

# Information driven healthcare – turning data into health for patients and quality of care

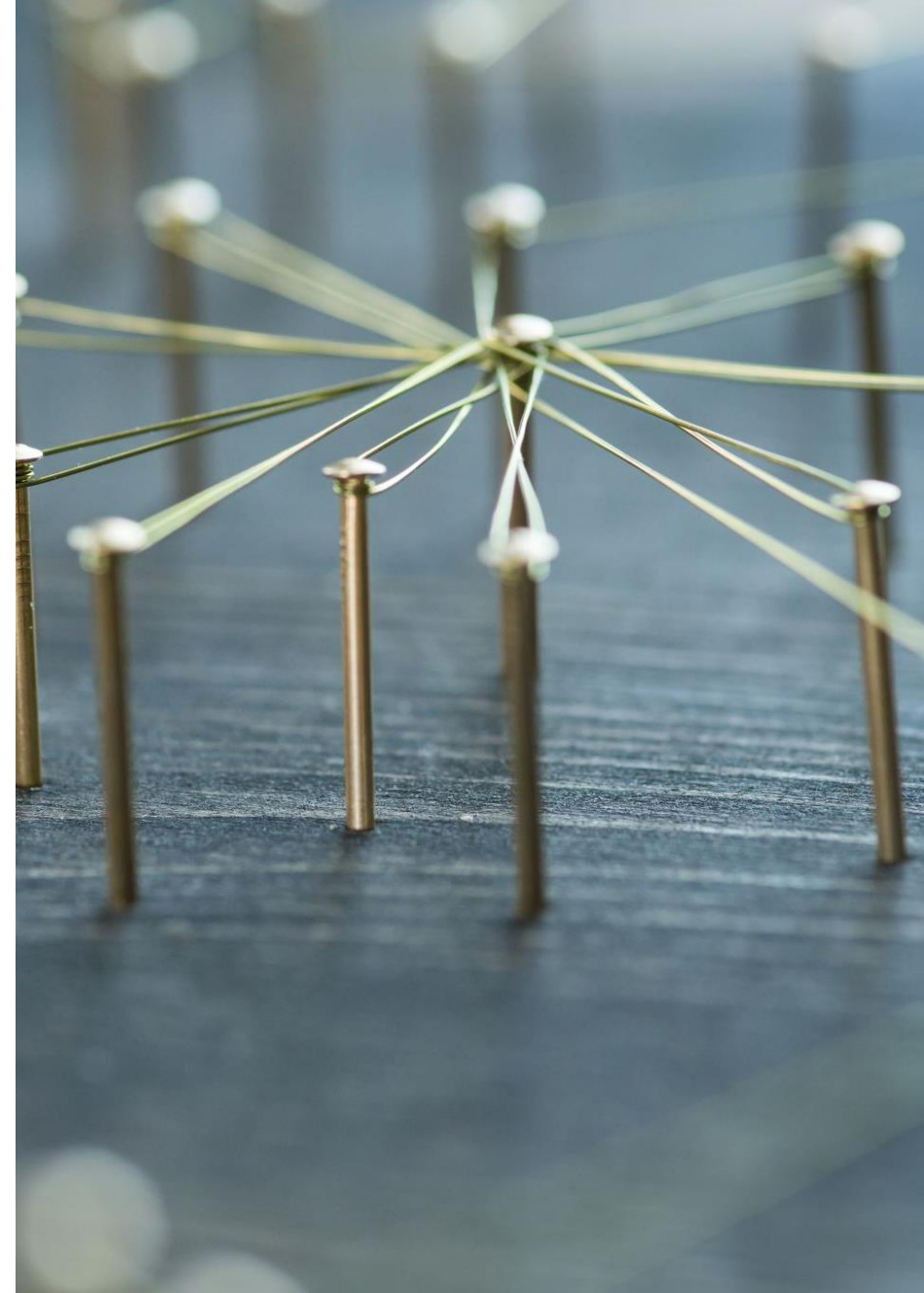
International Forum on Quality and Safety in Healthcare  
Gothenburg, June 22



# Agenda

**The session will be alternated between speakers and roundtable discussions on the following key topics:**

- Information driven care at a glance
- Prerequisites and pitfalls applying advanced analytics on health data
- Commitment and stakeholders – leadership in the information driven era



# Presenting our speakers



**Markus  
Lingman**

Chief Strategy Officer

Halland Hospital Group



**Farzaneh  
Etminani**

Associate Professor,  
Machine Learning

Halmstad University



**Martin  
Engström**

Healthcare Director

Region Halland



**Carolina  
Samuelsson**  
Chief Executive Officer  
  
Halland Hospital Group



# Information driven care at a glance

Markus Lingman MD, PhD

*Adj professor, Chief strategy officer, consulting cardiologist*

*Halland hospital group, Halmstad University, Sahlgrenska Academy*

# Face the facts!

"Fewer patients are admitted to the hospital when bed occupancy is high"

"When bed occupancy is high patients are discharged earlier"

"Early discharge drives readmissions"

"The number of hospital beds is tightly connected to bed availability and occupancy"

"Healthcare demand is increasing in general"

"Acute care cannot be altered – hence you can only react"

"If we improve efficiency in scheduled care the pressure on in-hospital care will decrease"

**”Data driven...**

...care”

...innovation”

