructure and Solutions

Growth opportunities in the global healthcare cloud market

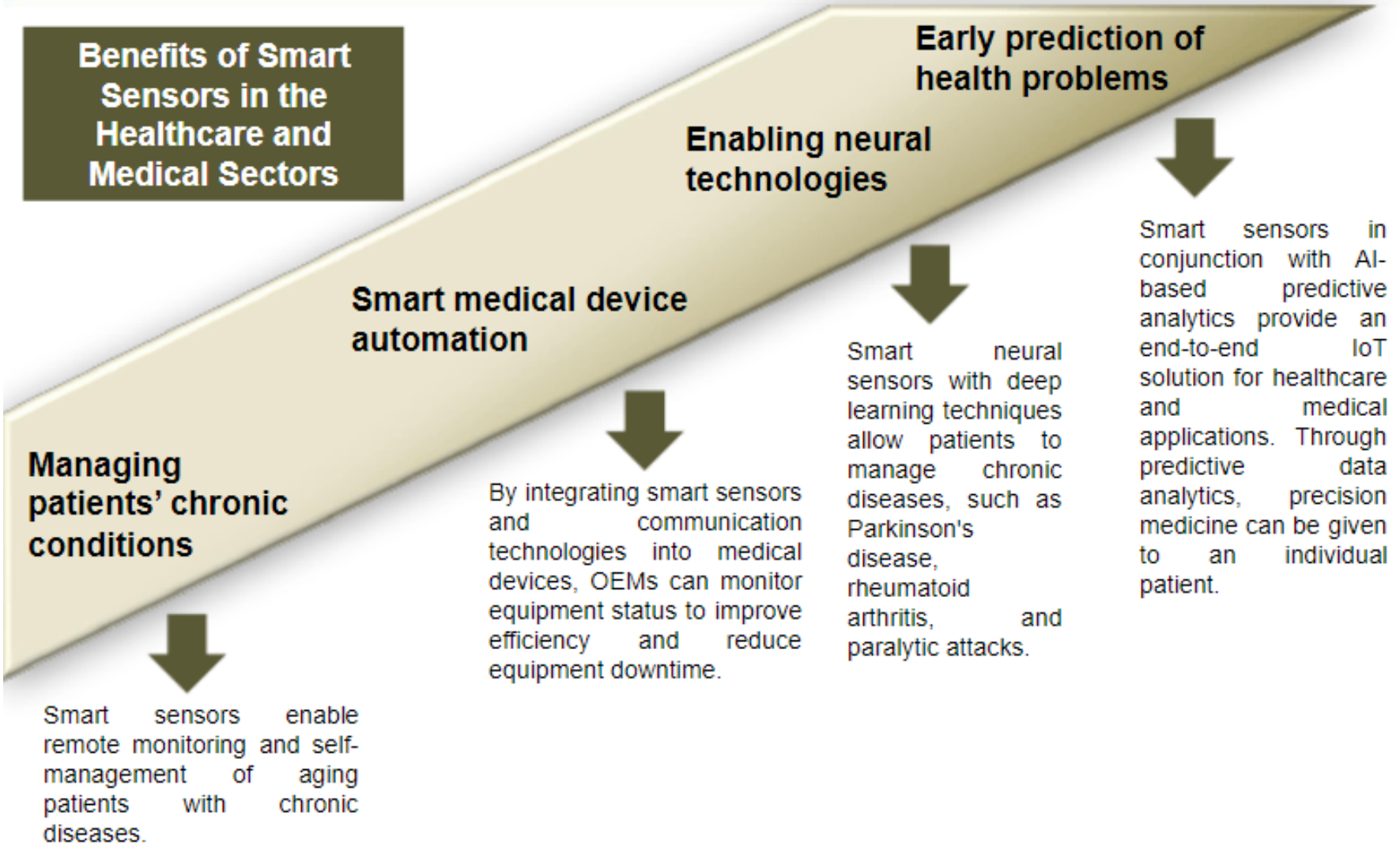


Note: The revenues mentioned above are approximate and could overlap with one or more growth opportunities.
Key: EMR—Electronic Medical Record, EHR—Electronic Health Record, HIE—Health Information Exchange

