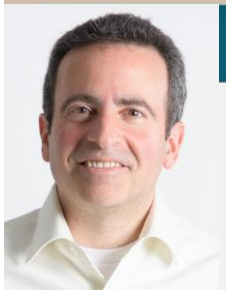
SYSTEMS ENGINEERING RESEARCH CENTER

# *"How are Digitalization and AI Driving Improvements in Healthcare Delivery?"*

SERC TALKS

**Dave Zion**
Head, Systems Engineering Center of Excellence and Strategic Program Leader
**Philips Healthcare**



**DIGITAL TRANSFORMATION**

Series Moderator: Dr. Daniel DeLaurentis, Director of the Institute for Global Security and Defense Innovation (i-GSDI); and Director of the Center for Integrated Systems in Aerospace (CISA); and Professor in the School of Aeronautics & Astronautics at Purdue University


***"How are Digitalization and AI Driving Improvements in Healthcare Delivery?"***

**June 16, 2021 | 1:00 PM ET**

David Zion
Head, Systems Engineering Center of Excellence and Strategic Program Leader, Philips Healthcare

- ❑ Today's session will be recorded.
- ❑ An archive of today's talk will be available at: www.sercuarc.org/serc-talks/ as well as on the SERC YouTube channel.
- ❑ Use the Q&A box to queue questions, reserving the chat box for comments, and questions will be answered during the last 5-10 minutes of the session.
- ❑ If you are connected via the dial-in information only, please email questions or comments to SERCtalks@stevens.edu.
- ❑ Any issues? Use the chat feature for any technical difficulties or other comments, or email SERCtalks@stevens.edu.

A University Affiliated Research Center (UARC) of the US Department of Defense, SERC leverages the research and expertise of faculty, staff, and student researchers from **more than 20 collaborating universities** throughout the United States.


# How are Digitalization and AI Driving Improvements in Healthcare Delivery?

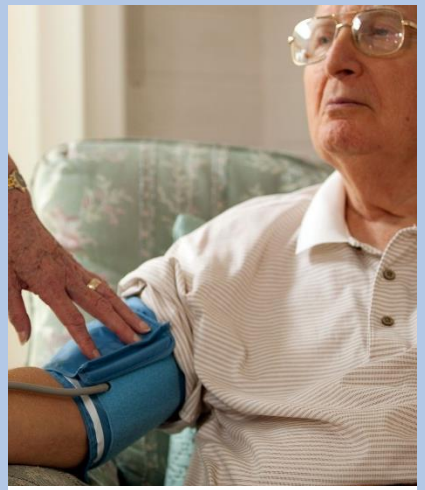
**David Zion**
**Head, Systems Engineering Center of Excellence, Philips**
SERC Talks, June 16th, 2021

innovation you

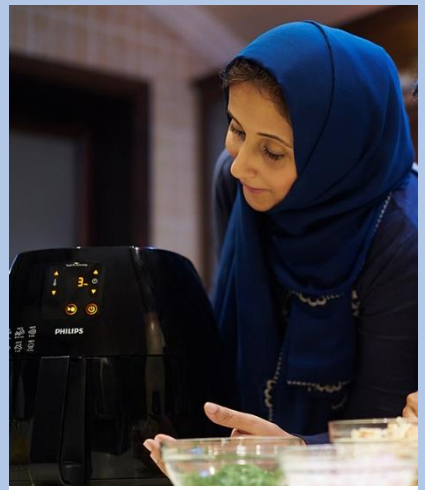
Based on a presentation by Henk van Houten, CTO, Philips
https://esi.nl/ecosystem/networking/symposium/esi-symposium-archive

# Four profound trends are shaping the future of health technology

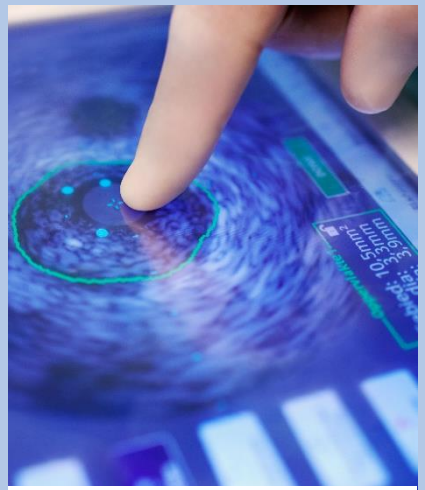
**Global resource constraints**



**Aging populations and the rise of chronic illnesses**



**Increasing consumer and patient engagement**

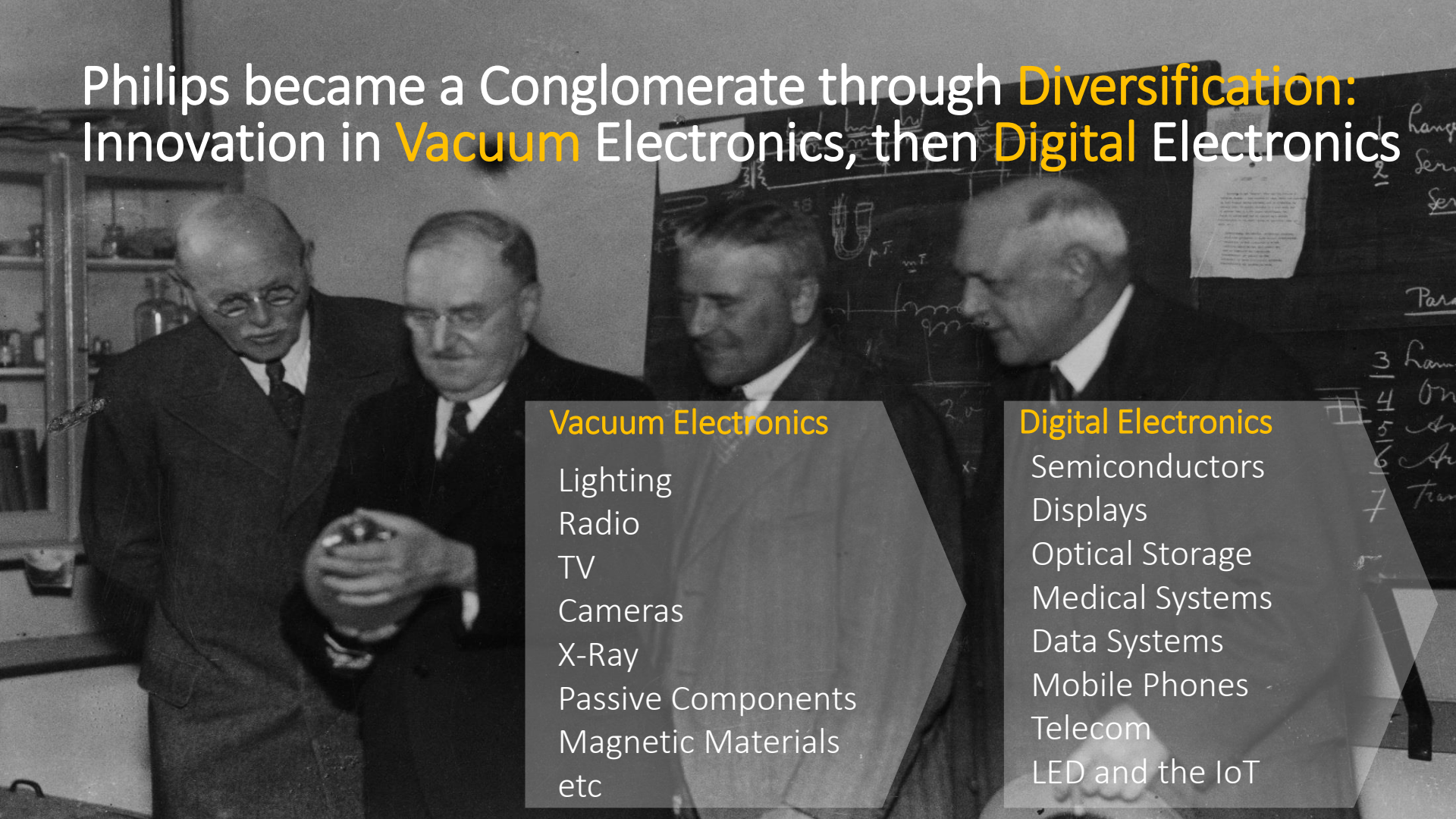


**Digitalization**

# Digitalization

# The force behind the transformation of Philips

# Philips became a Conglomerate through Diversification: Innovation in Vacuum Electronics, then Digital Electronics



## Vacuum Electronics

- Lighting
- Radio
- TV
- Cameras
- X-Ray
- Passive Components
- Magnetic Materials
- etc