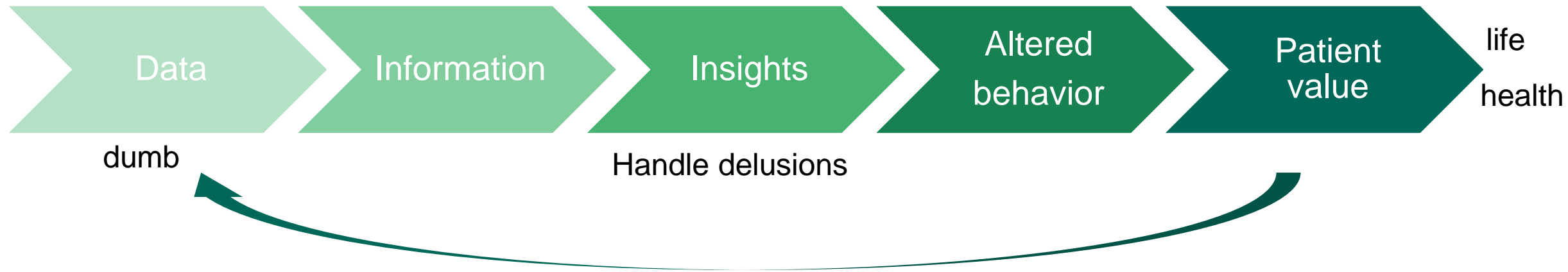
...development”

...patient safety”

**Fact based?!**

# Information driven Care

Work along the value chain of knowledge



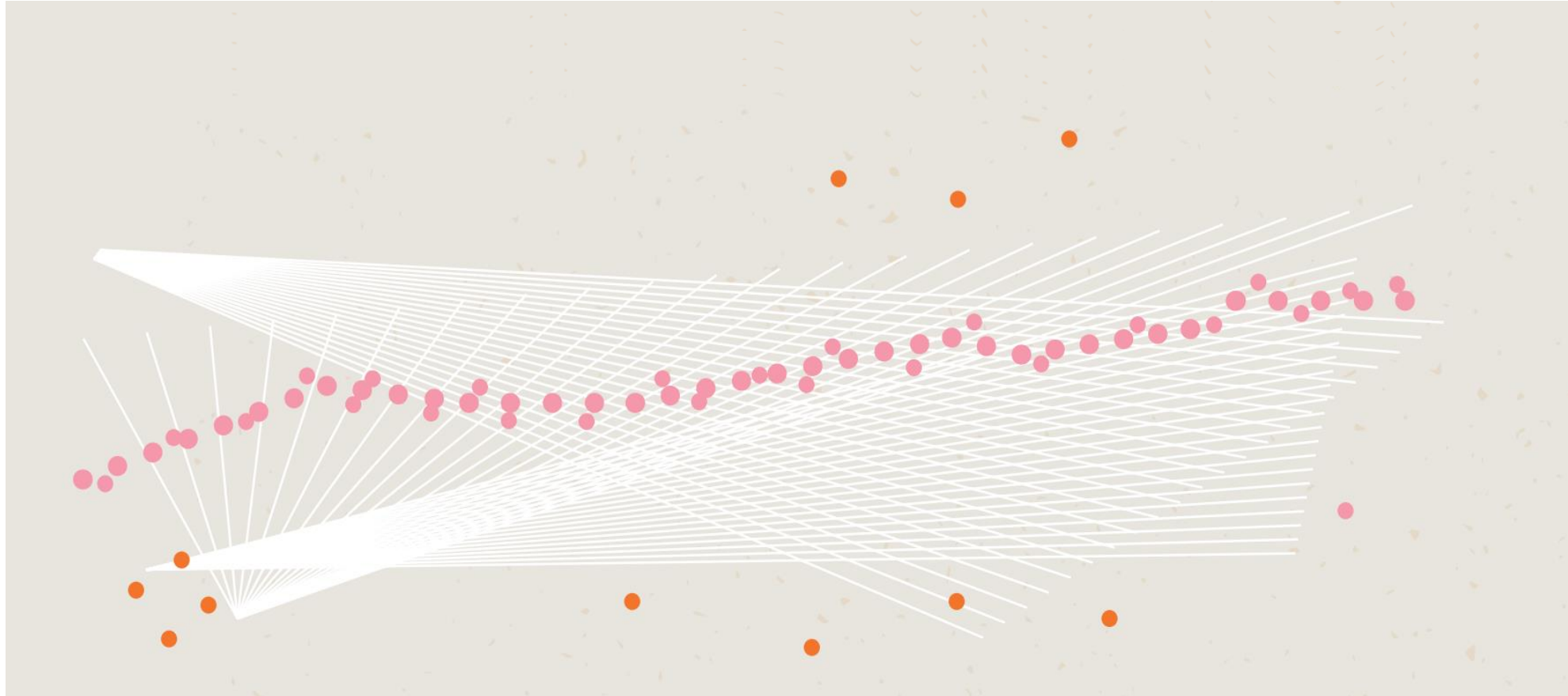
Imprecision medicine --> precision medicine

