Digital Care & Operations

# Using Patient Digital Twins in Healthcare

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# Content

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# Hitachi

## Healthcare – what we do

# Hitachi Healthcare Focus Areas

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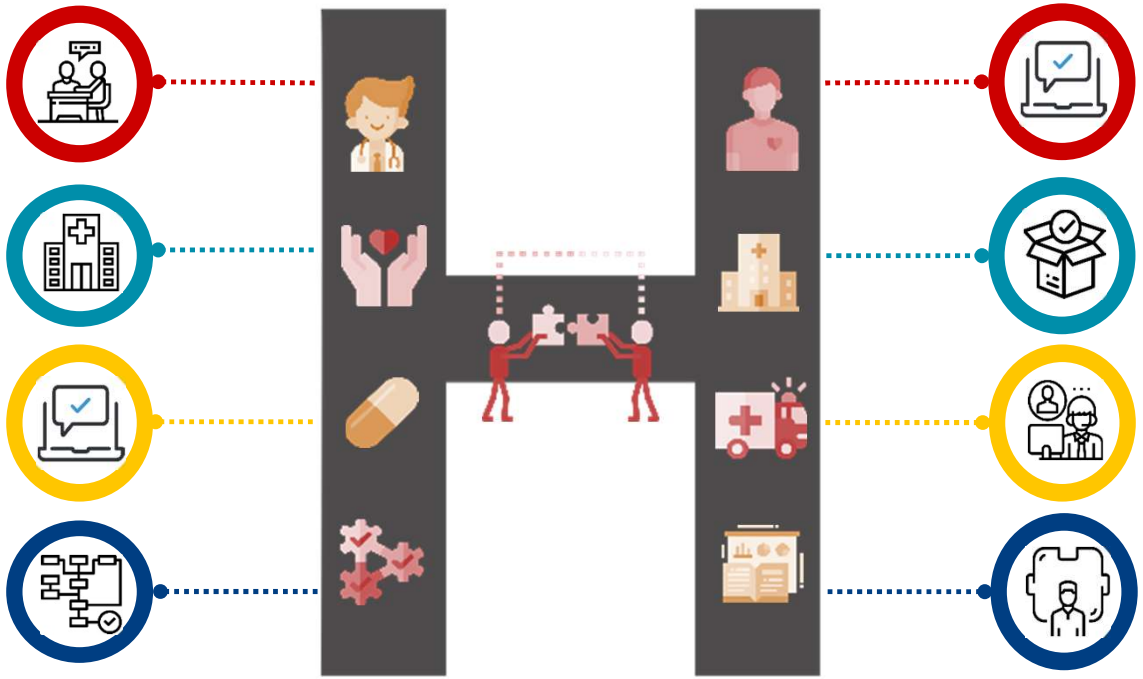
| Digital Experiences | Digital Infrastructure | Digital Solutions |
|---|---|---|

**Regenerative Medicine**
- Automated cell culture system
- Hitachi Value Chain Traceability Solution for Regenerative Medicine

**Precision Medicine**
- Precision Medicine Platform
- Risk Simulator
- Clinical Process Visualizer

**Robotic Automation (JRA)**
- Pharma, life sciences manufacturing, processing, testing, dispensing



**Digital Operations & Care**
- Care System Transformation
- Digital Hospital
- Digital Diabetes Prevention

**Oncology**
- Carbon / Proton Therapy
- Radiation Oncology
- Liquid Biopsy

**Digital Eco-System**
- Remote Patient Engagement
- Decentralized Clinical Trials
- Novel Drug Discovery

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# Healthcare

## Global Challenges

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# Today's Global Challenges

1

## Capacity

Increased and more complex demand is challenging available operating capacity with organizations frequently at > 95%. Increased backlogs, waiting lists and bottlenecks are delaying care and impacting quality.

2

## Workforce

Growing demand for care is outpacing supply putting strain on healthcare systems globally. COVID19 has exacerbated this challenge. Staff retention is a growing challenge.