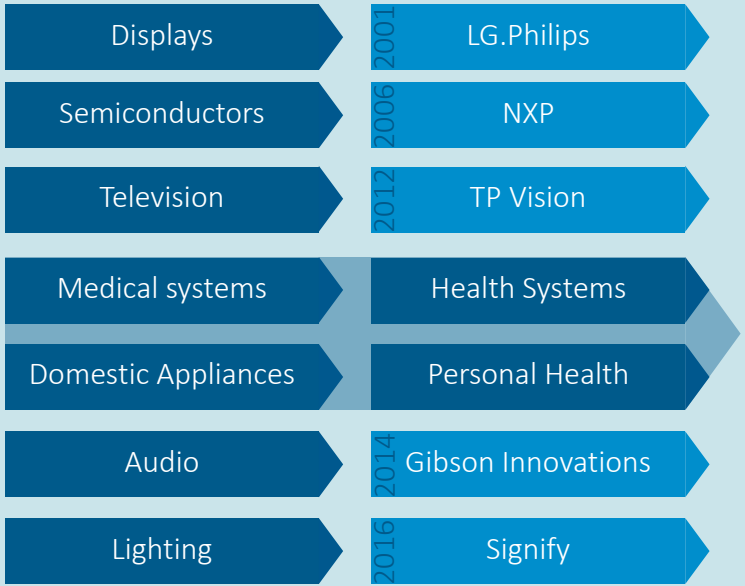
## Digital Electronics

- Semiconductors
- Displays
- Optical Storage
- Medical Systems
- Data Systems
- Mobile Phones
- Telecom
- LED and the IoT

# Digitalization led to Deverticalization

*Deconstructing the Conglomerate*

## From a diversified tech conglomerate….




## …to a focused company in HealthTech

**Organic growth through innovation:** e.g. Genomics, Digital Pathology, Cardiology Informatics, Image Guided Interventions,…

+

**Inorganic growth through acquisitions + innovation**: e.g. Respironics, Volcano, Spectranetics, VitalHealth, TomTec,…

*Not exhaustive*

# Philips Today: A focused leader in health technology

**EUR 1.8 billion**
invested in R&D in 2020

**818 new patents**
filed in 2020

Philips named
**Derwent Top 100 Global Innovator™**
for 8th year in a row

Approximately
**1 out of 2**
R&D personnel in software and data science

**59,000**
patents

**#1 medtech company**
in Boston Consulting Group's 2020 'Top 50 most innovative companies'

# The digital revolution: how photography evolved

Mechanization →


Digitization →


Integration →

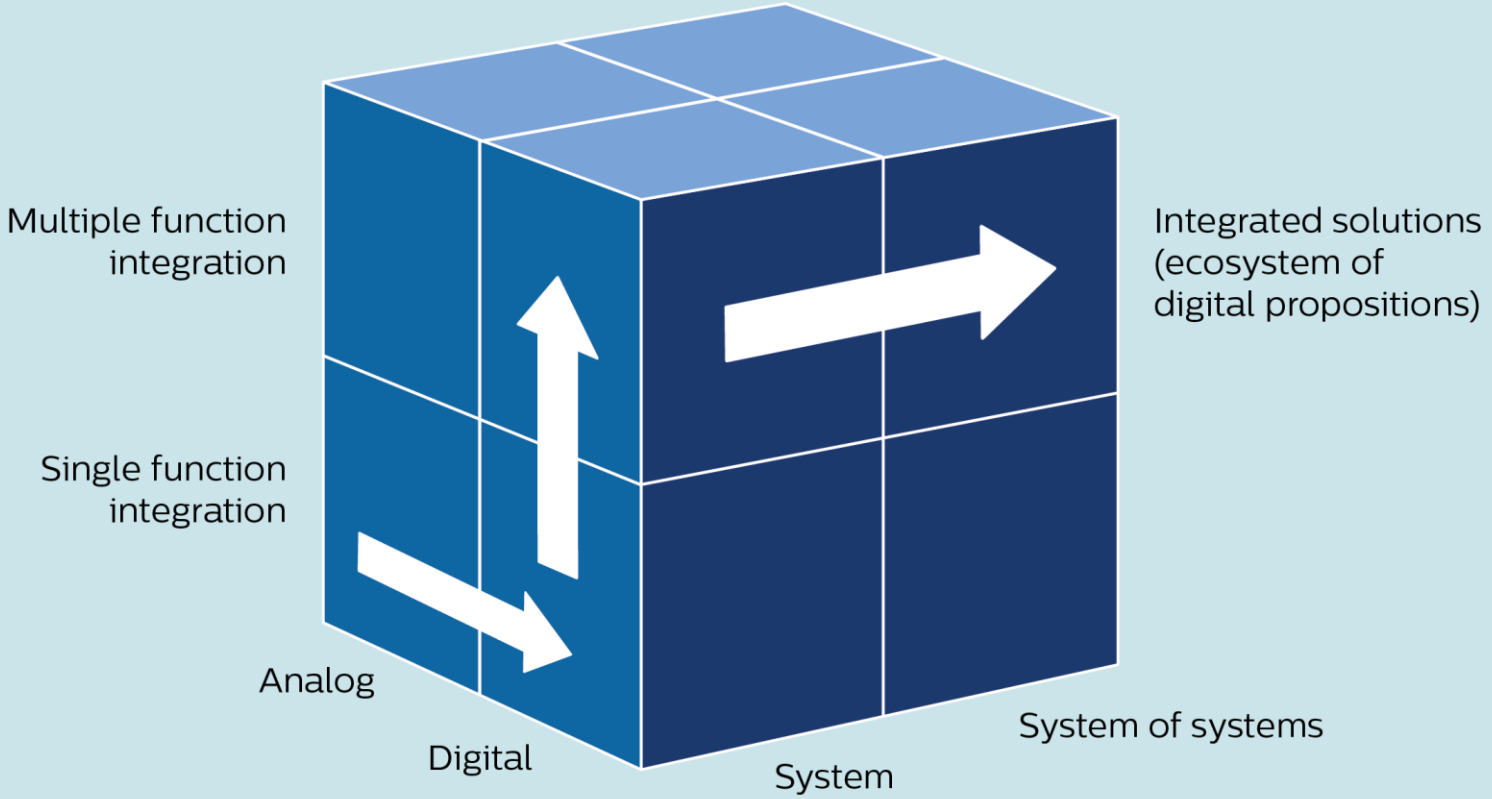
Internet →

An ecosystem of digital propositions



# The pathway of the digital revolution

## Disrupting industries and society



# Patient Monitoring start: analog, single function

Sanborn –
First portable
ECG Machine, 1928

First
Patient Monitor
'Viso-Scope', 1957

Cardiotachometer

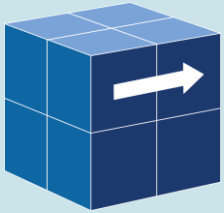
Blood Pressure Monitor

Body Temp and
Respiration Rate

Patient Monitoring
in the ICU today

# Digital monitoring platform: **all basis measurements plug and play**

# Coming up: decision support and analytics in the cloud



**CDS**

Acute respiratory distress syndrome

Acute kidney injury

Clinical information extraction

Acute respiratory failure

IntelliSpace console critical care

Decision for non-invasive ventilation

Patient deterioration

Patient acuity

Multi-organ failure

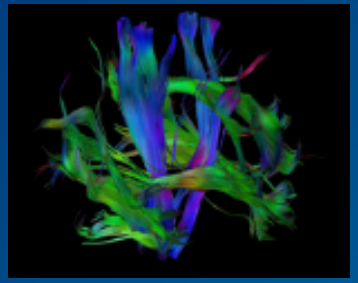
Critical care forecasting

Decision for emergency care

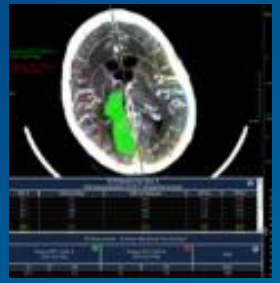
Hemodynamic instability

Patient deterioration at home

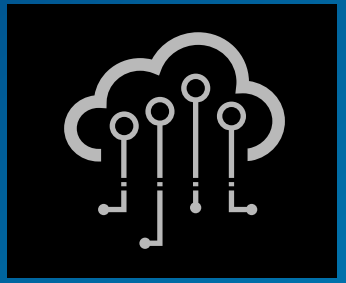
# Going forward, digital technologies will help transform healthcare in many different ways