**Imprecision "group" medicine --> precision healthcare**

Markus Lingman proprietary material



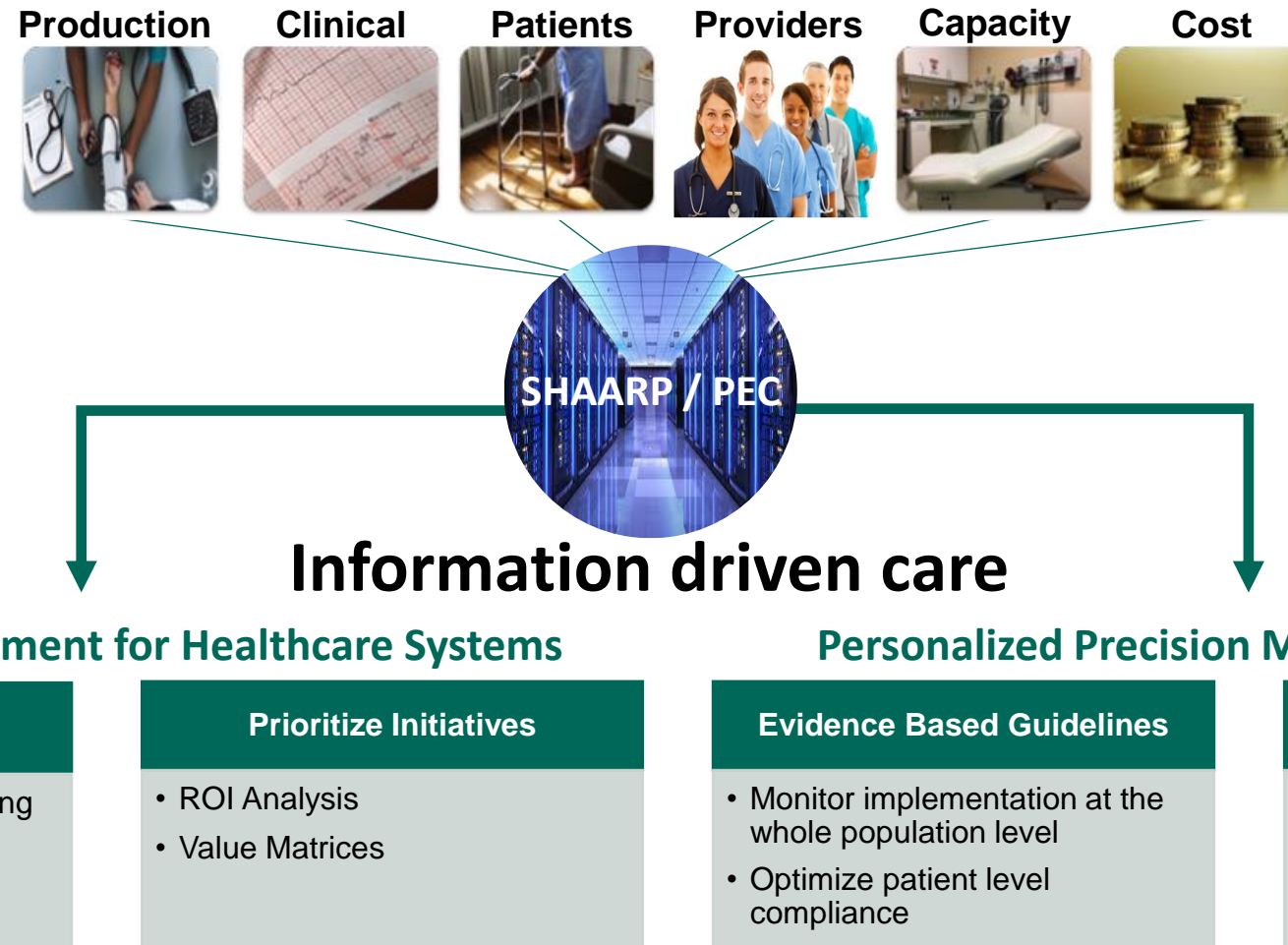
# From silos to system!



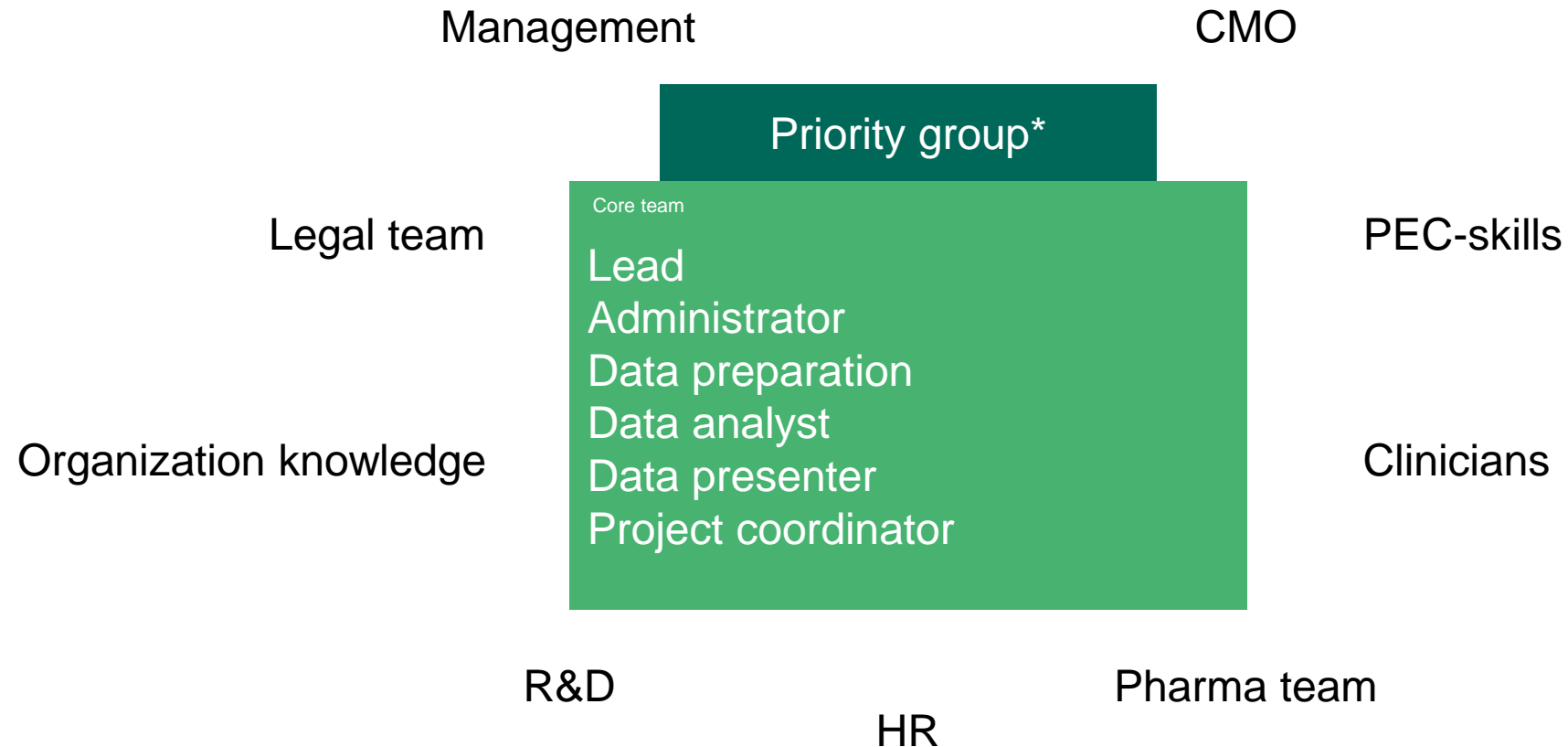
*Care process, care chain, care cycle...*