3

## Performance

Increasing cost of care demands continuous improvement in operational performance despite the challenges to capacity & workforce.

# Digital Healthcare

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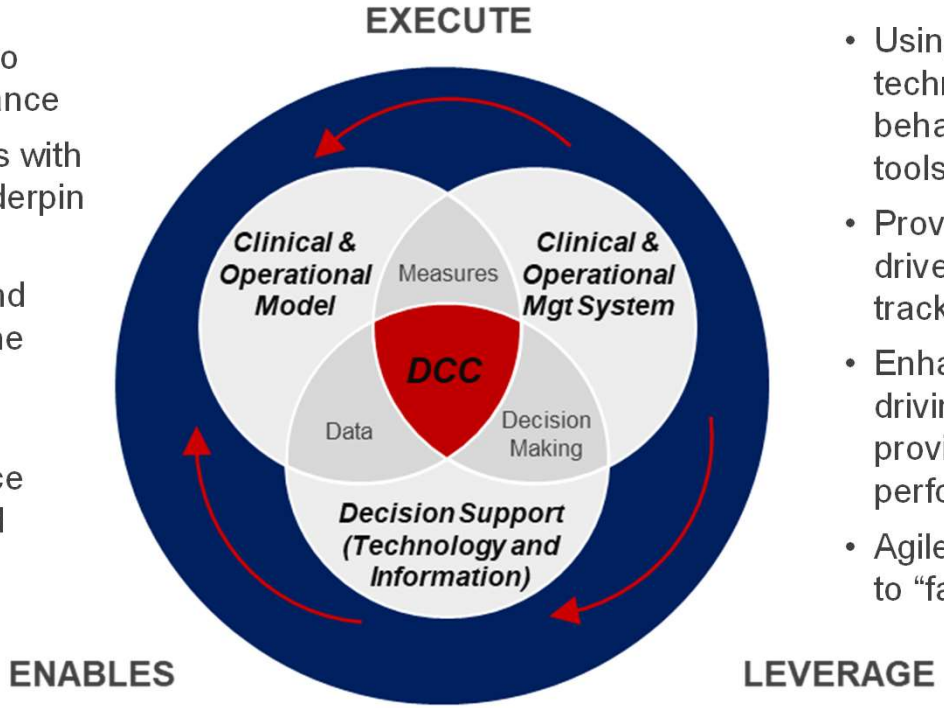
- Create a new operating model to drive a step change in performance
- Development of new behaviours with staff to drive innovation and underpin the new operating models
- Integration of existing clinical and operational information within the DCC to drive new insights and opportunities for improvement
- Creation of a decision excellence approach to support clinical and operational staff




- Using Data, AI, ML and new technology to support new behaviours using decision support tools
- Providing insights and measures to drive and realise new outcomes and track value
- Enhanced operational insights driving an improvement culture to provide a step change in performance
- Agile model development approach to “fail fast and learn faster”.

- Single source of the truth for demand, capacity and flow through the system
- Data driven decision support tools to enable the organisation to focus and prioritise action
- Tracking of patients, staff and assets within the system