Advanced Visualization



Quantification

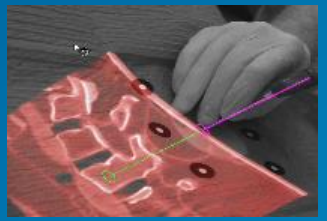


IoMT and cloud


Ubiquitous Patient Monitoring

Smart Catheters

Navigation Technologies



AR/VR


Digital Twin

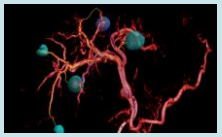
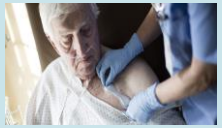
Artificial Intelligence

# Solutions and Outcomes

# Innovative value-added, integrated solutions

*Developed to better meet customer needs and capture greater value*

**Packaged suite of systems, smart devices, software and service**

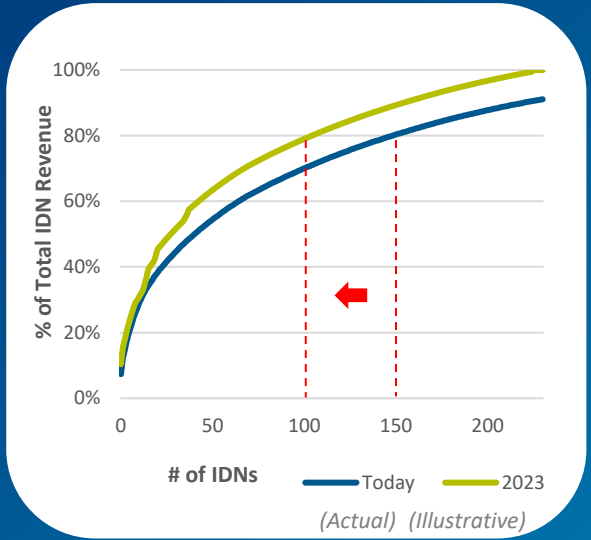
| | | | | |
|---|---|---|---|---|
| **Image-guided therapy solutions** |  Image-guide therapy systems | + |  Smart catheters | + |  Disease-specific navigation software | + |  Cath lab management, services, consulting |
| **Early warning of patient deterioration** |  Monitoring | + |  Cableless measurements, biosensors | + |  IntelliVue Guardian software | + |  Integration, services, consulting |
| **Total sleep management solutions** |  Dream Series therapy devices | + |  Care Orchestrator Care Management Platform | + |   Patient services | + |  DreamMapper patient engagement |

# Hospitals are consolidating & Industrializing

*Leading to shifting customer needs*

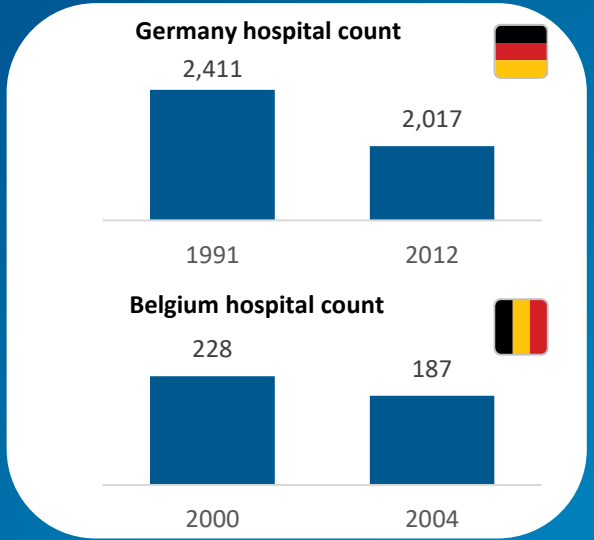
**North America:**

**~80% of IDN spend will be controlled by top 100 IDNs by 2023**



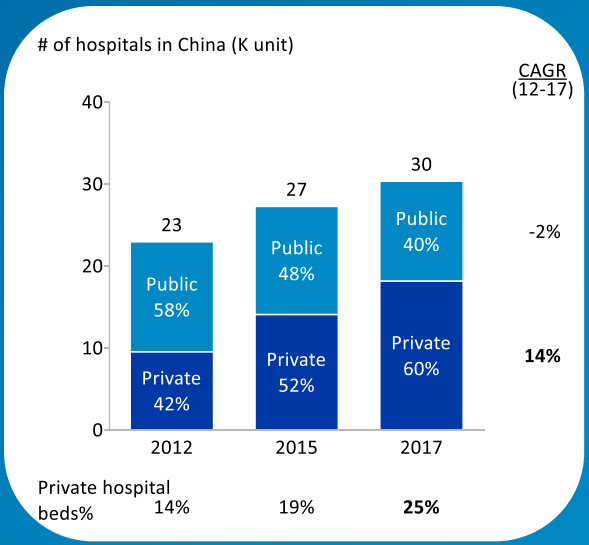

**Europe:**

**Hospitals have been consolidating across major markets**




**China:**

**Private hospital growth continues, while public hospitals are declining**

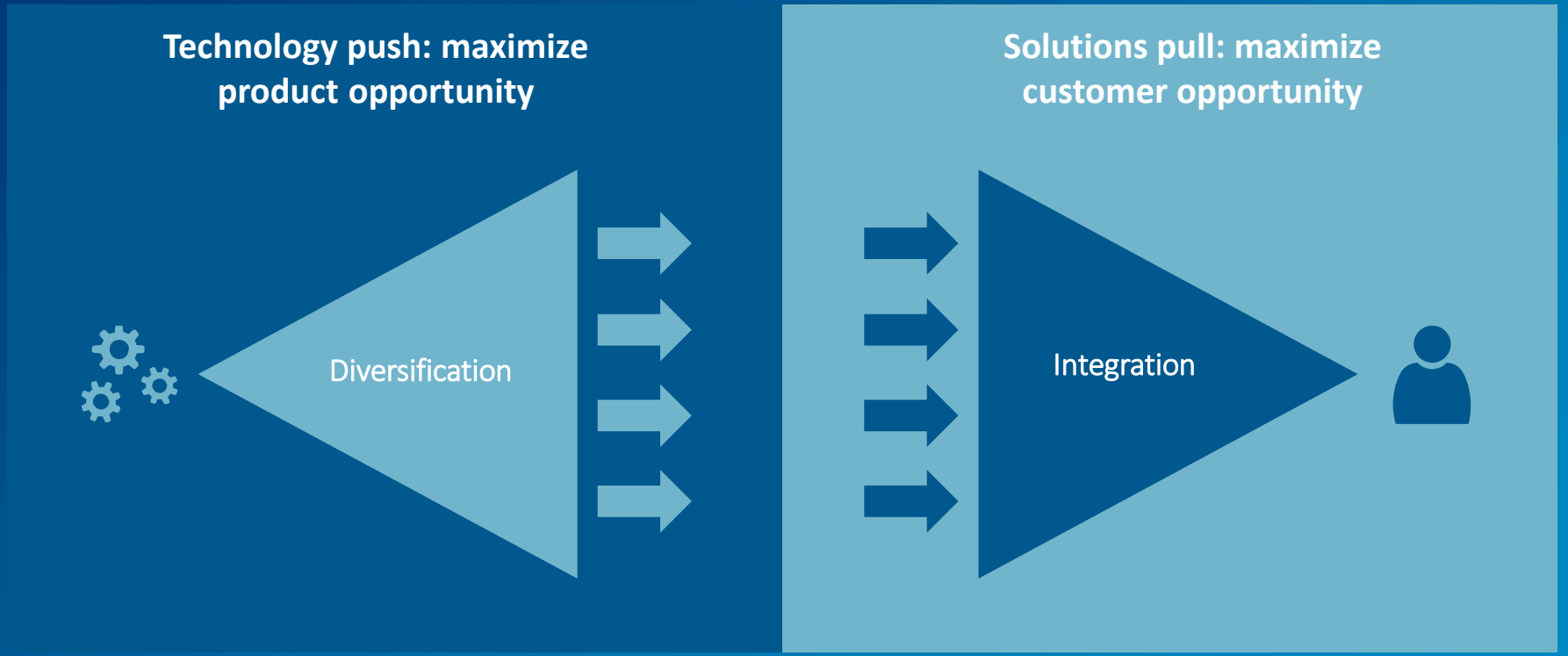


# C-Suite customers need new types of innovation

## Partnering opportunities to cope with challenges

| CEO | CIO | Chief Nursing Officer | CMO | CFO |
|---|---|---|---|---|
| Focusing on outcomes<br><br>New business models | System interoperability across care sites<br><br>Data and system security | Patient and caregiver satisfaction<br><br>Outcomes | Linking hospital care with the home<br><br>Optimizing clinical operations and workflow | Cost reduction<br><br>New financing models<br><br>Outsourcing, e.g. Radiology |