[En handbok för informationsdriven vård](#)

# SHAARP/Patient Encounter Costing (PEC) Enables Patient Focused, Data Driven Care



# Centre for Information driven Care



*\*Healthcare director, team lead, other key position*

Patienter med hjärtsvikt

Ej avlidna

Population

6 031

Prevalens

1,8%

Nydebuterad hjärtsvikt 2021

Under vald period

1 262

Incidens antal/1000 inv

3,72

Genomfört UKG

Antal

5 355

Andel

88,8%

-varav inom 6 mån

4 313

Andel inom 6 mån

80,5%

Avlidna inom 1 år

Av nydebuterade

222

17,6%

Hjärtsviktpatienter baserat på EF  
( 16% av 1 262 )

I501A= HFrEF

99

I501B= HFmrEF

68

I501C= HFpEF

35

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ÅrHjärtsvikt

ÅrMånadHjärtsvikt

Halland/Utomlän

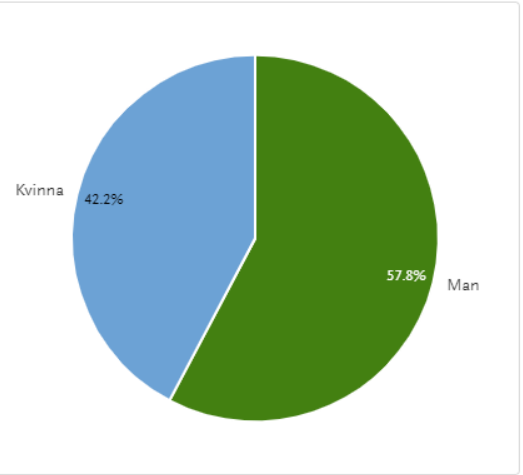
Huvud-/Bidiagnos

Avliden

ÖV/SV

DiagnosKod

ÅrAvliden

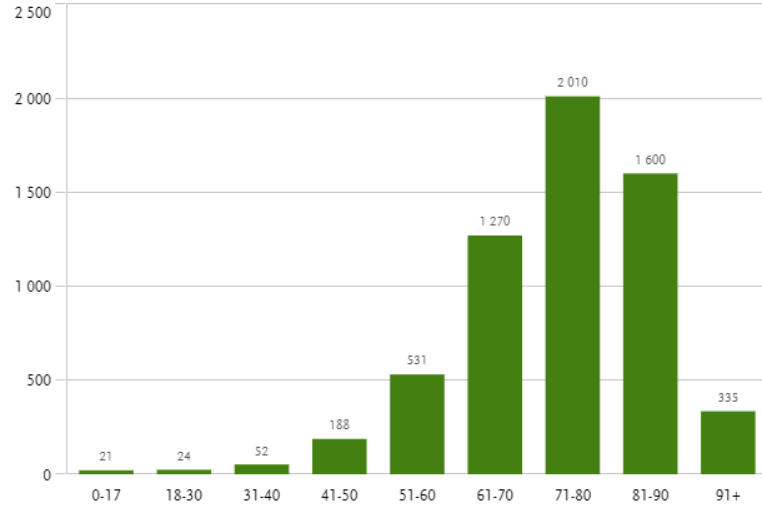


Per åldersgrupp

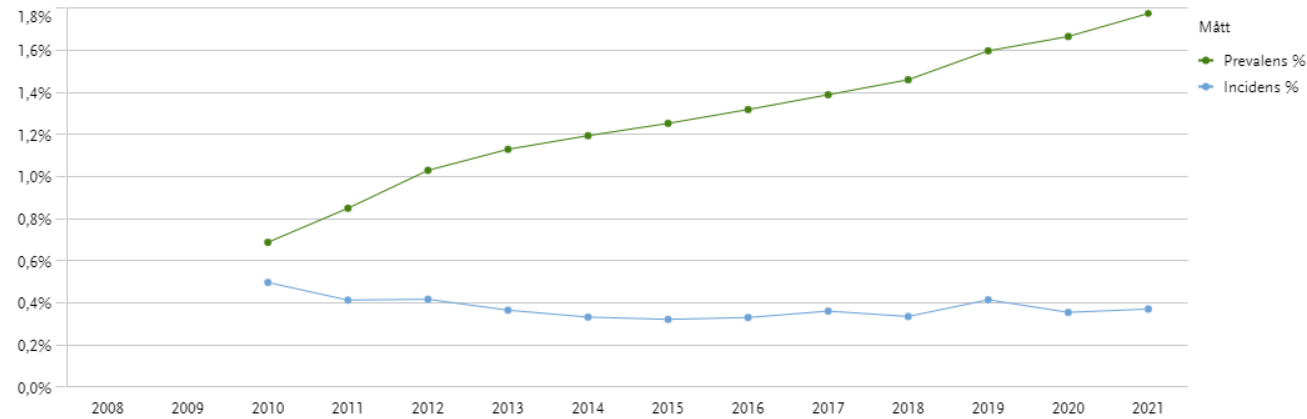
Per hemkommun

Per åldersgrupp (diagnostillfäl...