# Decision Support Tools

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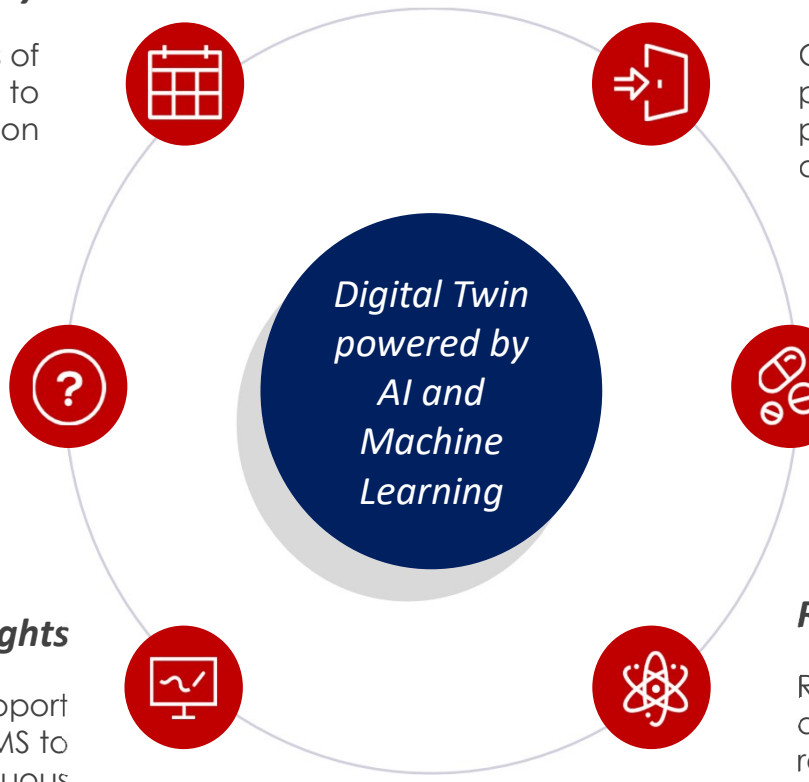
### *Demand & Capacity*

Leverage 72-hour predictive views of emergency and surgical demand to optimize flow and capacity utilization

### *Discharge Insights*

Gain deep insights on your patients and their discharge plans to identify risks, mitigate delays and improve pathways




### *Clinical Insights*

Provide staff with insights to better understand clinical variation, patient risks & deterioration to reduce harm

### *Care Management*

Improve staff efficiency and productivity through real time optimization & management of care

### *Operational Insights*

Embed data-driven insights to support daily decision making and the PMS to drive performance and continuous improvement

### *Real Time Operations*

Real time visibility of patients, staff and assets, automate workflows, respond faster, smart schedule activity to improve coordination

# General challenges

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- Digital Maturity in healthcare– varies widely !!!
- The Volume of systems that we could connect to 200 – 1400+
- Single version of the truth
- Data quality, accuracy
- Data literacy and maturity
- Data delivery and pipelines (near real time)
- Limited standard integrations
- Ways of working
- Differing groups across the healthcare sector

- ADOPTION, ADOPTION, ADOPTION !!!!

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# Digital Twin

Patient Centric View

# Typical Patient Journey

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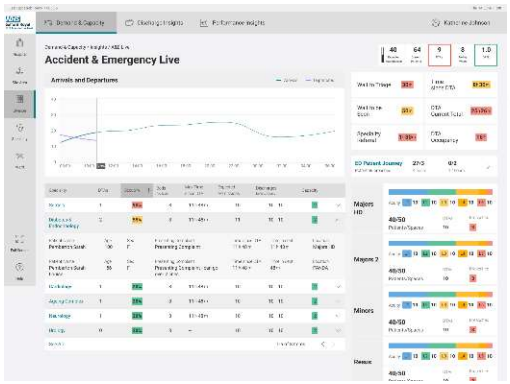
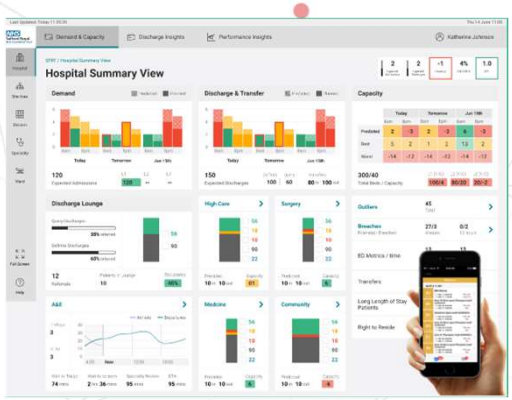
## Anticipating Primary Care