Source: Healthcare Cloud Computing Outlook, Frost & Sullivan

Smart Devices – IoT

Application of smart sensors in the healthcare sector



Source: Innovations in Smart Sensors, Frost & Sullivan

Digital Health Regional Hot Spots

Global Perspective—Emerging Markets

India

- Government reforms in regulatory policies for advanced diagnostics will encourage localization, streamline quality standards, and improve affordability.
- Large and growing populations are boosting the demand for bio-pharmaceuticals.
- Demonetisation will simplify payor-provider-patient transactions, and the Goods and Service Tax reform is expected to have a positive impact on pharma manufacturing.
- Digital India and Make in India campaigns will provide a boost for the biotech sector.

China

- Chinese technology giants, including Alibaba, Tencent, Baidu, and Neusoft, are investing in enterprise and consumer technologies for healthcare.
- Alibaba is harnessing the cloud opportunity in emerging markets, whereas Tencent is looking at care delivery services.

Latin America

- Brazil is leading the digital health market in the region.
- Vendors have the opportunity to target early diagnostics and preventative care solutions in the market.

Africa

- Countries in Africa are investing in national digital health strategies to achieve a well-functioning public healthcare system. Examples: the completed South Africa National eHealth Strategy 2012–2016 and Rwanda' ongoing eHealth Strategic Plan 2016–2020.
- Pharmacy kiosks, data management, AI, sensors for early diagnostics, and command centers for emergency care are some of the tech initiatives being explored.

Association of Southeast Asian Nations (ASEAN)

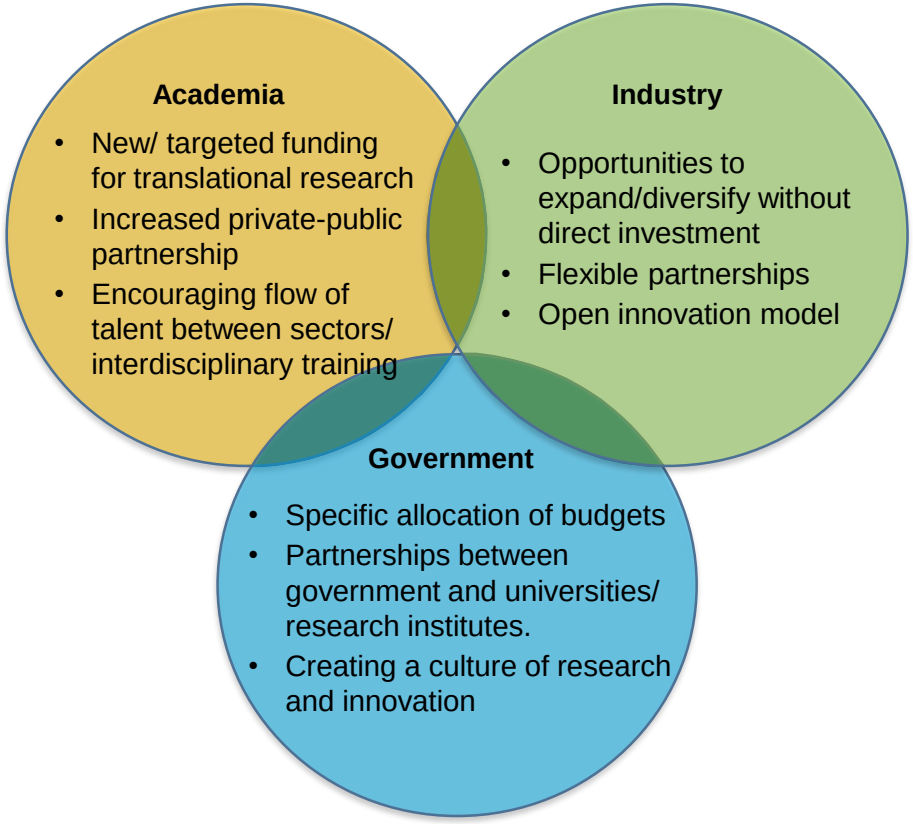
- The region will continue to be a checkerboard of opportunities for digital health, with Singapore piloting projects in remote care, population health management, and team-based care.
- Malaysia is developing its IT infrastructure for providers, and Indonesia is focusing on telehealth and mHealth services for consumers.

