Digital Healthcare Ecosystem Supporting Health And Wellness

August 20, 2019
Focus Points - Agenda

1. Recap of Digital Health Ecosystem of 2025 & Identify Key Digital Health Market Participants
2. Select Success Stories
3. Recognize Regional Innovation Hotspots & Trends
4. Learn About Global Academic Hubs for Digital Health
5. Key Takeaways
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
Technology enablers will support the paradigm shift to care delivery models in the future

- 5G
- Analytics and AI
- Virtual Reality
- Robotics and automation supporting care assistance
- IoT
- Cloud infrastructure and solutions
- Cybersecurity
- Decentralized Care Delivery
- Patient Experience and Customer Focus
- Preventive and Wellness Focused
- Cost Containment

Source: Frost & Sullivan Analysis
5G Is Now Being Implemented in Healthcare

Rush Aims to Be First Hospital in U.S. to Use Standards-Based 5G

January 8, 2019

Rush teams with AT&T to explore use of ultra-fast network in technology-driven therapies

“Rush University Medical Center plans to become the first hospital to use standards-based 5G (fifth-generation) in the U.S., ultimately bringing faster broadband speeds to support the innovative information technology that Rush currently is using throughout the Rush System. Provided by AT&T, the 5G technology will be employed in various use cases aimed at improving outcomes, increasing staff efficiency and enhancing the patient experience.”

East China to build 5G-based eye hospital

Source: Xinhua | 2019-06-02 22:08:52 | Editor: mingmai

“Xiamen, in east China’s Fujian Province, will build a 5G-based eye hospital for better patient experience.

The 5G hospital will be jointly set up by Xiamen Eye Center of Xiamen University, Xiamen branch of China Telecom and the tech giant Huawei, according to a cooperation agreement signed by the three sides Sunday.

In the future, online livestreaming eye surgeries, remote consultation of oculists and remote guidance of eye surgeries are key areas to apply the technology, Zhang said.
VODAFONE COMPLETES WORLD’S FIRST CONNECTION OF 5G SMARTPHONES TO ITS NETWORK

Vodafone has invested €90 million in Milan to build the first 5G network in Italy, covering over 80% of the city. It has launched 31 5G use cases to date working with 38 industrial and public sector partners. The use cases cover the fields of health and wellbeing; security and surveillance; smart energy and smart cities; mobility and transport; manufacturing and industry 4.0; education; entertainment; and the digital divide. The use cases include a 5G Connected Ambulance developed with San Raffaele hospital; Europe’s first live 5G news broadcast with Sky; and a self-driving robotic vehicle delivering books at the Polytechnic University of Milan campus. Vodafone has also allocated €10 million over four years for the ‘Action for 5G’ competition for start-ups, SMEs and social businesses.
Analytics and AI
Top 10 Healthcare AI Applications

Source: Frost & Sullivan Analysis
Top Vendors for Healthcare AI across Select Use Cases

**Drug Discovery & Research**
- BenevolentAI
- Biologic
- Exscientia
- BERG
- RECURSION

**Wearable/Sensor Data Insights**
- EarlySense
- AliveCor
- Propeller
- physIQ
- nanit
- BISOBERGY

**Predictive Insights & Risk Analytics**
- AYASDI
- Digital Reasoning Technologies
- NextHealth
- Qventus
- APLIXO
- OLIVE
- innovaccer

**Chronic Condition Management**
- GNS Healthcare
- Prognos
- ZEPHYR HEALTH
- Wellframe

**Clinical Decision Support**
- flatiron
- YITU
- Tempus
- maxQ Health
- CARIS
- SOPHIA GENETICS
- sensodata

**Virtual Assistance/Virtual Nurses**
- babylon
- Catalia Health
- CAREVIEW
- Your.MD
- intuition robotics

**Medical Imaging and Diagnostics**
- zebra
- ARTERYS
- iCAD
- IDX Systems
- Butterfly Network
- HeartFlow
- freenome
- sigTUPLE

**Emergency Room & Surgery**
- Augmedics
- Digital Surgery
- ACTIV Surgical, fka (Omniboros)

**Lifestyle Management & Monitoring**
- Welltok
- AiCure
- mPulse
- FREELETSIC
- SkinVision

**Mental Health**
- NEURAL ANALYTICS
- giner
- cogito

Source: Frost & Sullivan Analysis
Select Vendors for Healthcare AI across Care Continuum

### Screening & Diagnosis
- **Early Screening**
  - Breast/ Lung Cancer; Cardiac disorders; Afib, Mental health

- **Imaging and Non-imaging Diagnosis**
  - Neuro; Stroke; Cardiac; Fertility; Diabetes; UTI
  - AI apps; Chatbots; Virtual avatars