## Optimising Secondary Care

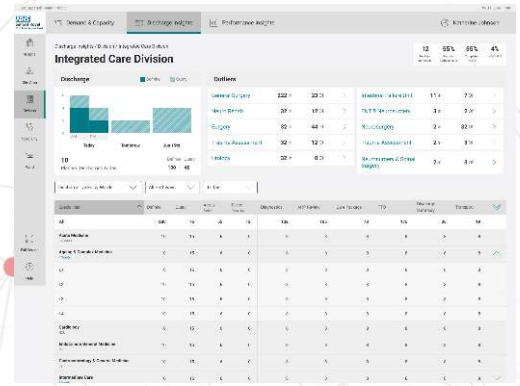
## Coordinating Ongoing Support in the Community




- Predicted demand forecasting
- Front door / back door A&E
- Patient streaming & rerouting
- Patient flow management.
- AI/ML risk assessment




- Proactive demand & capacity mgmt.
- Proactive bottleneck resolution
- Smart scheduling of resources
- Operational insights
- Real time task management




- Proactive care pathway management
- Patient risk stratification
- Discharge insights & optimisation
- Tertiary flow management

# New ways of working, data-driven, digitally-enabled

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1 **Early visibility of discharge demand.** Allows care teams to plan & coordinate discharge from admission, facilitating earlier engagement with supporting care teams to address complex needs.

3 **Real time visibility and smart scheduling of discharge tasks.** Care Flow™ enables staff to define, track and coordinate tasks. Operational Insights™ delivers actionable insights to proactively address resource & capacity constraints, to optimize length of stay.

4 **Coordinated planning of simple & complex discharge.** Care Flow™ & Discharge Insights™ used to prioritize discharge activity and smart schedule discharge based on forecasted demand in D&C Live™ to optimize patient flow and predict demand & capacity requirements post acute care services.

Attendance

Admission

Board & Ward Rounds

Board & Ward Rounds

Discharge or Transfer

2 **Predicted EDD, schedule & validation.** EDD predicted based on condition and validated through D&C Live™ at every board & ward round to improve organizational planning, prioritization and risk management.

5 **Early visibility and engagement of social & community care teams for complex care needs.** Discharge Insights™ provides early visibility to enable coordination between care providers, facilitated by unified task scheduling and management in Care Flow™.

# Predictive Model development

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## Admission Specialty

Models are trained to predict the most likely outcome for a patient after triage assessment in A&E. The outcome can be either predicted 'discharge' or the predicted admission to one of 25 hospital specialties.

Early warning of if the patient will be admitted to one of the hospitals 25 specialties or discharged, is pivotal for the proactive planning and management of patients. The aim of predicting admission specialty or discharge is to improve the flow of patients through the hospital.

## Length of Stay models

Models are trained to predict how long a patient will stay in the hospital at the point of admission.

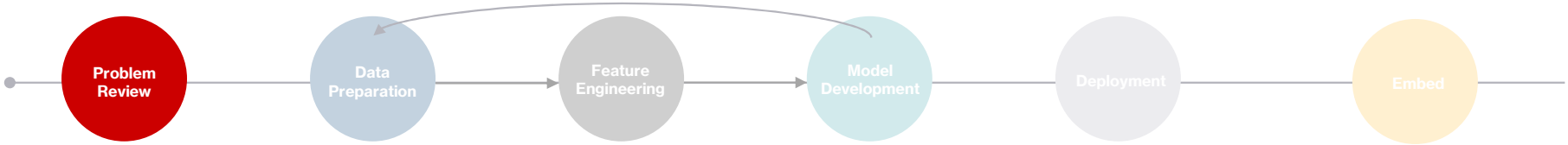
Length of Stay (LoS) of patients is a crucial factor for the effective planning and management of hospital resources. The aim of predicting the LoS of patients is to improve patient care, control hospital costs and increase service efficiency.

LoS is calculated as the time in minutes between a patient's admission and discharge.

## 72-hr Predictive Demand & Capacity Forecasting

Models are trained to produce 72 hours of forecasts for demand for each of the hospital's specialties.

Whilst the Length of Stay and Admission Specialty model support planning and management of resources for patients that are currently at the hospital, the Admission and Discharge forecasts provide a longer horizon on which to understanding the upcoming demand on the hospital system.