# Moving from products to solutions is transformative




It is only a solution if it addresses the customer KPI's: *becoming an outcomes company*

# Helping our customers address the Quadruple Aim

**Better health outcomes**

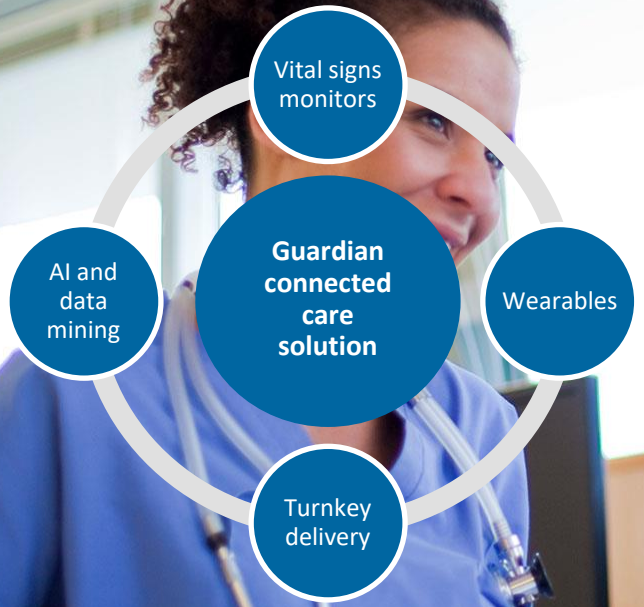
**Improved patient experience**

**Improved staff experience**

**Lower cost of care**

Win with solutions along the health continuum

# Guardian Early Warning connected care solution – addressing the Quadruple Aim




## Health outcomes

**86%** reduction of Cardiopulmonary Arrests[1]

**66%** reduction in mortality of patients transferred to the ICU[1]

## Cost of care

**24%** reduction in ICU admission rate[1]

can reduce length of stay[2]

## Patient experience

Patients feel safer in general care unit[2]

Faster hospital discharge[2]

## Staff satisfaction

**35%** reduction of severe Adverse Events[1]

**52%** improvement in notifications to trigger interventions[1]

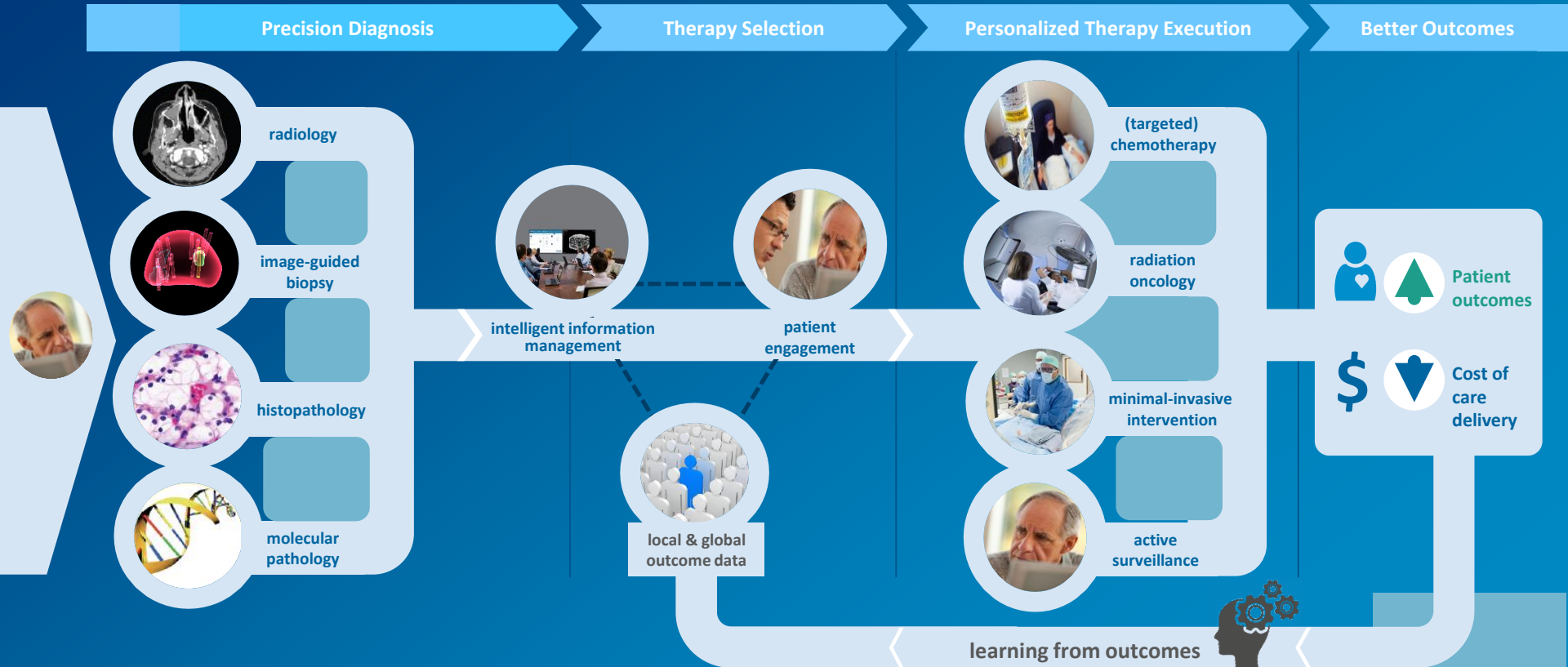
[1]Subbe et al. Effect of an automated notification system for deteriorating ward patients on clinical outcomes. Critical Care (2017) 21:52. Effect of an automated notification system for deteriorating ward patients on clinical outcomes. 2. Lilly CM, et al. Hospital Mortality, Length of Stay and Preventable Complications Among Critically Ill Patients Before and After Tele-ICU Reengineering of Critical Care Processes. JAMA. June 2011

# Extend access to care

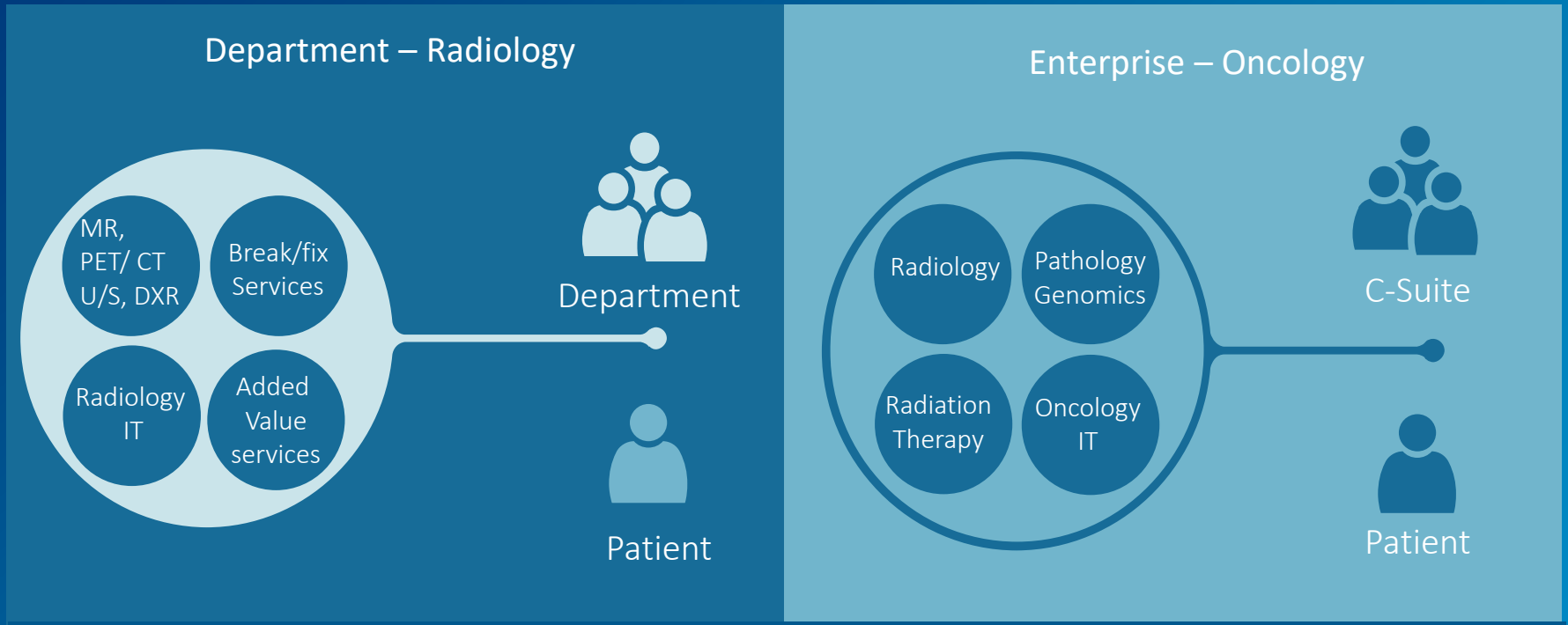
## Physical distance is no longer an obstacle