- **Primary Care Support**
  - Neuro; stroke; Cardiac; Fertility; Diabetes; UTI
  - Virtual avatars

- **Clinical Decision Support**
  - Neuro; stroke; Cardiac; Fertility; Diabetes; UTI
  - Virtual avatars

### Treatment
- **Therapy Planning**
  - Neuro; stroke; Cardiac; Fertility; Diabetes; UTI
  - Virtual avatars

- **Surgical Navigation & Execution**
  - Neuro; stroke; Cardiac; Fertility; Diabetes; UTI
  - Virtual avatars

### Post Care Management
- **Condition Management**
  - Diabetes, Cardiac; mental health; cancer

- **Patient Engagement**
  - Interactive robots; chatbots

- **Care Coordination**
  - Treatment adherence; integrated RPM; End of life care

### Key Companies
- CytRx
- Zebra Medical Vision
- Enlitic
- HealthTap
- MaxQ
- Babylon
- IQion
- Sompo Care
- Robear
- VEEBOT
- Kompai Robotics
- Vesta Robotics
- Catalia Health
- MedRobotics
- EAI Robotics
- AiCure
- HealthTap
- IDx
- VITREOS HEALTH
- Titan Medical
- DiCE AI
- Datamars
- Dreamtelligence
- BotPartner

### Phase of Adoption
- **Nascent**
- **Emerging**
- **Growth**

**Source:** Frost & Sullivan Analysis
Select Vendors for Healthcare AI Powered Clinical Management Applications

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Source: Frost & Sullivan Analysis
Robotics and automation supporting care assistance
Segmenting Healthcare Robots

- Personal Service Robots
  - Assistive Exoskeletons
  - Medical Service Delivery Robots
  - Intelligent Robot Companions
  - Home Care Servant Robots
  - Soft Robots
  - Person Carrier Robot
  - Social Robots

- Medical Robots
  - Rehabilitation Exoskeleton Robots
  - Training Robots
  - Nursing Robots in Hospitals
  - Diagnostic Robots

- Surgical Robots
  - Minimally Invasive Procedures
  - Tool Holders
  - Patient Positioner
  - Open Surgery Assist
  - Radiosurgery

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

Source: Frost & Sullivan Analysis
Select Healthcare Robots

Source: Frost & Sullivan Analysis
Virtual Reality Use Cases

Reality technologies are on the cusp of disrupting the human-machine interface, giving rise to an entirely new computing experience.

Source: Frost & Sullivan Analysis
Top Vendors in the XR Space

Phase of Adoption
- Nascent
- Emerging
- Growth

AR/VR Applications
- Patient Experience Management
- Treatment Planning & Simulation
- Surgical Navigation
- Telemecine
- VR based Gamification Therapy

Top Growth Areas
- MRI/ CT Scans
- Distraction therapy
- Surgical and medical training
- Treatment simulation
- Joint replacement surgery
- Tele-surgery
- Patient Monitoring
- Chronic Pain Management
- Ortho Rehabilitation; Physical Therapy
- Mental Health

Key Companies

Source: Frost & Sullivan Analysis
CLOUD INFRASTRUCTURE AND SOLUTIONS
In 2025, cloud platforms will have a high demand and critical functions will depend on them for scale-ups.

<table>
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<th><strong>Current Drivers</strong></th>
<th><strong>Applications in 2025</strong></th>
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<td>Cost Containment</td>
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<td>Data Management</td>
<td>Real World Data and Analytics</td>
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<td>Business Process Innovation</td>
<td>Population Health Management</td>
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<td>Industry Collaboration</td>
<td>Health Data Continuity</td>
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<td>Telemedicine</td>
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- **Imaging Informatics**: Storage and archiving of very sensitive, patient data.
- **Real World Data and Analytics**: RWD is becoming very important for pharma and med-tech players.
- **Population Health Management**: Collation and analysis of de-identified patient data from disparate sources.
- **Health Data Continuity**: Collation and analysis of de-identified patient data from disparate sources.
- **Telemedicine**: Providers will be keen on investing in cloud based telemedicine solutions.

Source: Frost & Sullivan Analysis
Healthcare cloud computing vendor landscape by segment

Enterprise Cloud Vendors (mainly IaaS and PaaS)

Application Vendors (mainly SaaS)

Source: Frost & Sullivan Analysis
SMART DEVICES – IoT
Select Healthcare IoT Vendors

Source: Why Now is The Time for Interoperable Healthcare Solutions?, Frost & Sullivan
Cybersecurity will be an essential component for digital health services characterized by integration and flexi-plans for users.
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What does Success mean for a Digital Health Solution?