# Next Steps for Digital Twins

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1

## Capacity

Increased and more complex demand is challenging available operating capacity with organizations frequently at > 95%. Increased backlogs, waiting lists and bottlenecks are delaying care and impacting quality.

>10%
CAPACITY UPLIFT

## Better care coordination and flow

DC&O improves visibility, planning and coordination by giving care teams predictive insights on demand and capacity, enabling them to optimize capacity utilization, proactively address bottlenecks and accelerate flow.

2

## Workforce

Growing demand for care is outpacing supply putting strain on healthcare systems globally. COVID19 has exacerbated this challenge. Staff retention is a growing challenge.

ZERO
DUPLICATION

## Simplified ways of working

DC&O connects care teams with unified task management, real time intelligence and actionable insights to improve efficiency, productivity and staff experience – giving your staff more time to care for patients.

3

## Performance

Increasing cost of care demands continuous improvement in operational performance despite the challenges to capacity & workforce.

>10%
REDUCTION IN ALOS *

## Better patient experience & outcomes

DC&O drives system-wide improvement and transforms care delivery by embedding a digitally enabled operational management system. Reduced delays, cancellations, readmissions, outliers and stranded patients – improve patient flow, experience & outcomes

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# Digital Twin

Next Steps and the Future

# What else could be done?

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## Future Digital Twin Usage

There are multiple areas where the use of a digital twin when integrated with other digital capabilities such as AI/ML could rapidly change the way the healthcare system currently works, such as:

- Strategic Scenario and options analysis – multi-level
- Hospital and healthcare system design
- Population health management
- Disease progression
- Resource optimisation
- Capacity analysis
- Operational efficiency
- Value & benefit analysis
- Clinical outcome / variation analysis

The outcomes of these types of use of Digital Twins could lead to:

- New models of care
- New healthcare systems
- Optimized clinical pathways & diagnostics
- Automated scheduling of care
- Enhanced data science models
- Better patient outcomes
- Reduced costs
- Etc.

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# Thank You

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# Appendix

# Hitachi, 70 years in Healthcare

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## Hitachi Hospitals (Japan)

- Operates 5 Hospitals (>3000 beds)
- Healthcare Insurer, using Big Data Risk Analytics
- Digitally Integrated Community Care for 3 cities (Japan)

## Medical Equipment (Globally)

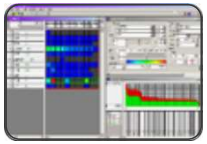
- MRI, CT, Ultrasound, Particle Therapy (e.g Proton)
- AI Predictive Maintenance
- AI Imaging & Diagnosis, Smart Operating Theatres

## IoT Facilities Optimisation (Global)

- Advanced Analytics, RTLS, LiDAR
- Ward / Theatre Optimisation
- Asset tracking and smart scheduling

## Precision Medicine Platform (Global)

- Cloud based secure data exchange
- Supports diverse data-sets, facilitates research collaboration and accelerates research activities



## Clinical Process Variation (Japan / UK)

- Clinical Process Visualiser
- ML-based identification of clinical / operational variation

## Breast Cancer Screening (UK)

- Outsourcing provider for UK National screening
- Supporting 3M women for screening annually
- Assisting with transformation of the service

## Lifestyle Disease Management (Japan)

- Lifestyle service for citizens at risk of lifestyle related diseases (type 2 diabetes, Hypertension, etc.)
- Served 40,000+ patients since 2007

## Digital Diabetes Prevention (UK)

- Co-Designed with NHS (Salford CCG / SRFT)
- CATFISH Clinical Service Trial (2014-17)
- UK National Digital Diabetes Programme (2019)

## Smart Hospital (DCO) (Global)

- Transformation / Change programme enabled through digital modules which span the entire hospital (A&E, In-Patient settings, and Discharge lounge)

## Clinical Analytics (Global)

- Cardiac Readmission Risk Prediction (Partners)
- Pharmacology Outcome Prediction (PDSS, Utah)
- Precision Medicine Platform (AHA)