Whether in a hospital, clinic or remote satellite office, Collaboration Live lets you remotely and securely communicate with your team and patients in real time through the ultrasound system - wherever you are.

# Cancer Care from Diagnosis to better Outcomes



# Solutions can be at department or enterprise level

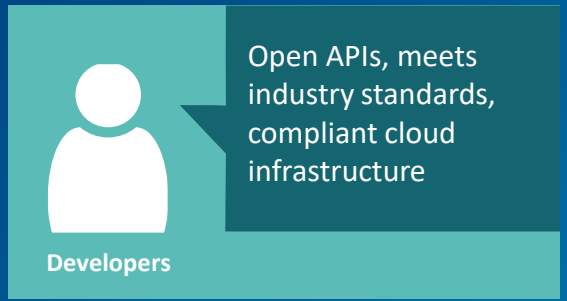



Both require a shift from product to solution and from transaction to relationship


PHILIPS
Solutions are unlocking the power of Data
HealthSuite as “System of Engagement”

# Customer needs related to Data



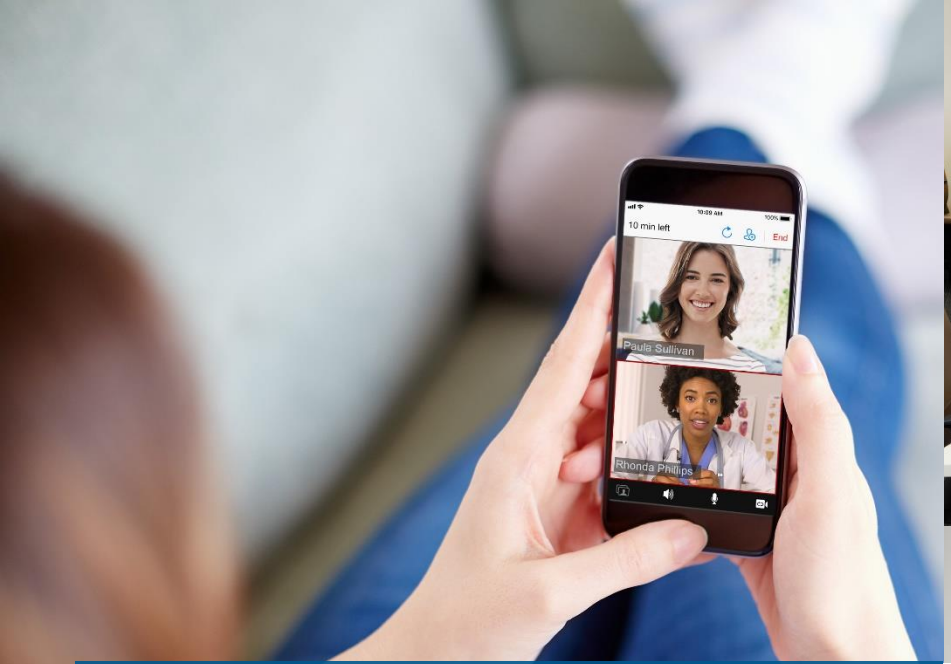


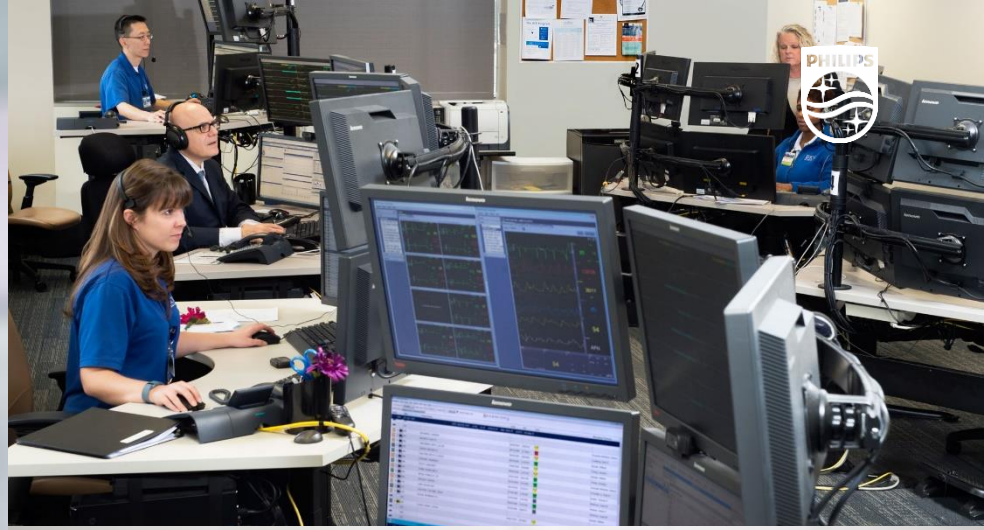

Seamless, connected care that fits the workflow and daily routines of staff

# **Health**Suite – a unique Platform evolving into a System of Engagement on top of the EMR*

| | | | | |
|---|---|---|---|---|
| Quadruple aim | Better **health outcomes** | Improved **patient experience** | Improved **staff satisfaction** | Lower **cost of care** |
| Clinical journeys | **In the home** | **In the hospital** | **Care management** | **Precision diagnosis** |
| Solutions | **Products, SW, Systems** → | **Services** → | **Ecosystems** | |
| **Health**Suite | **Workflow** | **Intelligence** | **Engagement** | |
| | **Host** Cloud and On Premise | **Authorize** Federated identity Access control | **Connect** Healthcare IoT | **Store** Secure data stores Data federation | **Share** Interoperability | **Analyze** Analytics |
| EMR | **System of Record:** Patient History, Medication lists, Clinical Documents, Notes, Protocols, Guidelines | | | |

*and other Hospital IT systems for billing, lab mgt etc



# Enabling Virtual care

Making scarce resources available 24/7
Optimization of resources and better quality of care, by virtual consults, networked care and remote monitoring

**eICU**

**Remote Monitoring**

**Command Center**

# Enterprise Clinical Operations Center

Orchestrating Patient Flow and Hospital Resources *with* real time forecasting and decision support to aid patient and resource coordination and reduce unnecessary delays