Source: Global Digital Health Outlook, 2018, Frost & Sullivan

Role of Academic hubs

Collaboration between academia, industry and government nurtures the medical technology industry by providing the platform for clinically led innovation

Triple Helix Model of Academia-Industry-Government Collaboration

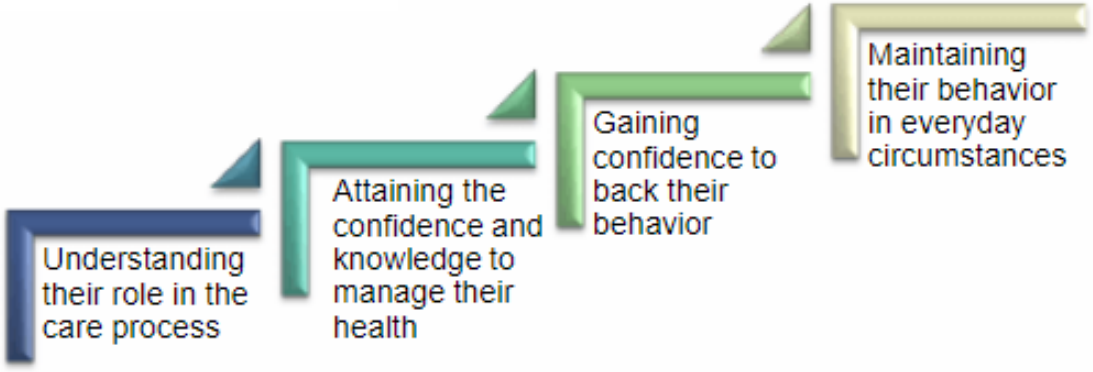


- Research and development of digital health devices faces several challenges such as **financial constraints, long lead times** to bring the product to market, and even a **lack of viable business models.**
- This has motivated several stakeholders in the industry to reconsider collaborative approaches to technology innovation.
- Best examples for medical device innovation are seen where collaborators each uses their core competence. For instance, the **clinical community provides end user input and professional opinion, academia powers innovation with its research, and industry participants with their manufacturing prowess.** This is also supported by governments and regional authorities through a favourable business environment and through research support.

Source: Global Digital Health Outlook, 2018, Frost & Sullivan

Trends Towards Wellbeing, Stay Healthy

There is a shift in culture among patients with them taking a more active role in managing their health.



Increasingly, European patients are inclined towards having a more active role in their healthcare.

- **80%** Want to share their health data if privacy is ensured
- **80%** Want to provide feedback on treatment quality
- **90%** Want access to their health data

Patient portals are a common patient engagement medium in Europe.