# One Hitachi Digital Healthcare

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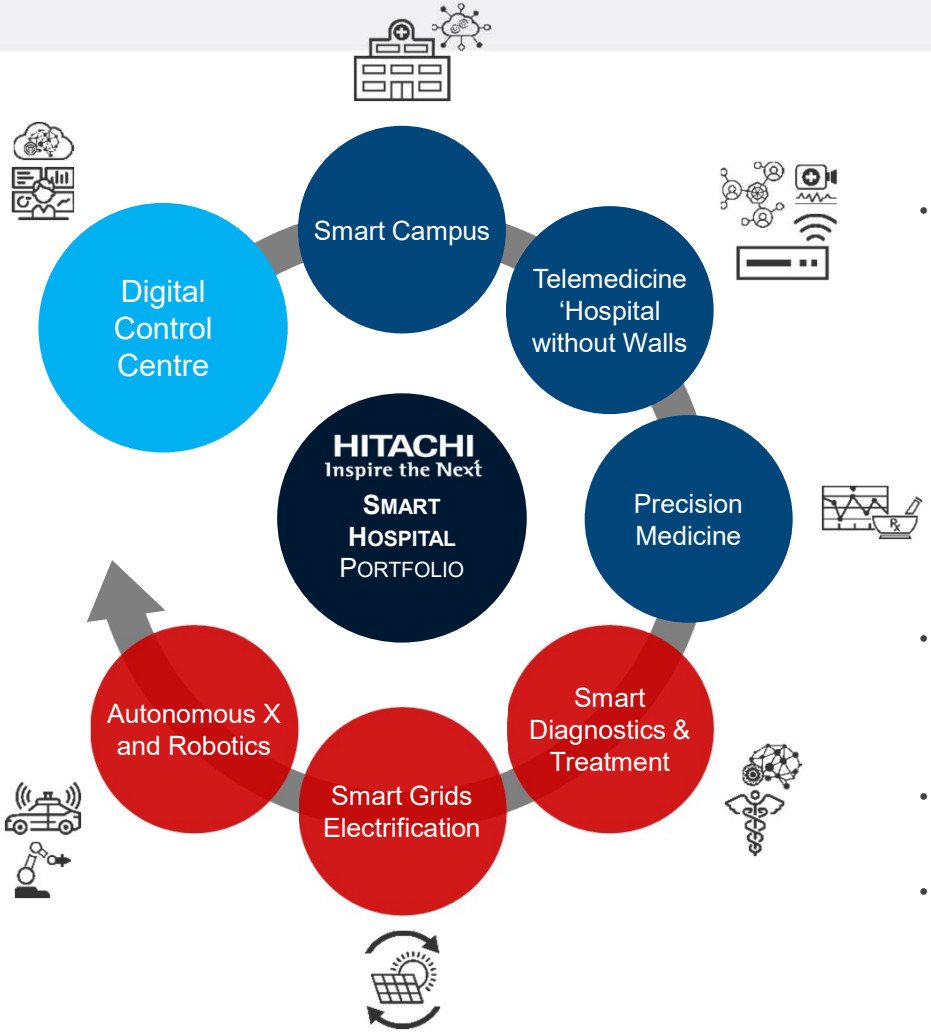
## Provider Transformation

- **Digital Control Centre** delivers the core platform and foundation for IoT and Connected Care expansion
- **Hitachi Smart Campus capabilities** (facilities, security, vehicles, retail, IoMT) and centralised visualisation for integrated care operations

## Sustainability & Innovation

- Leverage / expand **Smart Campus** through **Hitachi Group** extensions
- Address decarbonisation in healthcare with **Smart Grids** / renewable energy
- **Hitachi mobility / fleet electrification** solutions for ambulance / transport
- **Hitachi Automation & Robotics** to expand autonomous patient transport, guided medical equipment, etc.



