Patient Journey Modelling

from data to insights into patient pathways

Professor Barry Drake

Faculty of Engineering and Information Technology

University of Technology Sydney

Context and needs

Context

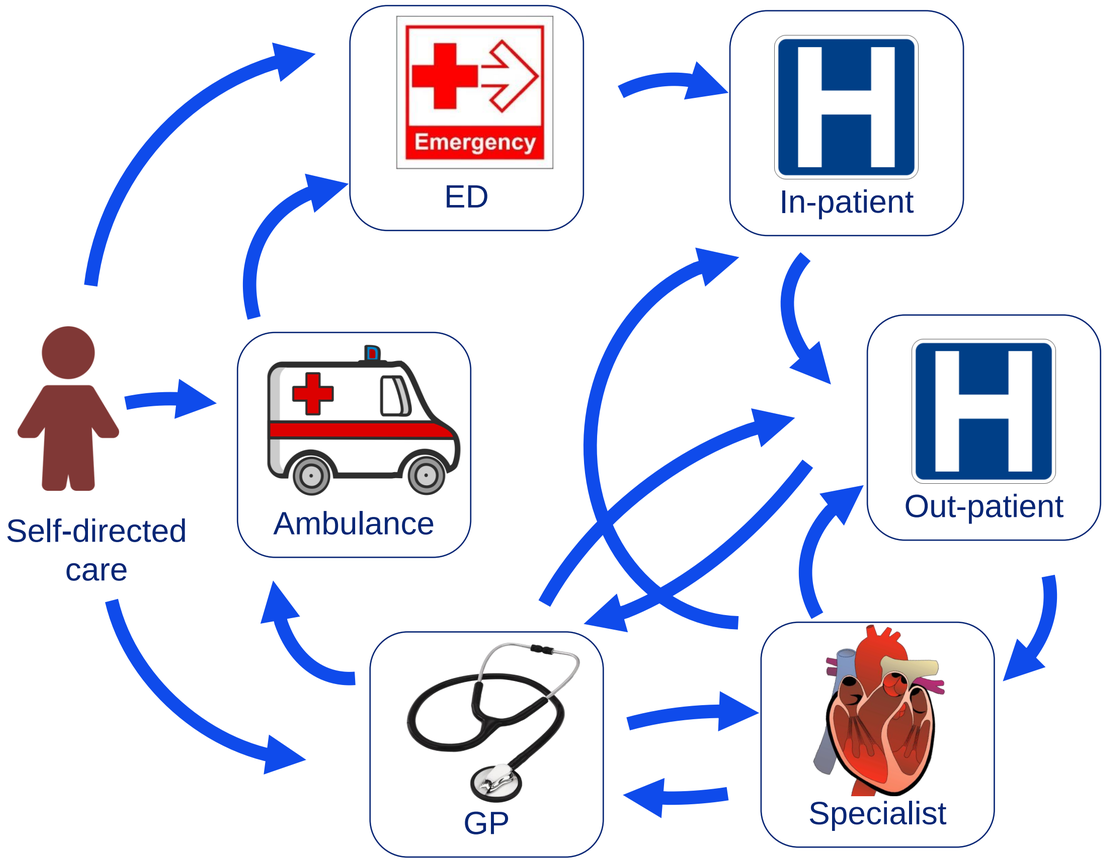
- average age increasing
- growing number of people living with chronic or complex health conditions
- NSW initiatives: Leading Better Value, Care Integrated Care, Collaborative Commissioning

Collaborative Commissioning needs insights

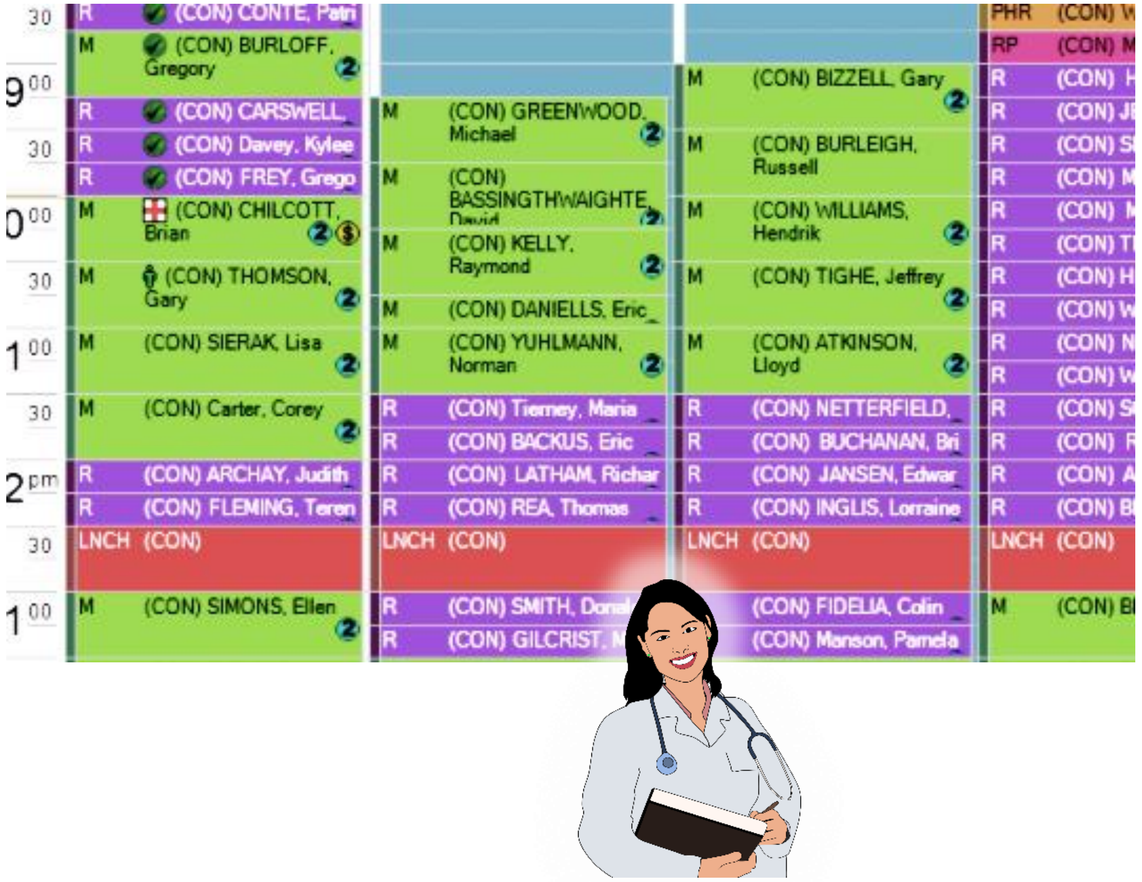
- health care choices by patients and clinicians?
- crucial transitions in care where important health care choices are made?
- patterns of access to health care for cohorts of interest?