SAVINGS

PATIENT OUTCOMES

OPERATIONAL EFFICIENCY

Source: Frost & Sullivan
Hospital Care Pathway Improvement – Analytics Solution

Applicable Area:

- **Smart Hospitals**
  - Operational Efficiency
  - Clinical Excellence
  - Patient Experience

Opportunity

- Data Analytics / AI

Pilot Project:

- 9 weeks
- $75,000 invested
- **10X ROI**
- Savings Generated: $800,000 / Year

Details:

Analytics + AI on

- Medical Records
- Claims Data

Pneumonia Care Pathway Improvement

- $1,356 saved per patient
- 2-day reduction in hospital stay

Future Plans

- Expand to 12 conditions
- Generate $20 million in savings over 3 years

Source: Frost & Sullivan
Use of VR in pediatric setting leads to less reported needle pain

A new study published in the Journal of Pediatrics found that patients using a VR system reported less pain when being treated with a needle than their counterparts who received the standard of care.

Study: VR stimulates memories, improves quality of life for dementia patients

Image Source: Mobihealthnews
Source: Frost & Sullivan
Bridging Interoperability Gap – Cloud Based Solution

Clinical, Fitness, and Wellness Data from Non-hospital Settings
- Health Apps
- Wearables
- Implants
- Home Medical Devices
- Other mHealth Solutions

On-body/In-home/RPM
- Peripherals
- Activity Monitoring

Quick Fact:
Ecosystem of 280+ integrations with consumer and clinical digital health technologies, Validic’s platform reaches 223+ million people in 47 countries.

Monetization Model
- Service fees for pulling standardized, bulk data from Validic to organizations
- Pushing data to Validic is free for app and device makers

Benefits to End Users:
- One-to-many connectivity platform helps to aggregate and standardize most relevant health data into EHR and health systems.
- Software-as-a-service (SaaS) asset light model avoids infrastructure and installation cost.
- Drive more efficient remote patient monitoring, home care, patient discharge management, and wellness initiatives.

Source: Frost & Sullivan
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Culture of Wellness
A growing number of people of all ages, particularly middle to upper income groups, have become more aware of the importance of healthy lifestyles and are increasingly adopting digital health tools to self-track and monitor their health.

Millennials Have Kids
In 2019, Millennials (age 20 to 35 in 2016) will surpass Baby Boomers as the largest US generation and will be in prime child-bearing years. For most of these people, this time period will be their first encounter with healthcare, and many will expect to use digital health.

Growing Importance of Medicare
Each day, 10,000 Baby Boomers reach Medicare eligibility. This age wave will last through 2029. Medicare accounts for 20% of US health spending, and costs are growing. The government is focused on driving the use of digital tools to reduce costs.

Source: Frost & Sullivan
Innovation Hotspot – Western Europe
Regional Trends and Highlights

The United Kingdom
- Initiatives such as Five Year Forward View, TechUK Interoperability Charter, coordinated care efforts, and Connecting for Health
- NHS STP project
- NHS Digital, Patient Online portal by NHS, and Citizen Identity Project
- NHS One platform and NHS virtual wards
- EU-Nightingale: Smart RPM Project

Scandinavia
- A highly advanced market with new eHealth objectives and smart hospitals focused on large-scale integration projects expected to create a highly potential market for device connectivity
- Sweden, with an ageing population, investing heavily in telehealth, homecare, bring your own device (BYOD), digital health, and population health management (PHM) solutions
- Behavioral health and mHealth solutions as the most lucrative segments

Germany
- Smart eHealth citizen card rollout
- High-Tech Strategy 2020: Telematics Infrastructure rollout by June 2018
- About 44% of health investment and expenditure devoted to hospital modernisation
- Draft law on eHealth issued in January 2015 focuses on HIE and interoperability
- CCS Telehealth and Telemedicine project

Benelux
- NL top ranked for best healthcare system in Europe in 2014 by Europe Health Consumer Index
- NL priorities: to implement advanced health analytics and Big Data solutions in healthcare
- Focused on increasing number of primary care centers and digital hospital strategies across country
- Belgium investing €3.62 million in digital health solutions

Spain
- Increased funding from Spanish national health system encourages digital transformation and remuneration
- Prioritizes hospital modernization in suburban and rural locations for better care
- Spain's MoH to implement interoperable ePrescription systems (07/19)

Italy
- Focus on formation of integral national eHealth strategy
- Aims to improve exchange of ePrescriptions and eTransfer of lab data as current use is low
- Solutions currently implemented: NSIS, TSE, and CRS-SISS