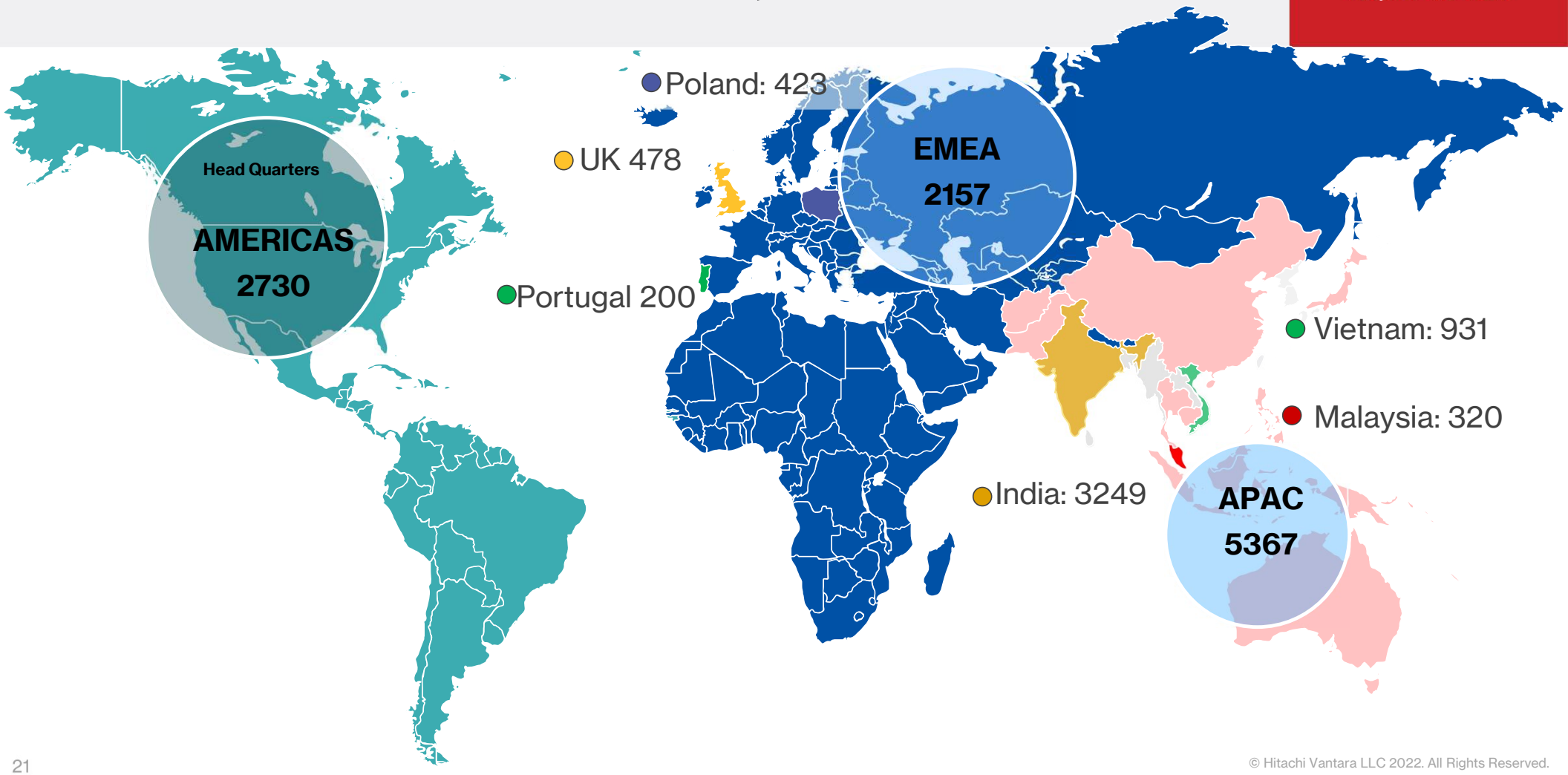

## Connected Care

- Delivering the 'Hospitals without Walls' capability by leveraging **Hitachi groups companies, Industry partnerships and Eco System partners** to deliver telehealth across integrated care systems

## Personalised Care

- Development of **Hitachi personalised care** and **population health management** through the development of AI capabilities and products with **Hitachi R&D**
- **One Hitachi collaboration** and ecosystem for Precision Medicine from research to operations
- **Hitachi Smart Life offerings:** PBT, Regenerative Medicine, Cancer Diagnosis

# HV Global Headcount: Over 10,000



# Innovating Healthcare, Embracing the Future

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## Digital Healthcare

DIGITAL HEALTH AGE
HEALTHTECH FOR HEALTHCARE

Hitachi & NHS collaborate to fight diabetes with digital health

## Digital Transformation

WIRED

The digital tools that could save the NHS

NHS hospitals face smaller budgets and more patients — but there are digital tools that can lower costs while significantly improving care.