Perspectives

System



Clinician



Perspectives

Patient Pathway

A patient pathway is a sequence (or network) of health events types that abstracts and groups patient journeys.

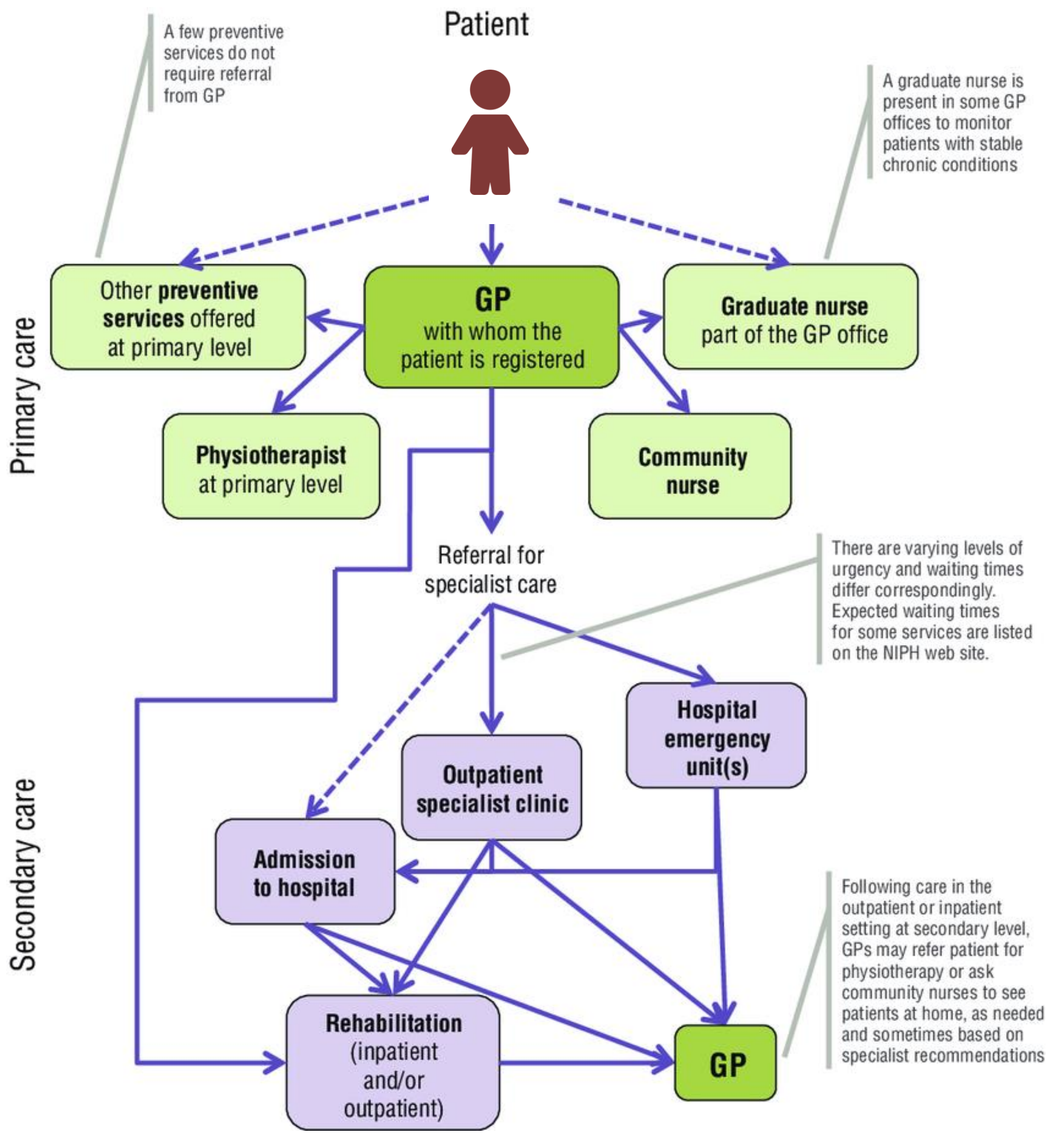
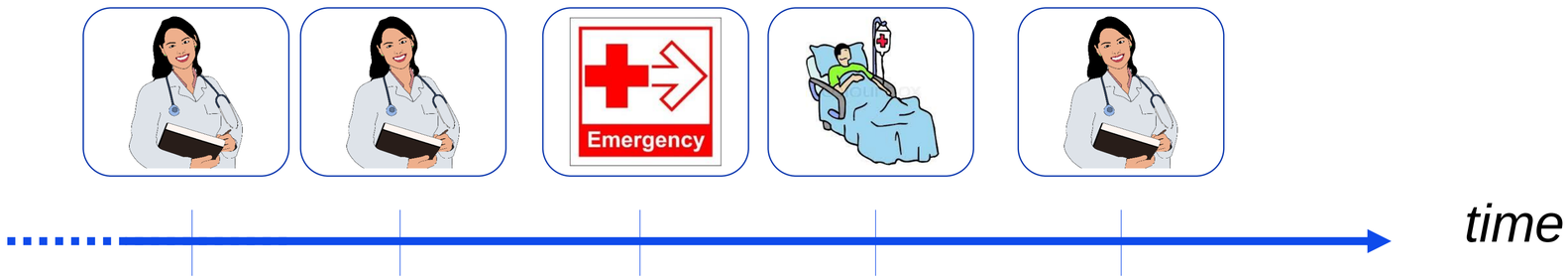