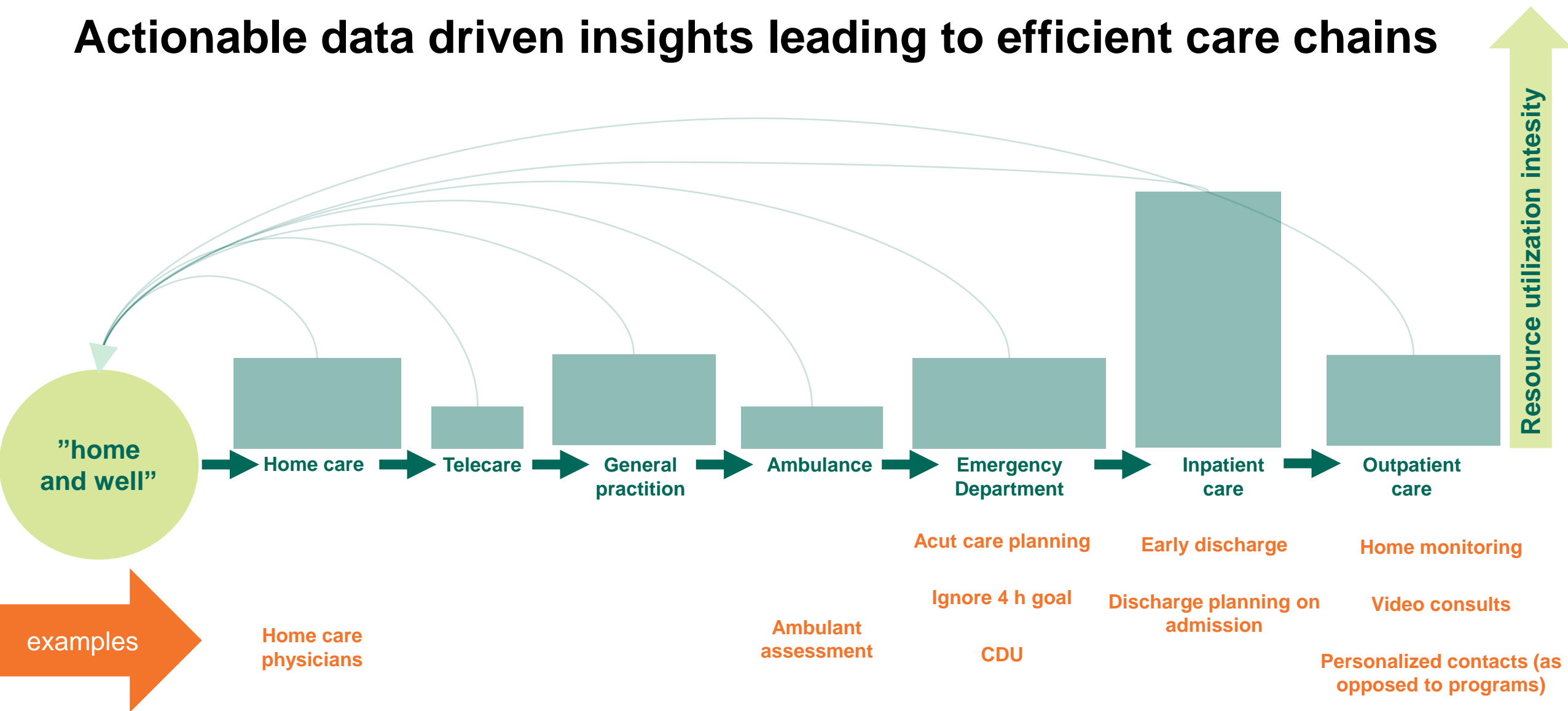
Hjärtsviktpatienter per åldersgrupp



Utveckling över tid



# Actionable data driven insights leading to efficient care chains



# Integrate resource utilization!

Resource utilization is driven by activities  
...across the care chain

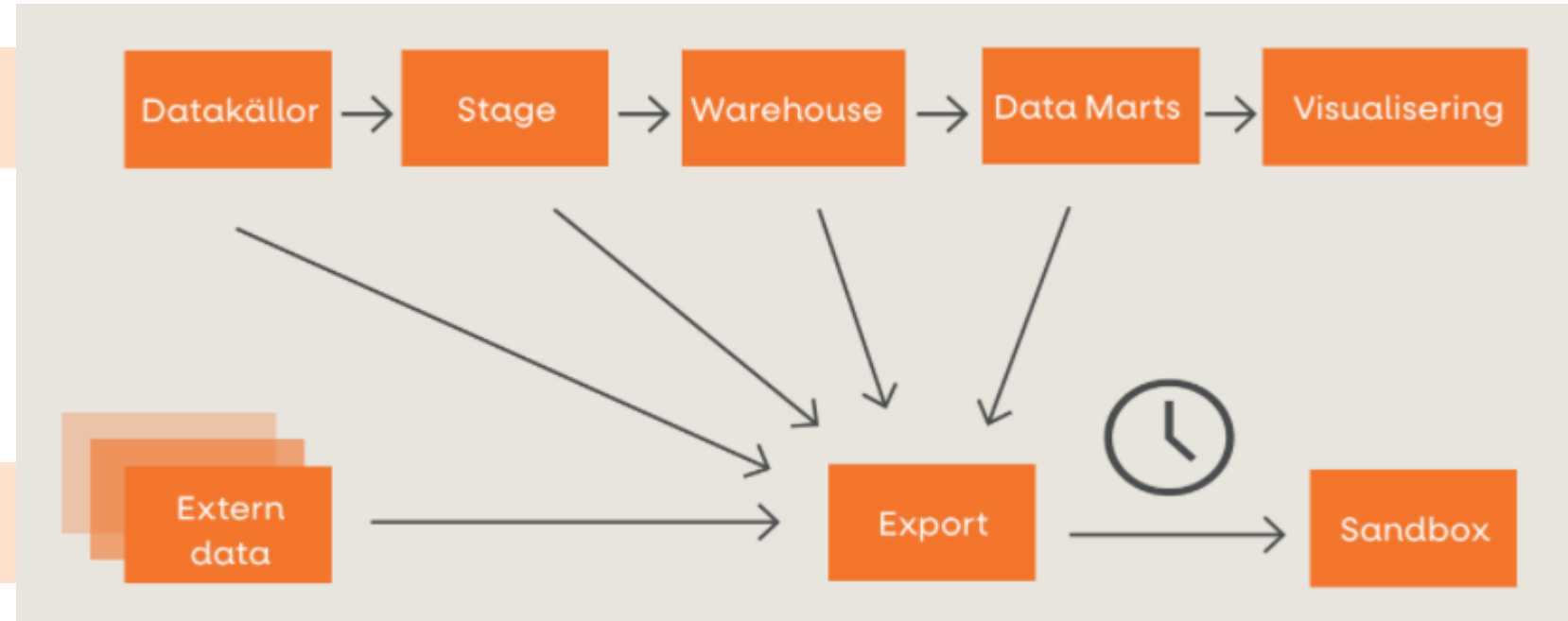
**Patient Encounter Costing**



# Data -> information

## Classic BI

## Data science



Hadoop  
No-SQL  
Graph database

# Advanced analytics to increase precision in healthcare provision.

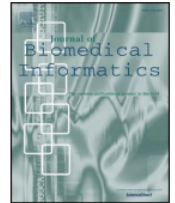
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## Readmission prediction using deep learning on electronic health records

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### ARTICLE INFO

#### Keywords:

Electronic health records  
Readmission prediction  
Long short-term memory networks  
Contextual embeddings

### ABSTRACT

Unscheduled 30-day readmissions are a hallmark of Congestive Heart Failure (CHF) patients that pose significant health risks and escalate care cost. In order to reduce readmissions and curb the cost of care, it is important to initiate targeted intervention programs for patients at risk of readmission. This requires identifying high-risk patients at the time of discharge from hospital. Here, using real data from over 7500 CHF patients hospitalized between 2012 and 2016 in Sweden, we built and tested a deep learning framework to predict 30-day unscheduled readmission. We present a cost-sensitive formulation of Long Short-Term Memory (LSTM) neural network using expert features and contextual embedding of clinical concepts. This study targets key elements of an Electronic Health Record (EHR) driven prediction model in a single framework: using both expert and machine derived features, incorporating sequential patterns and addressing the class imbalance problem. We evaluate the contribution of each element towards prediction performance (ROC-AUC, F1-measure) and cost-savings. We show that the model with all key elements achieves higher discrimination ability (AUC: 0.77; F1: 0.51; Cost: 22% of maximum possible savings) outperforming the reduced models in at least two evaluation metrics. Additionally, we present a simple financial analysis to estimate annual savings if targeted interventions are offered to high risk patients.



"Decrease NNT...Increase PTP..."