52% UK citizens

66% Benelux citizens

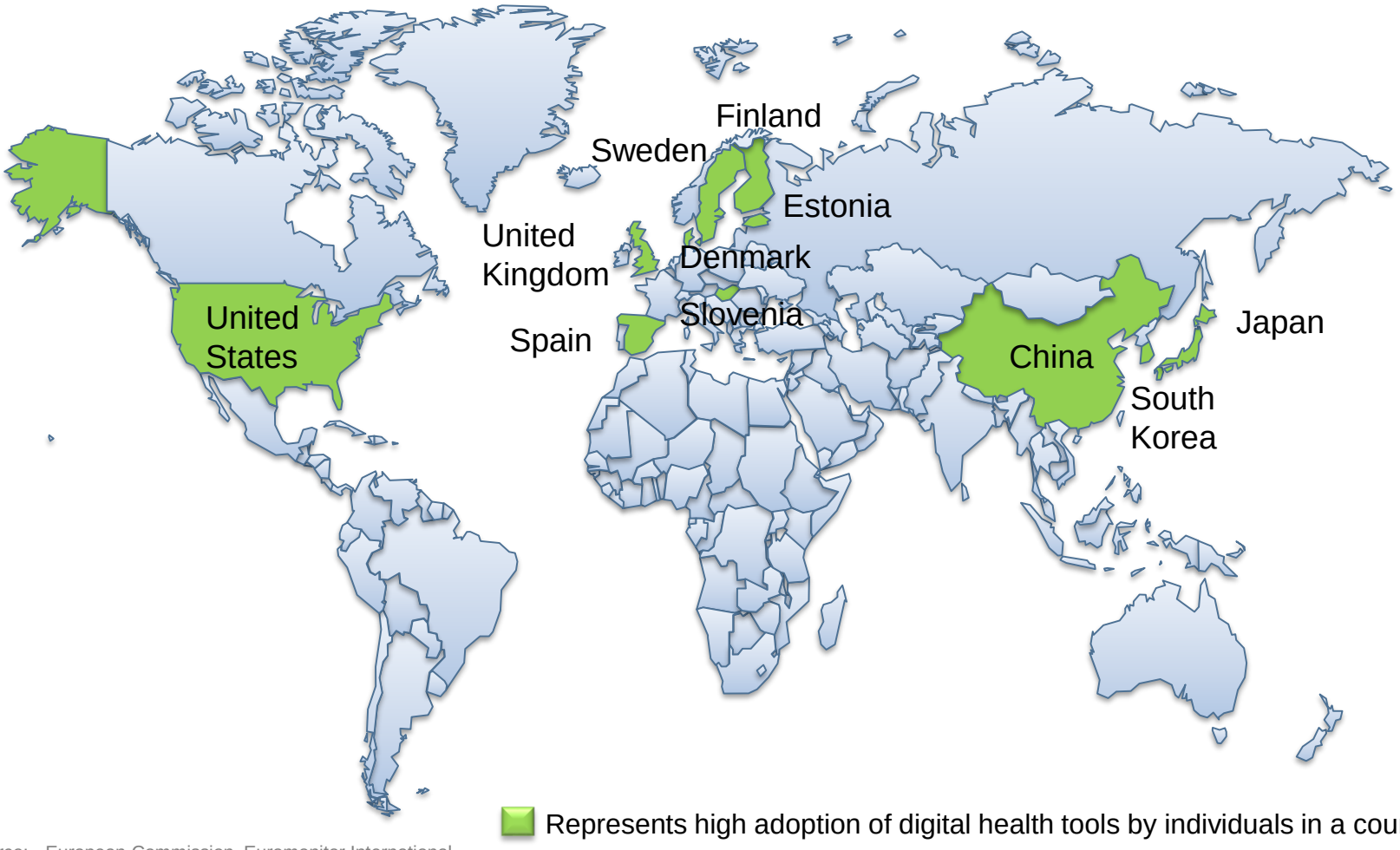
…are likely to use patient portals to get more involved in their healthcare

Source: HIMSS EU Insights, The Future of Patient Engagement 2.0 in Europe, Frost & Sullivan

Geographical variations and maturity

Estonia, Finland and Denmark lead in terms of percentage of individuals who have adopted e-health solutions.