Diagram from “Slovenia: Health System Review”, Albreht et al. 2016, Health Systems in Transition, Vol 18

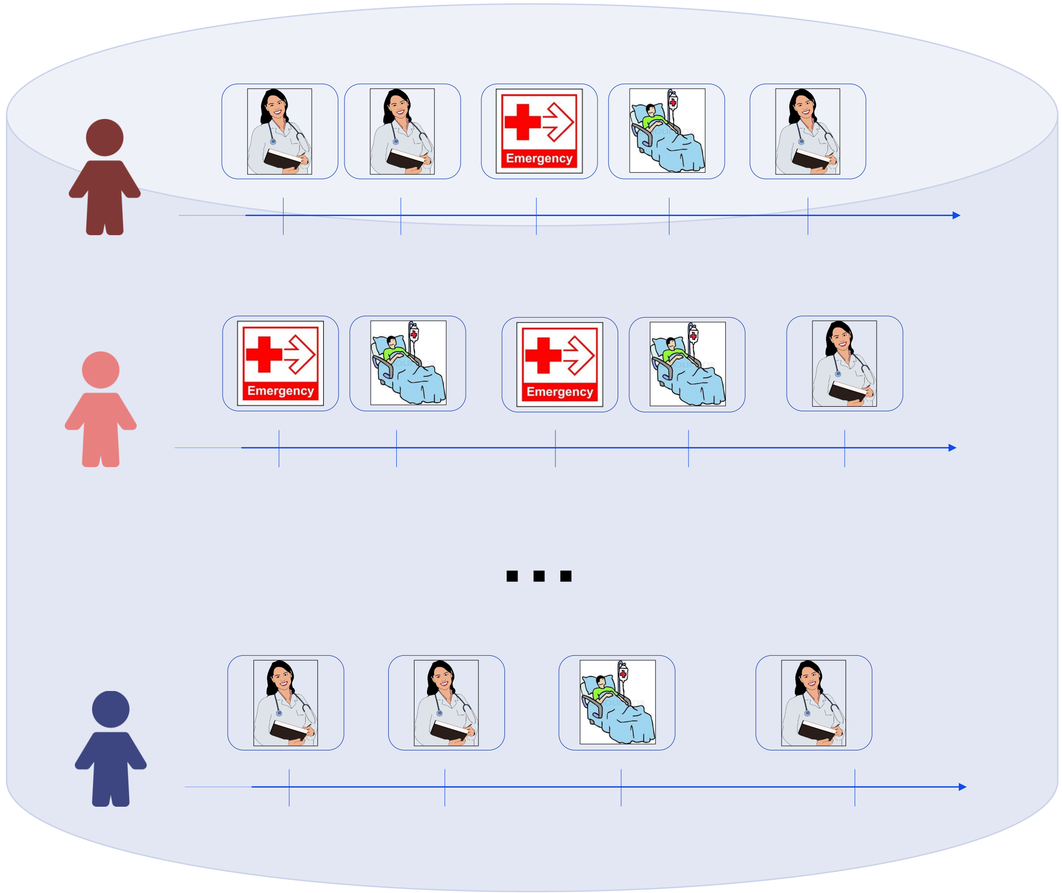
Perspectives

A patient journey is the collection of health events of an individual person.