Facilitate standards of care in all settings and locations

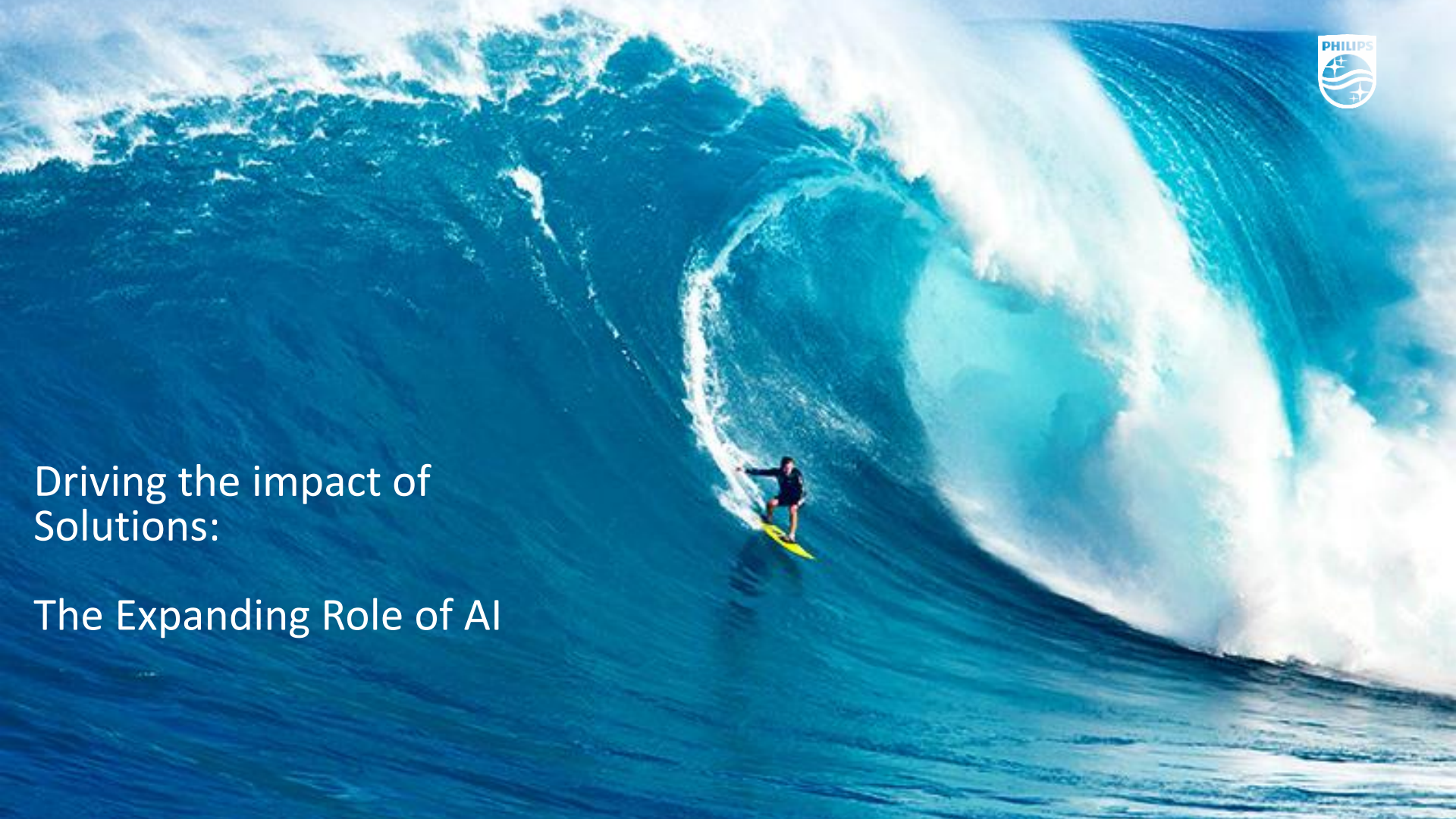
Centrally manage inpatient care with Telehealth / eCareManager

Building better flow mgt using clinically informed AI to identify patients best positioned for step-down to lower cost settings and manage to DRG codes

Make performance more transparent, comparable across IDN at hospital, unit and provider level

360 awareness- Predict tomorrow's flow bottlenecks via AI by leveraging wealth of operational and clinical data

Managed patients in the community with Philips remote monitoring and population health




# Driving the impact of Solutions:

# The Expanding Role of AI

# The opportunity of AI in Healthcare

- AI applications can potentially create $150B in annual savings for US healthcare by 2026
- Growth in the AI health market is expected to reach $6.6 billion by 2021— a CAGR of 40 %
- In just the next five years, the health AI market will grow more than 10x.
- Opportunities are in clinical, operational, and financial domains

| Application | Value* |
|---|---|
| **Robot-Assisted Surgery** | **$40B** |
| **Virtual Nursing Assistants** | **$20B** |
| **Administrative Workflow Assistance** | **$18B** |
| **Fraud Detection** | **$17B** |
| **Dosage Error Reduction** | **$16B** |
| Connected Machines | **$14B** |
| **Clinical Trial Participant Identifier** | **$13B** |
| **Preliminary Diagnosis** | **$5B** |
| **Automated Image Diagnosis** | **$3B** |
| **Cybersecurity** | **$2B** |
| **Total** | **~$150B** |

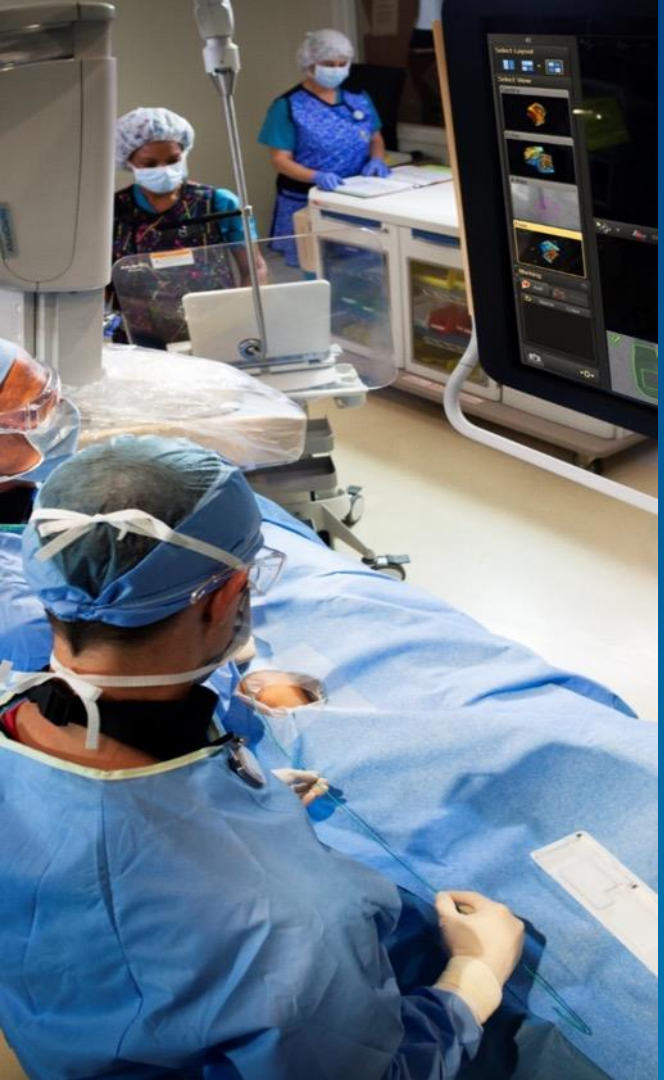
* Frost and Sullivan, by 2026


Coral Dev Board


# AI is starting in the cloud, but will become embedded as well

- AI software providers are tailoring their AI models and algorithms for deployment on machines and devices outside the data center
- Chip manufacturers are increasingly embedding support for AI directly into devices
- AI chips are being developed that can perform complex computations but consume minute amounts of power
- Machines with embedded AI are beginning to appear in many industries, including health care
- Annual shipments of devices with embedded AI are projected to increase from 79 million last year to 1.2 billion in 2023

https://www2.deloitte.com/insights/us/en/focus/signals-for-strategists/pervasive-intelligence-smart-machines.html



# Dealing with AI responsibly will be key to success

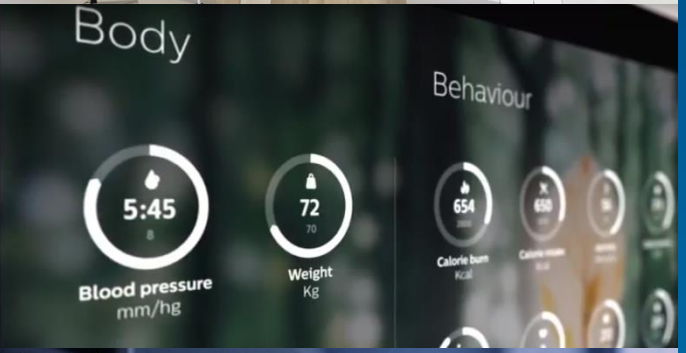
**Appropriate validation** on well curated , annotated, and representative test data is key (avoiding bias)