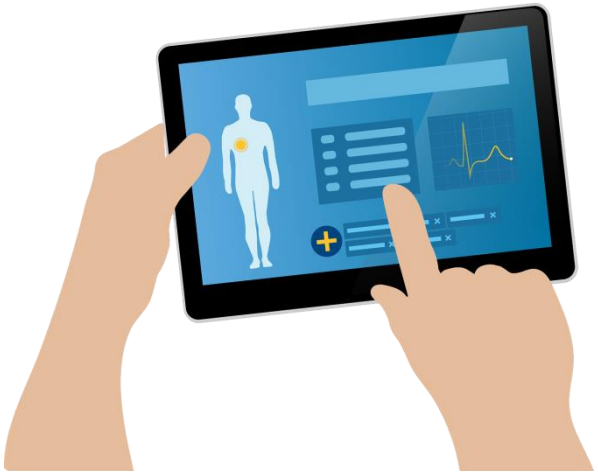
Global Digital Health Hotspots



Source: European Commission, Euromonitor International

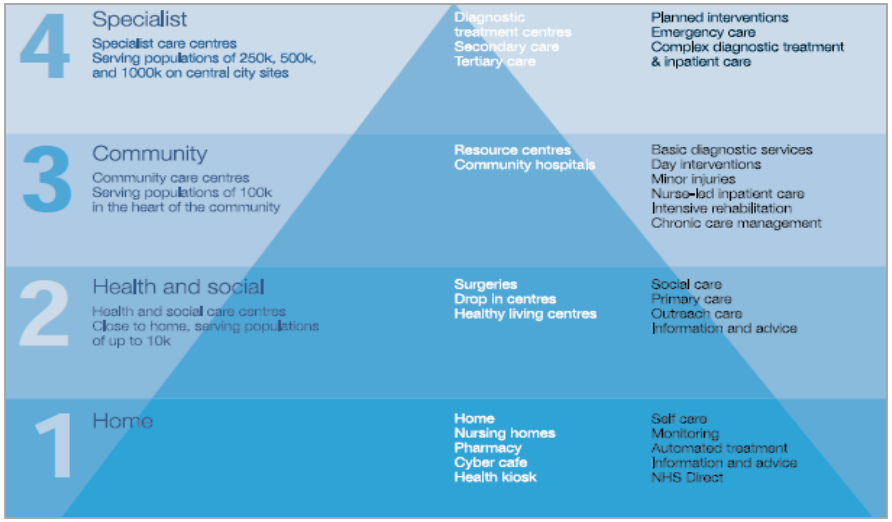
Motivations and Expectations

- **Payers** are increasingly adopting innovative methods to promote healthy behavior amongst consumers in their network. Many states in the US are developing programs to **motivate members to control weight, minimize smoking and promote vaccination**. They are trying to give members a greater stake in improving their health status, **by rewarding their healthy behavior.**
- For example, **California's Medicaid** program provides non-health-related incentives, such as movie tickets or gift certificates, to reward parents who keep up with scheduled well-child visits for their infants and adolescents.
- Similar incentives are being offered by **corporates to encourage employees to take charge of their own health**. Some common examples of such incentives include the following:
  - **Tobacco free discount** on medical plan premiums (20% off medical premiums for non-users or users who participate in a certified smoking cessation program)
  - **Drawings for iPads**, TVs with Wii Fit, gift cards, travel vouchers, fitness equipment, T-shirts
  - **5% premium discount** for sustained yearlong participation in the wellness program
- At the same time, **consumers are gradually taking up ownership of their wellness.** They are engaging more online to equip themselves with the latest know-how about their disease and available wellness options. It is expected that this behavior **will increase as share of tech-savvy Millennials rises in the global population.**



Source: The Commonwealth Fund, WellSteps

Shifts in the Future



Commercial Providers

Community Care

Shopping for Health

Living for Health

In the future, the average citizen will not just be a consumer of healthcare resources. It is predicted that local communities will take far greater responsibility for rethinking what it is to be healthy. Health will be seen as a product of broader policy and personal lifestyle choices. The associated recognition that prevention is better than cure will be driven by increasingly sophisticated social marketing techniques. It is predicted that a significant amount of national budgets will be put aside for a 'community wellness fund' in the mid term.

Healthcare Digital Transformation - So What..?

A common theme for all, yet disparate means to achieve the outcomes

	Past Approach	2019 and Beyond
Digital Transformation	What kind of Tech do we need?	What Outcomes are we trying to drive?
	How to monetize Cool Tech approaches?	How Tech & Industry convergence will drive Business & Care Delivery Innovation?
	How do you sequence and prioritize Tech adoption?	Finding the optimum Market Positioning with Intended End-users?