Patient



Lumos



Entities included:

- 156 practices across all 10 PHNs in NSW (over 200 practices enrolled for next update)
- 1.35 million patient journeys

11 linked data sets, including:

- GP visits and patient status
- Emergency presentations
- Hospital admissions
- Non-admitted hospital patients
- Ambulance
- Integrated Care
- Cancer registry
- Mental Health Ambulatory Data Collection
- Deaths

Lumos: Roadmap

1 — WSPHN — 5 practices 48,230 patients

2 — WSPHN — 16 practices 220,400 patients

3 — WSPHN — 19 practices 149,413 patients

4 — WS, NS, WNSW, and SENSW PHNs — 18 practices 196,690 patients

5 — 10 NSW PHNs — Over 90 practices with up to 1,000,000 patients - TBC

April 2020

First Scale Up Linkage

All 10 NSW PHNs
~150 practices
~1,500,000 patients

Statewide Expansion

- Collaboration between health providers at scale
- 500 participating practices
- 4 million patients
- 2 linkages per annum
- Cloud based data repository
- Routine, targeted and advanced analyses
- Reliable evidence base to inform policy and planning, and data driven quality improvement

Business As Usual

- Improve patient care and experience
- Reduce system costs
- Allow early identification of current and emerging population health issues
- Drive opportunities in primary care

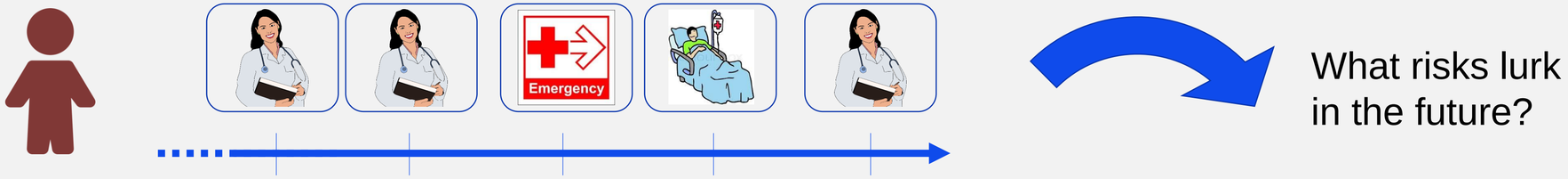
Pilot Tranches 1 - 4	Pilot Tranche 5	Scale Up
General Practice Records	Integrated Care Database (ICD)	NSW Ambulance (EMR and CAD)
Admitted Patient Data (APDC)	NSW Patient Survey (IC)	Cause of Death (RBDM)
Emergency Department Data (EDDC)		Non-Admitted Patient (NAP)
Mortality (RBDM Deaths)		Central Cancer Registry
		Mental Health Ambulatory

Pilot Ethics — 2016 to 2019

Scale Up Ethics — 2020 to 2022

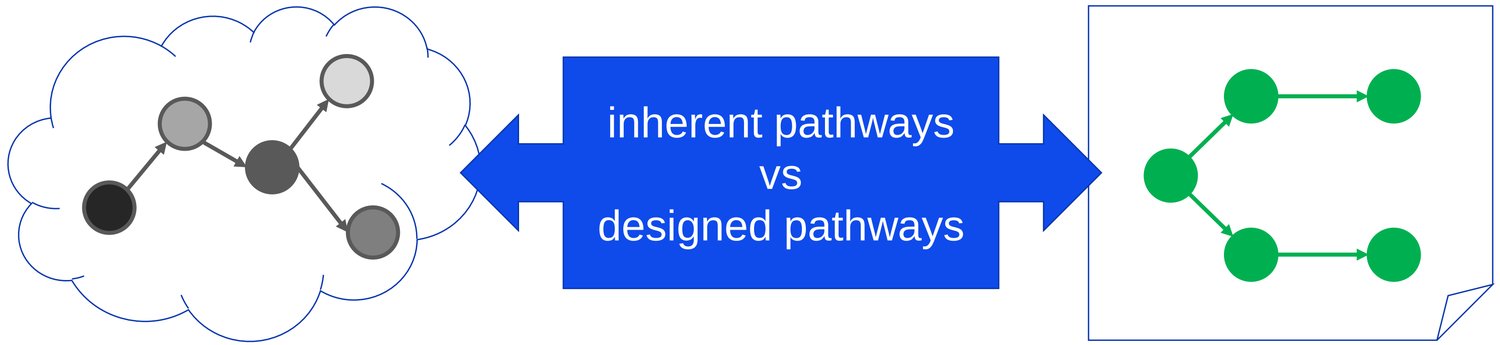
What is interesting about patient journeys?

the perspective of patient journeys lets you uncover insights that depend on **specific unfolding circumstances**



What risks lurk in the future?

- placed in a system or clinical perspective
- applied at individual, cohort or system level



Program status

2019 H1	Mining Primary & Acute Care Linked Data (competed with NSW Ministry of Health)
2019 H2	Visualising Patient Journeys (completed with NSW Ministry of Health)
2020 (3-years)	Patient Journey Modelling (in planning with WentWest, NSW Ministry of Health & DHCRC)