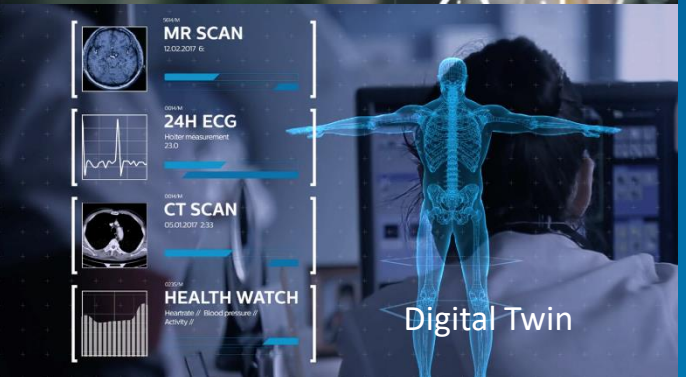
We must be mindful about customer/patient concerns related to **their personal data**

Trustworthy companies become **preferred data partners**

Ethical dimension is very important. AI must not **harm or adversely affect citizens**

When it comes to legal requirements, **transparency, choice and access** are fundamental principles




# Effective use of AI
*Attributes*

**Dynamic:** changes dynamically, in response to you

**Unobtrusive:** integrates into the environment

**Context-aware:** devices recognize you & your context

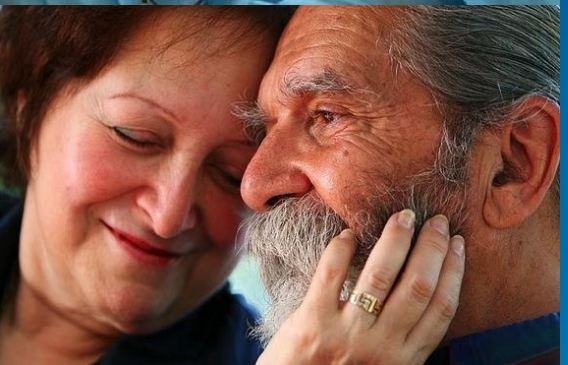
**Natural:** interact and converse in an intuitive way

**Precise:** multi-modality perspective for precision

**Personalized:** configured to your needs

**Predictive:** anticipate your condition & needs

**Pro-active:** preventative, enabling early intervention

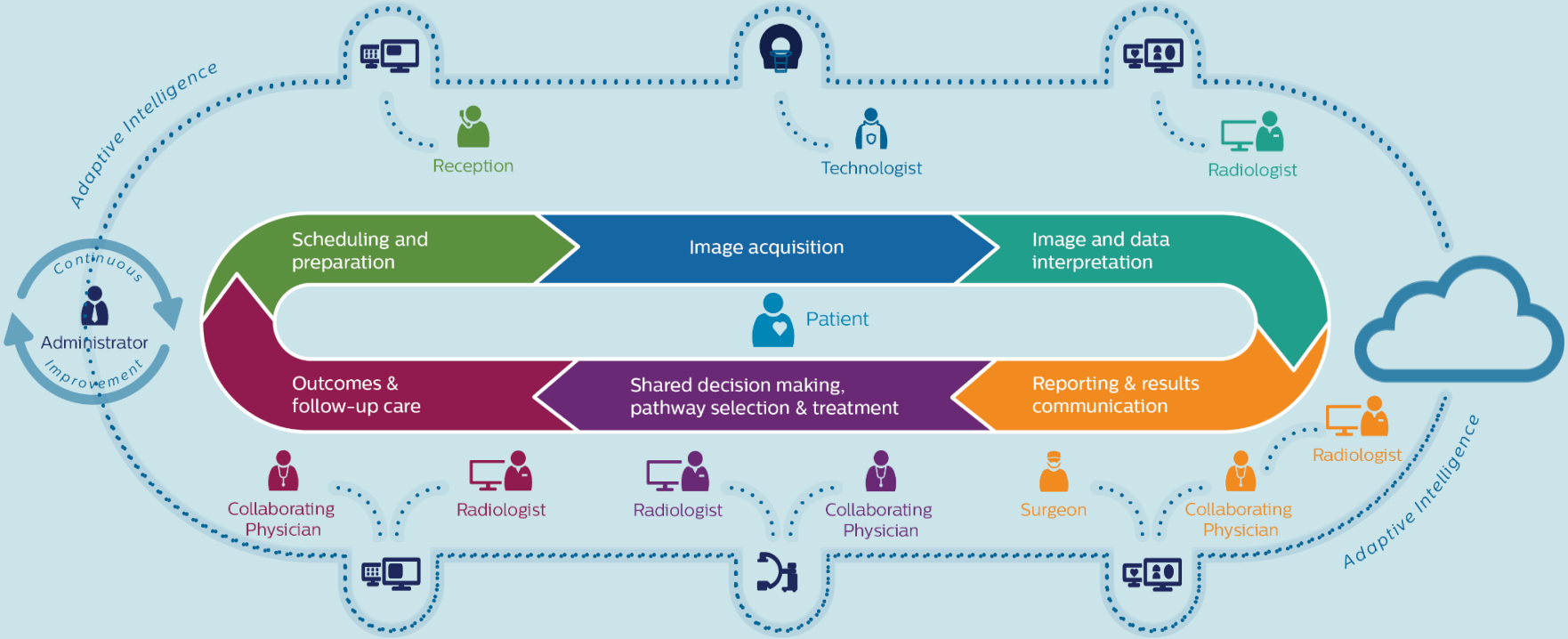


# AI in radiology will enable **precision diagnosis and efficiency**

- Integration of vast amounts of diagnostic data for earlier and more definitive diagnosis
- Right study, at the right time, leading to the right therapeutic interventions
- Precise therapies guided by imaging
- Optimal operational performance to ensure equal quality of care across hub-and-spoke health systems
- Simplified and automated workflow to reduce staff workload and variability

Using AI to **augment** healthcare providers

# A solutions approach for AI in Radiology



# Data analytics and insight gathering using Performance Bridge

Phoenix Children's Hospital, USA

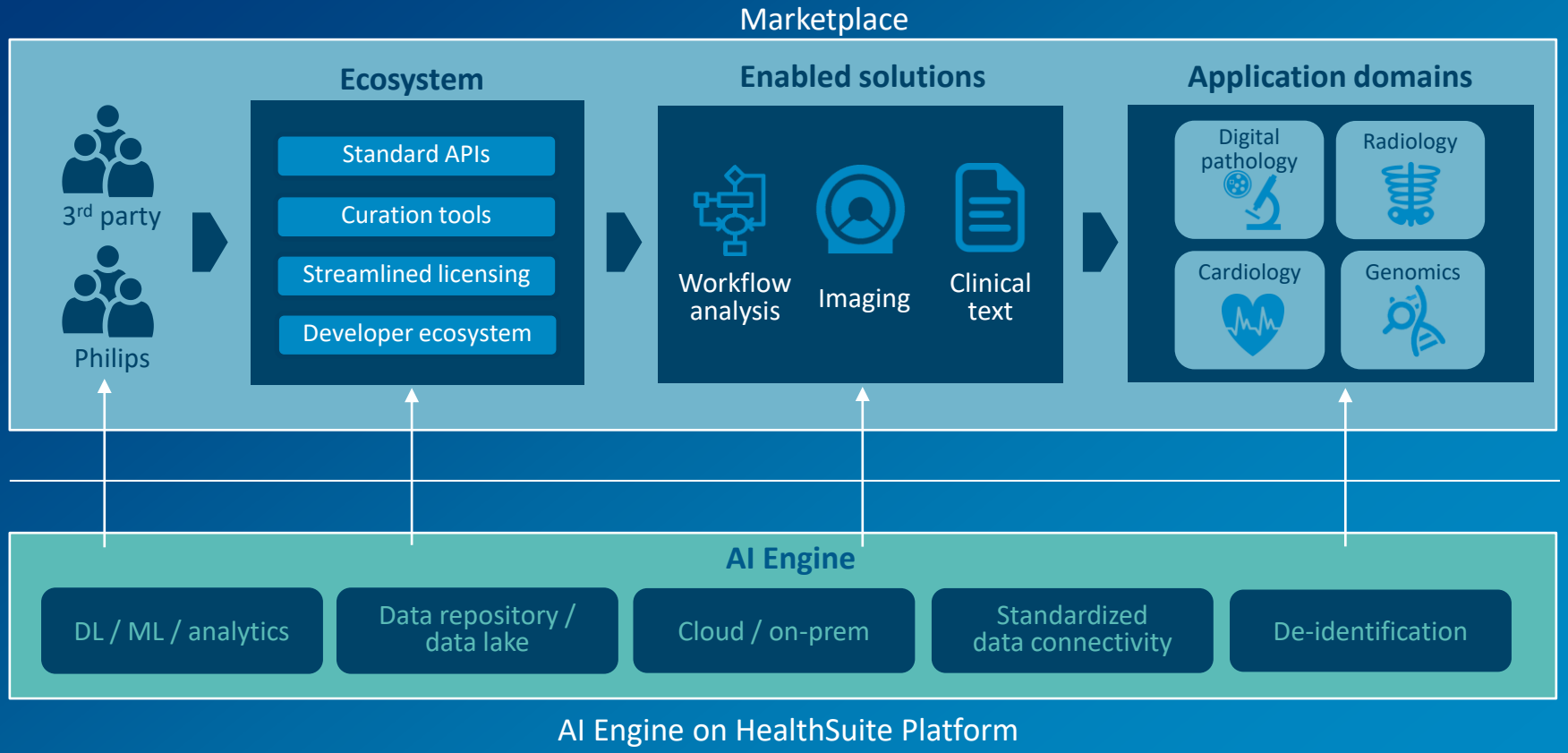
**Reduced waste**
**60** Unnecessary exam cards eliminated
**7%** Repeat scans reduction