## Data-Driven Healthcare

NEXT 2020
NOVEMBER 16-18 | LAS VEGAS

Cloud Technology Brings the American Heart Association Precision Medicine Platform to Life

# Case Study - Hospital – Digital Transformation – (Digital Care & Operations)

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We partnered with a digitally advanced acute Hospital in the North of England with 840 beds and approximately 8000 clinical and operational employees, to transform siloed systems and processes into a Smart Hospital. We combined design, advanced analytics, and healthcare strategy to launch a first-of-its kind digital control center, enabling clinical decision making and operations to improve the delivery of care.

## Client Background & Challenge

- The acute healthcare sector has been under intense pressure in terms of demand, capacity, workforce and cost challenges, all of which have been exacerbated by the global pandemic
- The client was particularly challenged with respect to its ability to meet the increasing demand on its capacity and the flow of patients through the hospital
- Therefore, a vision and a series of requirements was created which it believed would address these challenges, this included:

1. Vision - Create a learning Healthcare system and culture across the organization and to become the most digitally advanced organisation in the world
2. Improve outcomes and experience for the Patients and users across the organization
3. Create a quality-based culture of learning and improvement across the organization
4. Implement a data-driven digital transformation, to support enhanced decision making for operational and clinical staff
5. Co-create digital tools and services to enable staff to work more efficiently and effectively across the hospital.
6. Embed sustainable ways of working to enhance patient and user experience
7. Provide decision support and operational insights from across hospital systems

## Solution

Hitachi worked with the clinical & operational teams and patient advocates utilizing a patient and user centric design service design approach to address these challenges; which culminated in the development of; a new operating model, a digital control center to support decision making and an underpinning management system to improve the delivery of care and to drive continuous improvement across the organization and an outline implementation plan.

A joint team worked in partnership to create and implement a detailed design and change program which outlined the operational & clinical processes, the organizational structures, operational & clinical routines, services and products required to deliver the operating model and the new ways of working.

This resulted in:

- The creation and deployment of a new digital operating model and supporting operational management system that utilised lean & quality thinking and new technology products to support decision making
- New core products to manage, demand, capacity, flow, discharges, care tasks and ED; and analytical products to generate operational, discharges and performance insights in near real time
- The creation of a data engine and KPIs to create a single source of truth regarding the patient journey and the integration of existing and new clinical and operational systems and information within the control center to derive new insights.
- Implemented machine-learning & AI to drive efficiencies within the management of hospital demand & capacity and to generate predictions of LOS and discharges
- Implemented a real-time location system increasing the visibility and operational efficiency of clinical and operational workflows.
- The creation of a new Centre of Excellence to own, develop and continuously improve the operating model, management systems and products across the organisation
- Implemented a modular solution, to enable scaling of products across the control center and the wider organisation

## Digital Transformation

- Effectiveness Benefits
  - Improved flow
  - Released Capacity
  - Enhanced Decision making through decision support
  - Single line of site
  - Enhanced operational management system driving continuous improvement
  - Near Real time hospital performance
  - Predictive capability
  - Enhanced board and ward rounds
  - No lost tasks
- Efficiency Benefits
  - Reduced Length of Stay
  - Increased Bed Utilisation
  - Reduced stranded and super stranded patients
  - Released value / benefits
- Qualitative Benefits
  - More time to focus on patients, quality and safety improvements
  - Increased morale
  - Better patient experience
  - Finding ‘lost’ equipment

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