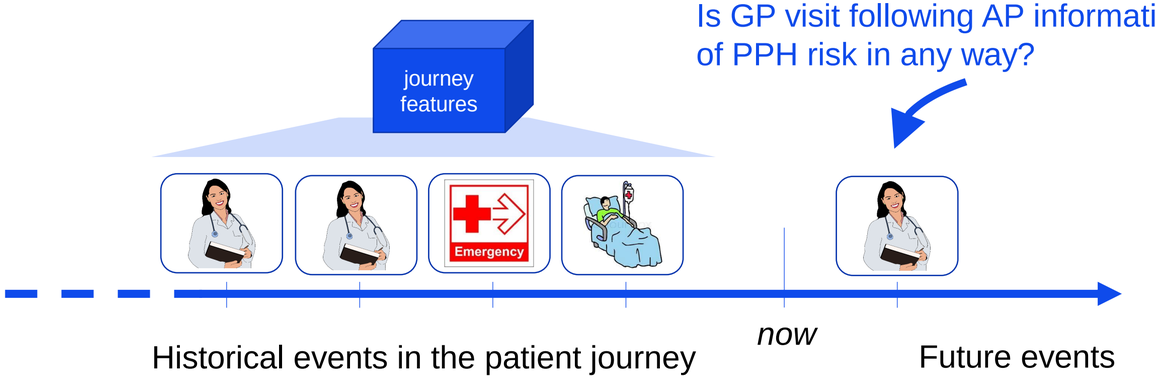
NSW Health

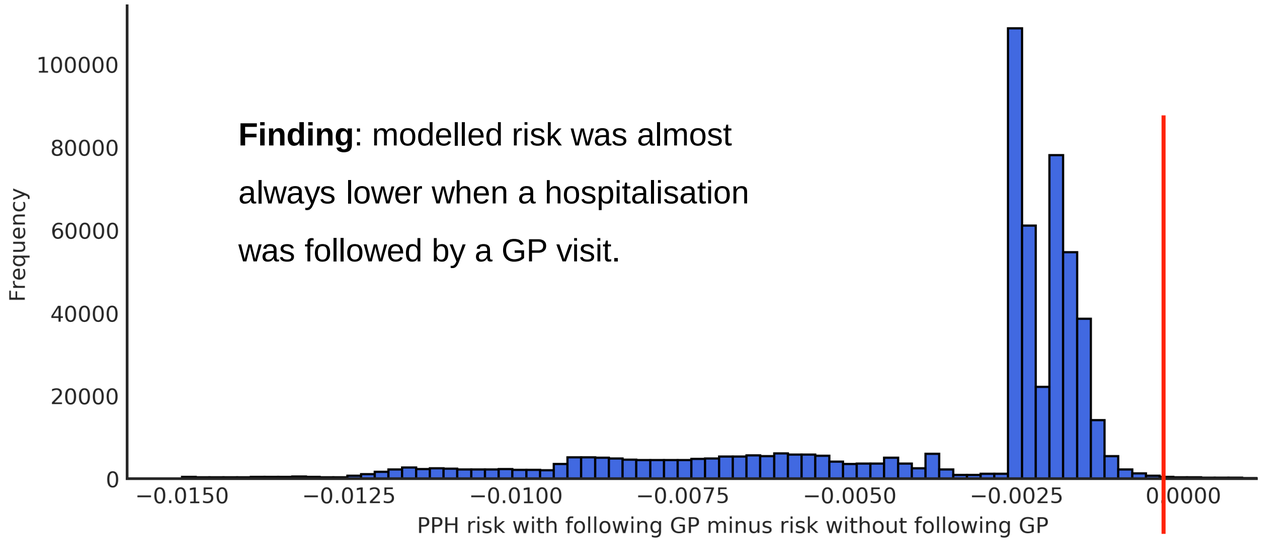
UTS

WentWest

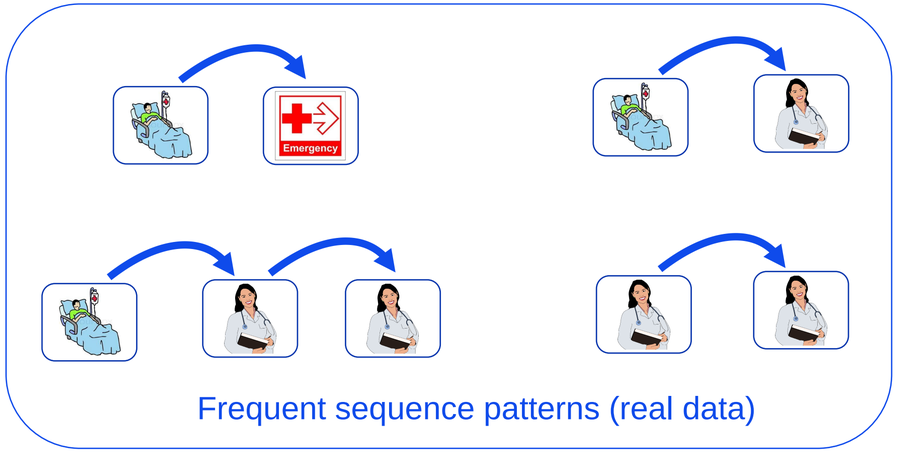
digital health CRC

Mining Primary & Acute Care Linked Data





Finding: modelled risk was almost always lower when a hospitalisation was followed by a GP visit.