# **Prerequisites and pitfalls applying advanced analytics on health data**

# Challenges with healthcare data

- Access
  - European General Data Protection Regulation (GDPR)
  - Patientdatalagen
- Quality
  - biased
  - imbalanced
  - missing values, sparse
  - ... and more
- Quantity
- Multi-modality
- ... and more



# What are the opportunities?

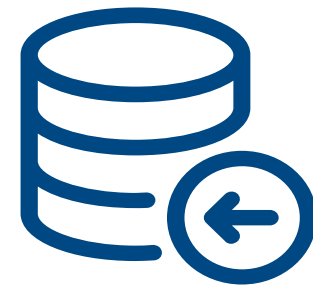
Synthetic  
health data



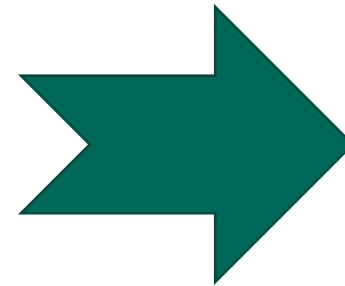
Federated  
learning

# Synthetic health data

- data-driven approaches
- preserves the utility and fidelity of the original real data
- maintaining privacy

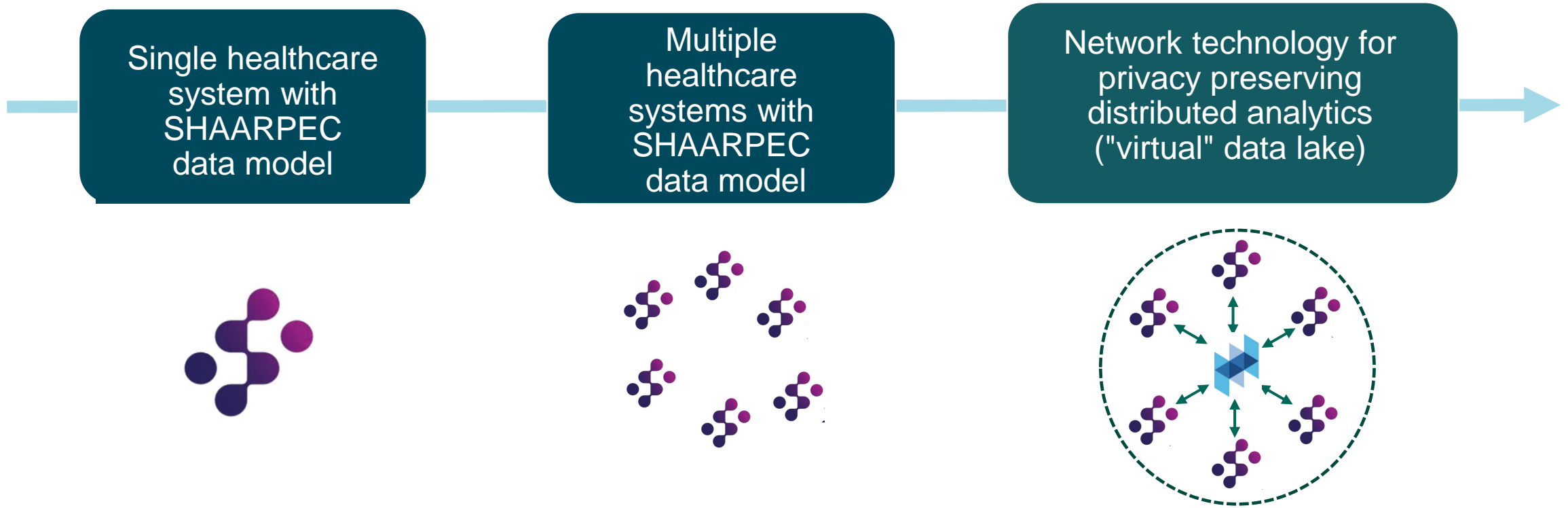


original data



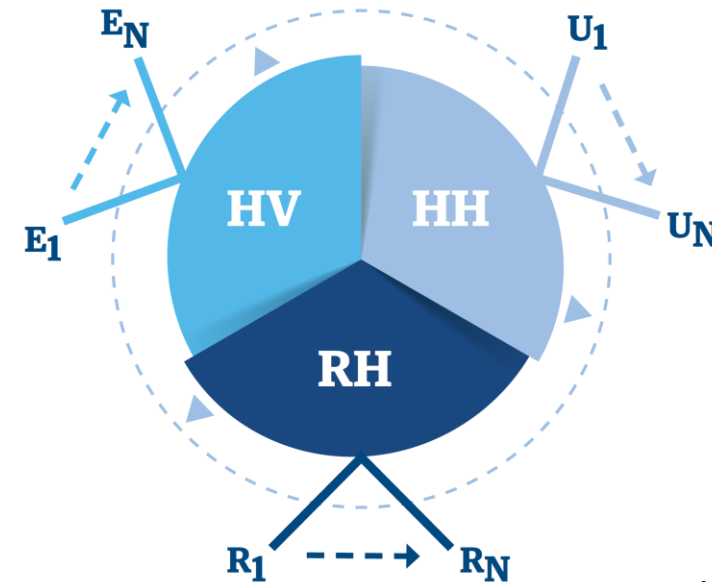
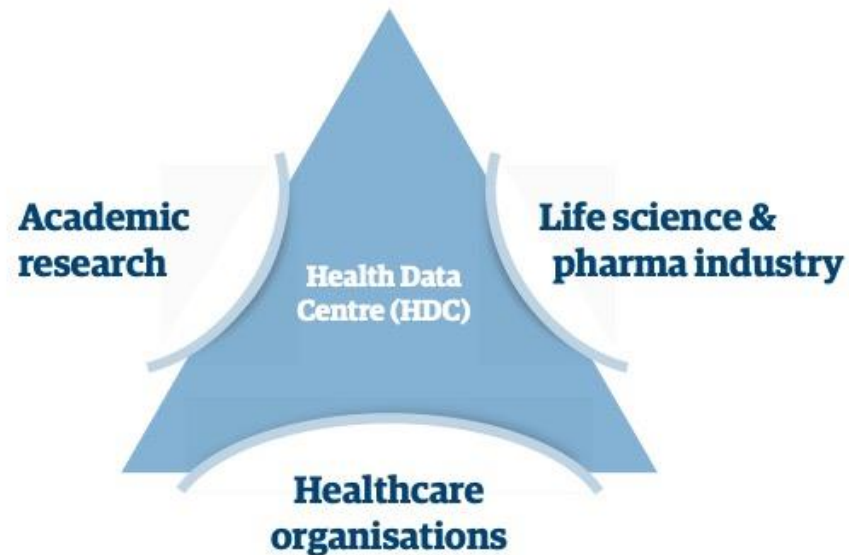
Synthetic data