France
- Reorganizing its healthcare system by combining 38 regions to form 12 regions for more joint-up care.
- The epSOS project and eGovernment plan of Italy (2012) as nationwide initiatives
- Most investments in clinical HIT, telecare, and hospital digitalization

Source: Frost & Sullivan
Innovation Hotspot – Central & Eastern Europe
Regional Trends and Highlights

**Austria**
- With more than 80% of the digitized patient records, Austria will be focusing on completely eliminating paper-based medical records and on EMR/EHR optimization in 2018.
- Austria is experiencing difficulties in rolling out enterprise-wide clinical systems because of funding issues.
- Telemedicine and telehealth are imminent trends with a high priority. In 2018, Austria will be focusing on integrating telemedicine with EMR/EHR systems.

**Poland**
- Poland’s MoH plans will introduce eHealth systems incrementally, starting with ePrescriptions, eAppointments, and health registers, from 2018 onwards.
- Poland is developing an eHealth infrastructure co-funded by the EU, which promotes the adoption of clinical IT systems and the digitalization of medical data.
- With more than 850 hospitals and 233,000 beds, Poland will be focusing on consolidation using smart solutions to centralize healthcare services delivery in 2018.

**Switzerland**
- In 2018, Switzerland will witness a high priority for standardizing health IT infrastructure under eHealth Suisse.
- A new federal law mandates hospitals to implement interoperable EHRs to facilitate data sharing and cooperation among healthcare providers.
- The country has set a deadline of 2020 for hospitals adopting interoperable EHRs and 2022 for nursing homes adopting interoperable EHRs.
- In 2018, the major focus will be to provide digital support for treatment processes, providing doctors, pharmacies, and hospitals electronic with access to information about patients medication.

**Rest of Europe**
- EHR implementation is an especially urgent topic in Central Europe.
- The primary focus will be to introduce and actively promote healthcare digitalization, increase patient safety by reducing medical errors, and provide digital access to patients’ health information online.
- High investment is expected in digital health platforms and telehealth.
- Most countries will focus on forming an integral national eHealth strategy. The Rest of Europe aims to improve the exchange of ePrescriptions and eTransfer of lab data as current use is low.

Source: Frost & Sullivan
Innovation Hotspot – Emerging Markets
Regional Trends and Highlights

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: 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

- Estonia
- Finland
- Denmark
- Finland
- Sweden
- Slovenia
- Spain
- United Kingdom
- China
- South Korea
- Japan
- United States

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

Source: Frost & Sullivan
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Source: Frost & Sullivan
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:** Frost & Sullivan
Globally, Stanford Byers Center for Biodesign is a leading example of clinically led innovative academic hub

- Numerous academic institutions in the US are innovating in the digital health space, making it a leading global destination for digital health R&D. **Stanford Byers Center for Biodesign** is a leading example of clinically led innovation that has benefited immensely from effective partnerships between academia and the health technology industry.
- By offering innovation **fellowships and training programs**, students and research fellows are encouraged to benefit from the facilities provided by the **Stanford Institutions for engineering, design and business** to create innovative solutions for the healthcare industry. These innovators-in-training are supported to take their solution to the next level, whether via start-up, corporate investment, or other implementation channels by using their worldwide network of innovators.
- To date, the network has attracted an overall investment of **$453 million** and **32 health technology companies** have been formed from fellowship projects.

- **Canada** has its own ‘Digital Health Hub (DGH)’, which is a conglomeration of **Simon Fraser University, Fraser Health, City of Surrey and many others within the emerging Surrey Innovation Boulevard**.
- The various programs running in the DGH are focused on mobile solutions, cloud computing and computer aided diagnosis.

Source: Frost & Sullivan
Europe has several academic hubs that are leading in digital health innovation.

- The prominent medical innovation clusters in Europe are scattered around the Grand Est area of **France**, Medical Valley in Nurnberg and Tuttlingen in **Germany**, Emilia-Romagna of **Italy**, Galway in **Ireland**, BioRegion of Catalonia, in **Spain**, Canton Zurich in **Switzerland** and the “golden triangle” between London, Cambridge and Oxford in the **United Kingdom**.

- The Asia-Pacific region is not far behind in establishing Medical technology hubs.
  - Examples include the Biopolis, biomedical sciences research and development (R&D) hub in **Singapore**, **Japan** Agency for Medical Research and Development (AMED) and **China** Center for mHealth Innovation (CCmHI).

**While clinical led innovation and academic partnerships can drive research, medical technology innovation clusters provide the infrastructure, facilities and opportunity to attract investment from industry.**
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