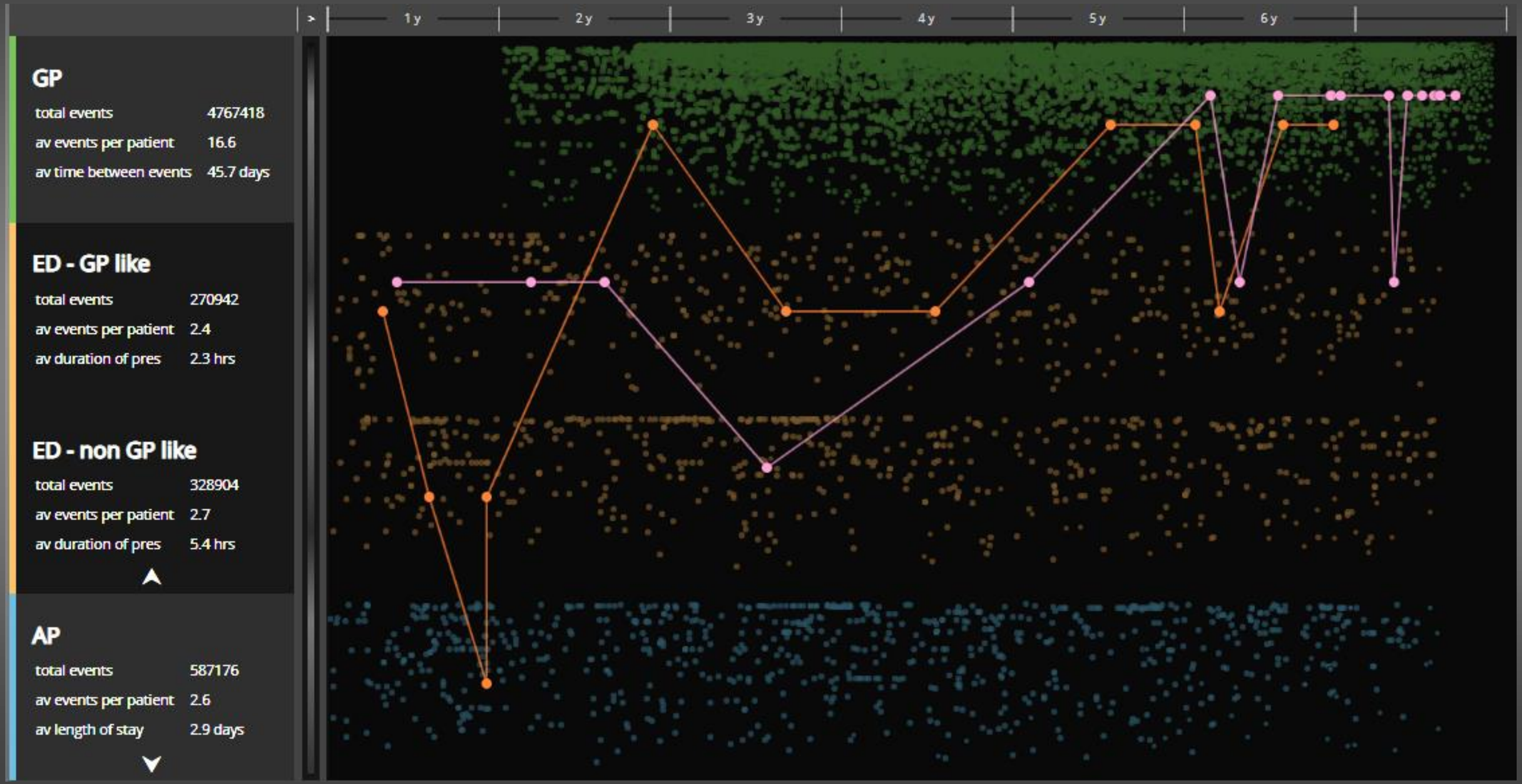
Finding: Top variables for predicting potentially preventable hospitalisations

Model AUC 76%

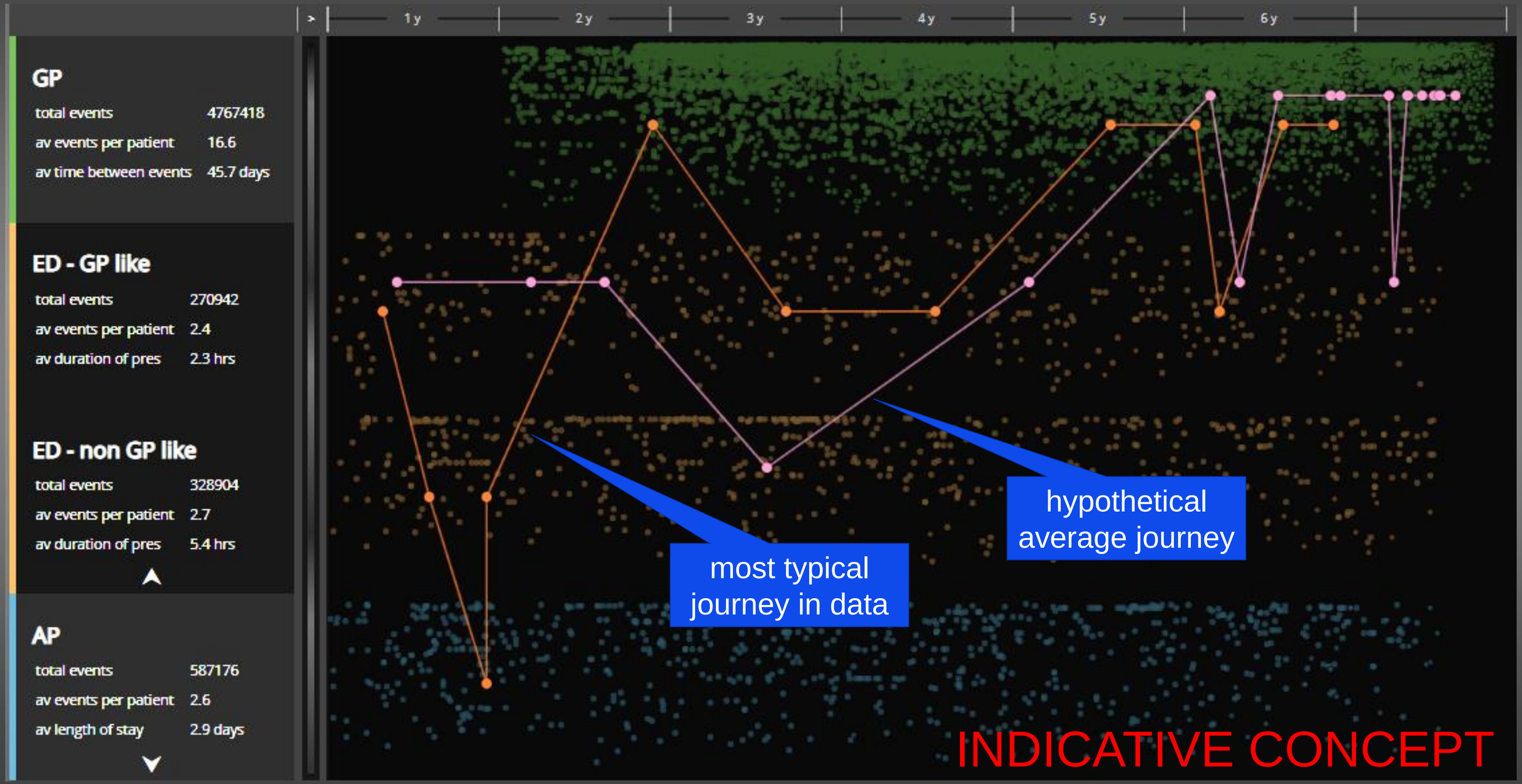
(without sequence features 72%)

