Health Tuesday: Launching Smart Life Finland program

Time: 5.3.2019, From 7:30am to 9:30am
Place: HTC Pinta (Tammasaarenkatu 3, 00180 Helsinki)
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

- **Shortage of healthcare professionals**
- **Burgeoning healthcare budgets falling short of expected outcomes**
- **Limited healthcare infrastructure**
- **Increasing number of Chronic patients**
- **Ageing population**
- **Rising population**

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 Expectancy vs. health expenditure, Global, 1970 to 2015

Health System Goals – Value Based Care
Focus is on improving health outcomes and overcoming regional fragmentation

The New Definition of Value Based Care

Value-based Care = \frac{(Clinical Outcomes \times Patient Outcomes)}{Burden to the System} \times 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**.
Settings for Care Provision

Care delivery moving beyond the hospital

**Specialist**
- Specialist care centres
- Serving population of 250K, 500K, and 1,000K on central city sites

**Diagnostic**
- Planned interventions
- Emergency care
- Complex diagnostic treatment & inpatient care

**Community**
- Community care centres
- Serving populations of 100K
- In the heart of the community

**Resource centres**
- Basic Diagnostic Services
- Day interventions
- Minor injuries
- Nurse-led inpatient care
- Intensive rehabilitation
- Chronic care management

**Health and Social**
- Health and social care centres
- Close to home, serving populations of up to 10K

**Surgeries**
- Social care
- Primary care
- Outreach care
- Information and advice

**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

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.

Depending on location, wait times to 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

Errors resulting from 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

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

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

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

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

- **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

- **Teenagers**
  Preventing mental health issues and substance abuse

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

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

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

Source: Vision 2025 – Healthcare in the Smart Home, Frost & Sullivan
Alternate Care Locations
Health and Wellbeing in the car

**Diagnostics**
- 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.

**Monitoring**
- 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.

**Connected Support**
- 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.

**Therapy**
- 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

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

Smartphone Apps
- Medication adherence tools
- Personal disease management diaries or logs
- Disease management information tools

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

For providing a valuable service or insight, not possible or available earlier

Achieve better patient care, experience and operational efficiency

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.

Source: Future of Smart Hospitals, Frost & Sullivan
Smart hospitals – An Example
Digital health has long-term healthcare implications.

Capacity Command Center

**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

**Objectives**
- 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.

**Benefits**
- 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.

**Current Progress**
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
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 & Analysis
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 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

5G trials are underway using various spectrum bands

<table>
<thead>
<tr>
<th>Potential 5G bands</th>
<th>Potential 5G bands</th>
<th>Potential 5G bands</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>US</strong></td>
<td><strong>EU</strong></td>
<td><strong>CJK</strong></td>
</tr>
<tr>
<td>600 MHZ</td>
<td>700 MHZ</td>
<td>3.3-4.2 GHZ</td>
</tr>
<tr>
<td>2.6 GHZ (sprint)</td>
<td>2.6 GHZ (sprint)</td>
<td>4.4-4.9 GHZ</td>
</tr>
<tr>
<td>3.55-3.7 GHZ</td>
<td>3.4-3.8 GHZ</td>
<td>28-39 GHZ</td>
</tr>
<tr>
<td>20, 37, 39 GHZ</td>
<td>26 GHZ</td>
<td></td>
</tr>
<tr>
<td>57-71 GHZ (&lt;______)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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?**

<table>
<thead>
<tr>
<th>Medical Imaging</th>
<th>Digital Pathology</th>
<th>Drug Discovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operationalizing AI platforms would result 15–20% gain in productivity for Radiologist in 12-18 months</td>
<td>AI will make its way into pathology as far as clinical diagnostic spectrum is concerned</td>
<td>For pharma AI and real-time analytics will make 'adaptive clinical trial' a reality than a concept.</td>
</tr>
</tbody>
</table>
Robotics and Automation Supporting Care Assistance
Categorization of Robots Used in Healthcare

Source: Care Assistance and Pharma Automation Robots., Frost & Sullivan
Virtual Reality Applications

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

**Imaging Informatics**
- Storage and archival will continue to be the key drivers for cloud investment and imaging data takes the lead in generating massive volumes of sensitive patient information.

**Population Health Management (PHM)**
- Applications that leverage de-identified patient information that is collated from and analyzed at multiple points of care are an important growth opportunity. PHM is a prime example of this.

**Real-world Data (RWD) & Analytics**
- Healthcare data volume is expanding exponentially with significant contribution coming from RWD. RWD is a gold mine for providers and suppliers (pharma and med tech) for driving patient engagement and developing new solutions.

**Health Data Continuity**
- To improve interoperability and manage, store, and archive medical data, EMRs, EHRs, and HiEs will rapidly adopt cloud platforms globally in the next few years.

**Telemedicine**
- Teleradiology services are already leveraging cloud platforms. An increasing number of telemedicine vendors are offering cloud-based services to providers, which the latter group is keen on investing in.

---

*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

Benefits of Smart Sensors in the Healthcare and Medical Sectors

Early prediction of health problems

Enabling neural technologies

Smart medical device automation

Managing patients’ chronic conditions

Smart sensors enable remote monitoring and self-management of aging patients with chronic diseases.

By integrating smart sensors and communication technologies into medical devices, OEMs can monitor equipment status to improve efficiency and reduce equipment downtime.

Smart neural sensors with deep learning techniques allow patients to manage chronic diseases, such as Parkinson’s disease, rheumatoid arthritis, and paralytic attacks.

Smart sensors in conjunction with AI-based predictive analytics provide an end-to-end IoT solution for healthcare and medical applications. Through predictive data analytics, precision medicine can be given to an individual patient.

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 payer-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.

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’s 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.

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.

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

Academia
- New/targeted funding for translational research
- Increased private-public partnership
- Encouraging flow of talent between sectors/interdisciplinary training

Industry
- Opportunities to expand/diversify without direct investment
- Flexible partnerships
- Open innovation model

Government
- Specific allocation of budgets
- Partnerships between government and universities/research institutes.
- Creating a culture of research and innovation

- 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.

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

Represents high adoption of digital health tools by individuals in a country
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
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

What kind of Tech do we need?

How to monetize Cool Tech approaches?

How do you sequence and prioritize Tech adoption?

2019 and Beyond

What Outcomes are we trying to drive?

How Tech & Industry convergence will drive Business & Care Delivery Innovation?

Finding the optimum Market Positioning with Intended End-users?