**20+ minutes of time savings**
in changeover time

**Improved patient and staff experience**

Results from case studies are not predictive of results in other cases. Results in other cases may vary.

# Creating an Artificial Intelligence Ecosystem

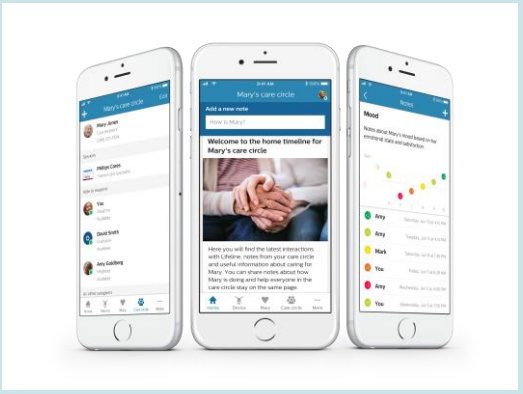


# It all comes together in a Connected Care ecosystem

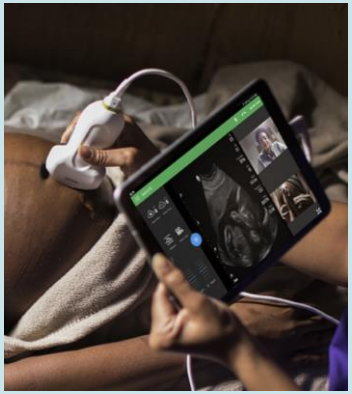
AI will enable deep insight in a person's health, disease drivers and state.
AI supports a more precise diagnosis, better therapy fit and improved adherence

**Sleep & Respiratory Care**
Coaching & therapy compliance

**e-ICU**
Real-time monitoring and Intervention



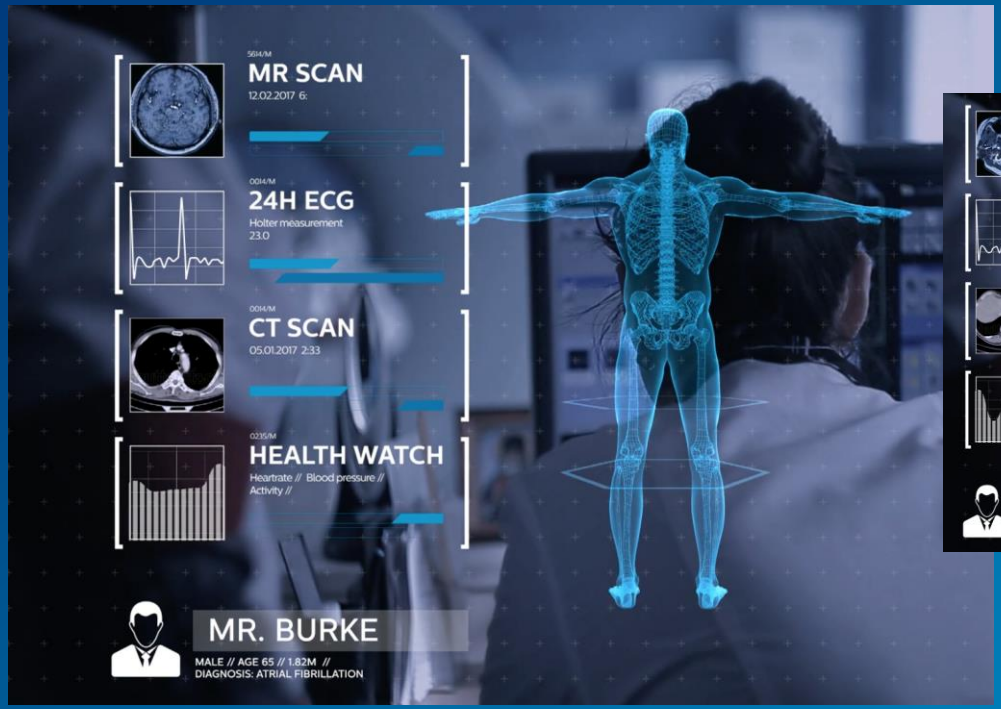

**Elderly Care**
Behavioral pattern recognition

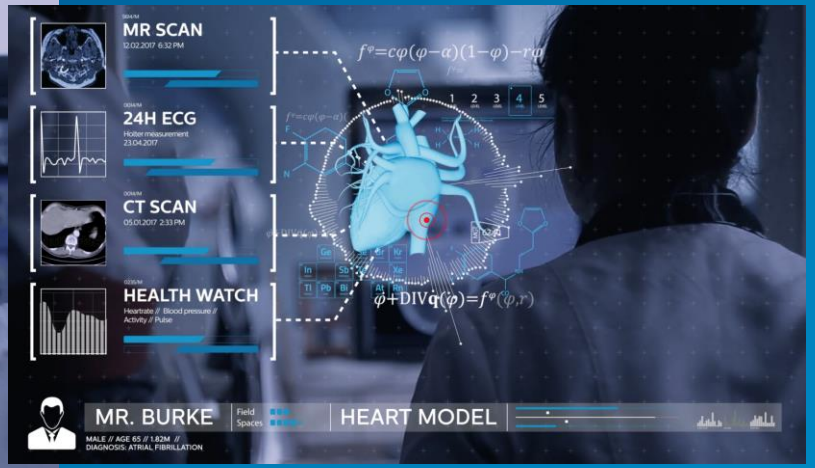


**Precision Diagnosis**
At the point of care

# Your digital twin

## Putting data and AI into a personalized clinical context

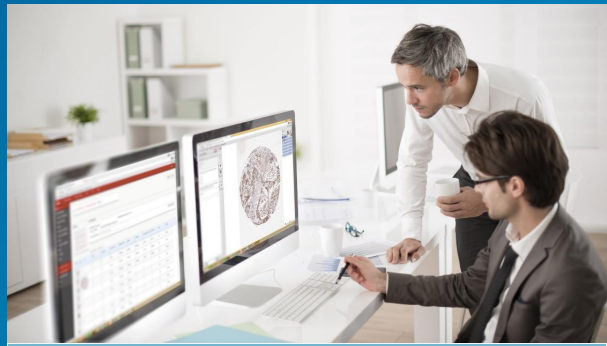


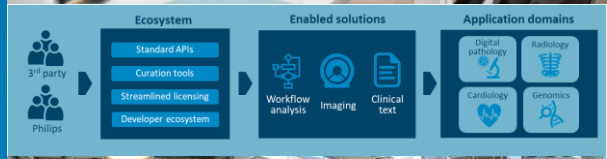



# Five ways in which healthcare innovation is changing

- From product features to solutions for value-based care
- Designing solutions aligned with customer KPI's is critical
- This requires ecosystem innovation on open digital platforms
- To unlock the power of data we need a *System of Engagement* aided by AI to translate EMR and device data into actionable insights embedded into the workflow
- Research is moving out of the lab to the frontline of innovation – co-creation with customers and ecosystem partners

https://www.linkedin.com/pulse/five-ways-which-healthcare-innovation-has-changed-over-van-houten/







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