Feature	Rank
Age	1
Mode of separation = transferred to other hospital	2
Sequence: AP, ED, GP	3
Sequence: ED, AP	4
Mode of separation = type change separation	5
Emergency status = Emergency	6
Sequence: AP, GP, GP	7
Sequence: AP, AP	8

Patient Journey Visualisation



Patient Journey Modelling



Query

clear

chronic disease

- ☐ (all)
- ☐ no disease
- ☒ CVD
- ☒ diabetes
- ☒ cancer
- ☒ CKD
- ☒ respiratory
- ☒ mental
- ☒ osteoporosis
- ☒ liver

lifestyle

drug abuse: no ▼

alcohol: never ▼

smoking: (all) ▼

BMI status: (all) ▼

demographic

age group:

☐	☐	☐	☐	☒	☒	☐	☐	☐
(all)	0	10	20	30	40	50	60	70

sex: ☒ male ☒ female

IRSAD:

☒	☒	☒	☒	☒	☒
(all)	1	2	3	4	5

Query the patient journey model

query type: prototype ▼ run

Result: typical patient journey

chronic disease

- \- CVD
- \- diabetes
- \- cancer
- \- CKD
- ✓ respiratory
- \- mental
- \- osteoporosis
- \- liver

lifestyle

drug abuse: no (selected)

alcohol: never (selected)

smoking: never

BMI status: normal

demographic

age group: 40-49

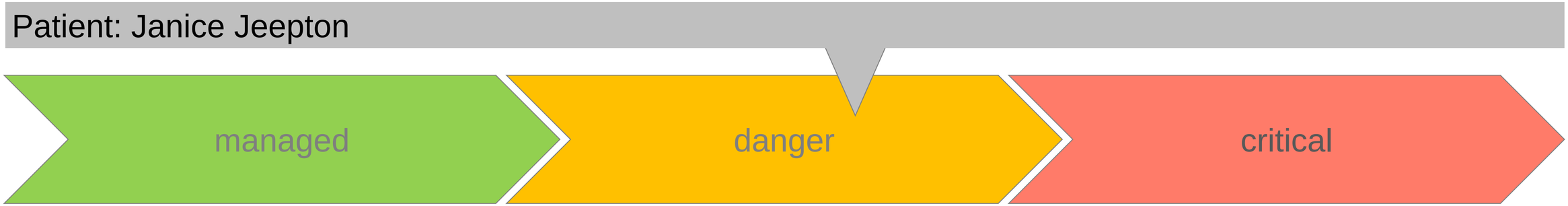
sex: male

IRSAD: 3 (of 5)