# Building a “virtual” federated data lake



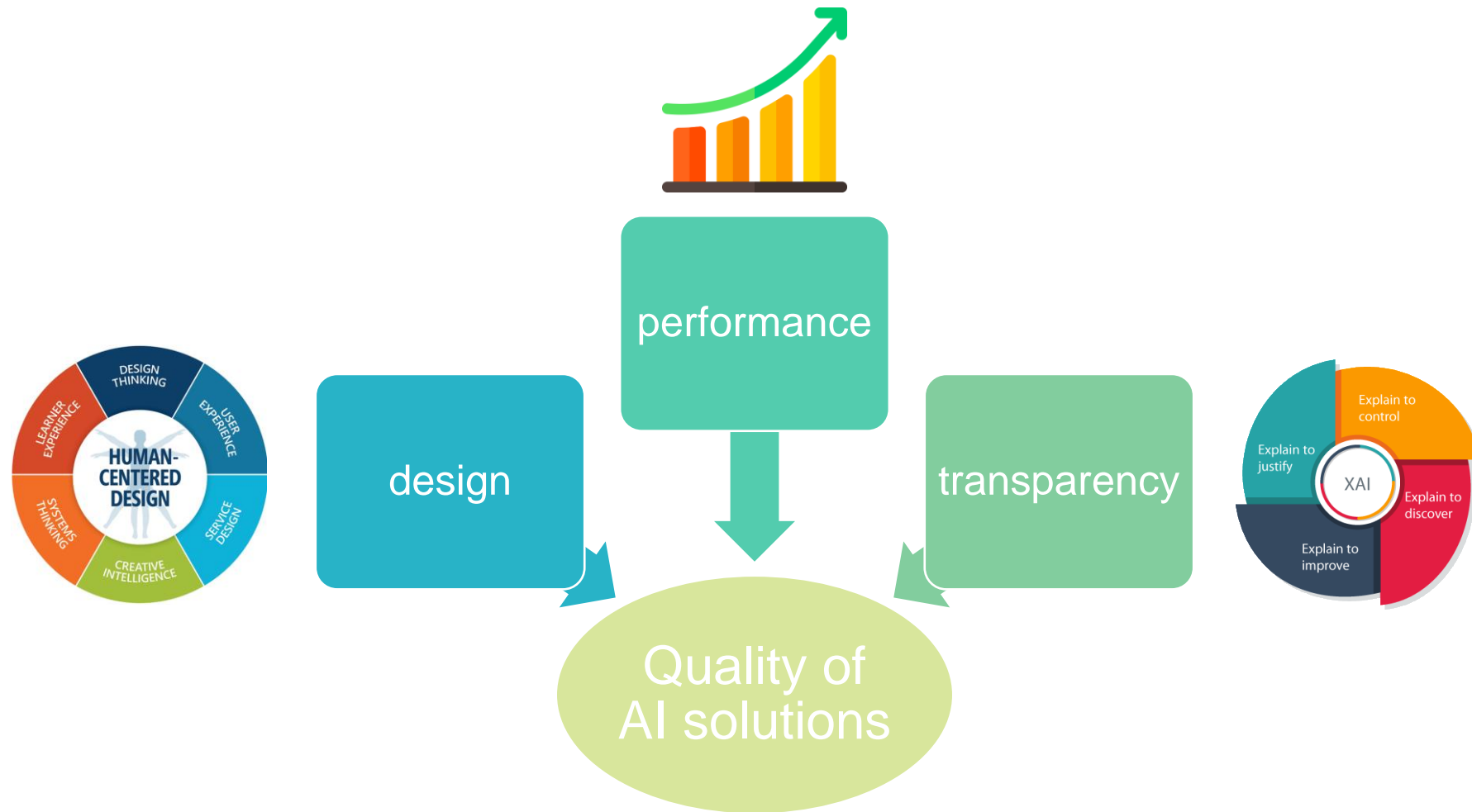
# Collaboration across organisations

Health Data Center (HDC) gathers the **necessary** eco system for improved care delivery.



HDC includes:  
HH = Halmstad University  
RH = Region Halland  
HV = Hallandia V

# Challenges of AI/Analytics in healthcare





# **Commitment and stakeholders – leadership in the information driven era**

# The questions will make the difference

- Traditional leadership has been based on opinions and personal experiences
- Modern leadership will be based on facts and collective experiences
- Leaders are responsible for the utilization of facts
  - Which questions are being asked
  - Do we dare to act on fact-based answers
- Consensus will be based on facts – not opinions



# Keys to fact-based leadership

- Act based on a systematic analysis of our common facts
- Apply leadership and guide the organisation asking questions and promoting dialogue
- Define and decide directions rather than goals
- Dare to lead through questions rather than decisions
- Avoid acting on unfounded opinions and emotions
- Facts will kill a lot of darlings – are you prepared to kill yours...





**Region Halland**