INDICATIVE CONCEPT

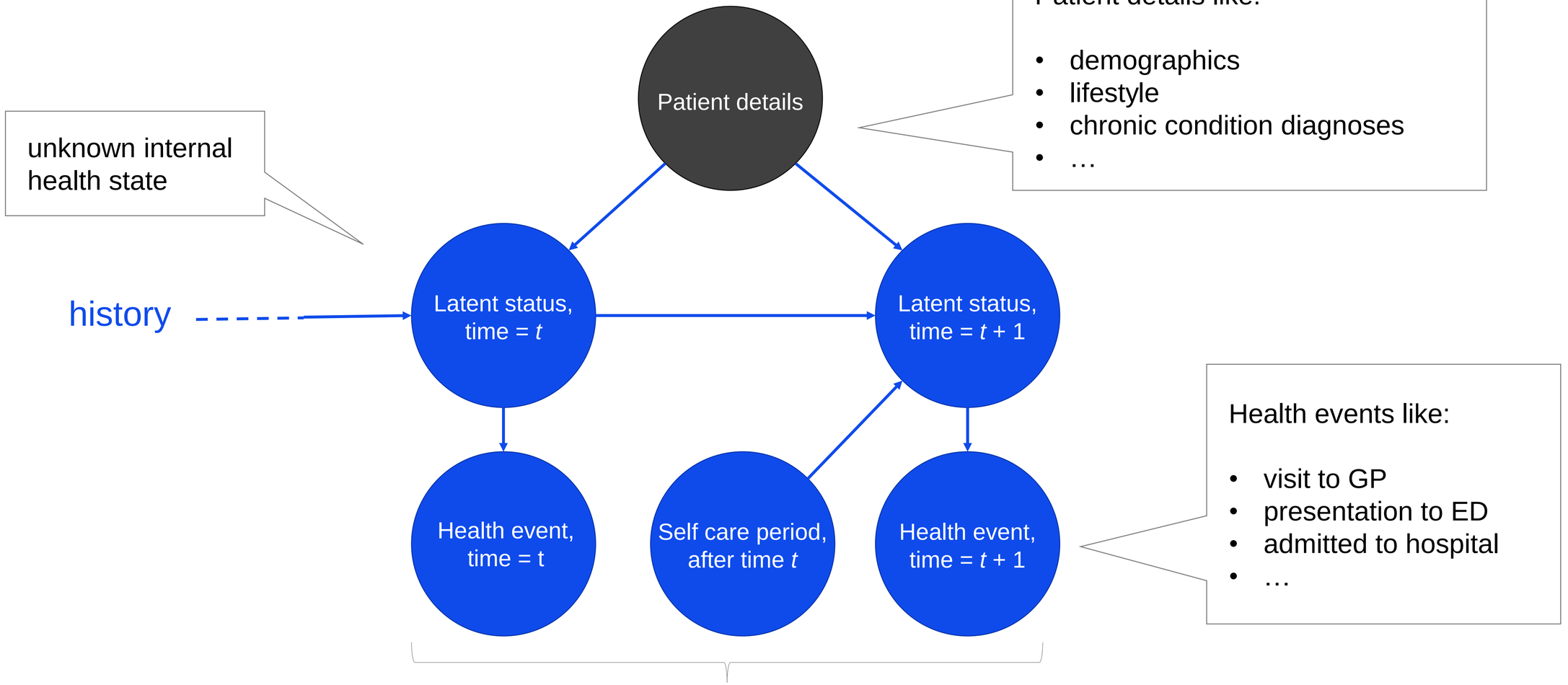
Applying a patient journey model to an individual patient

Where is a cardiac patient positioned in the spectrum of health transitions…

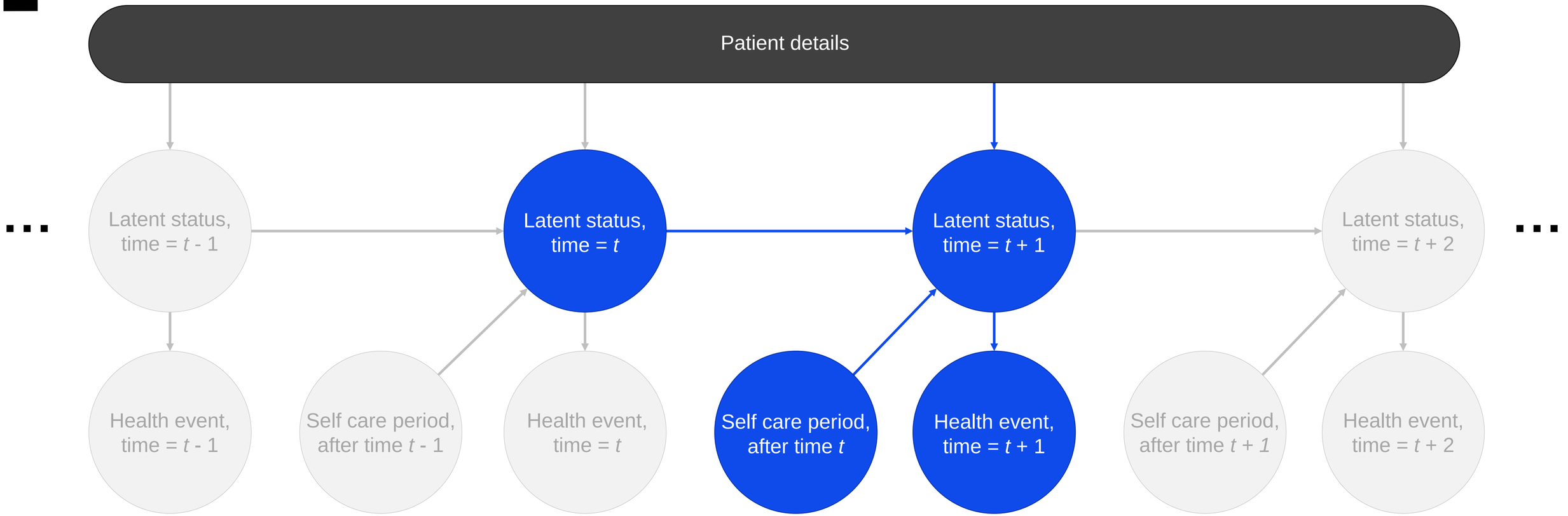


INDICATIVE CONCEPT

Modelling patient journeys

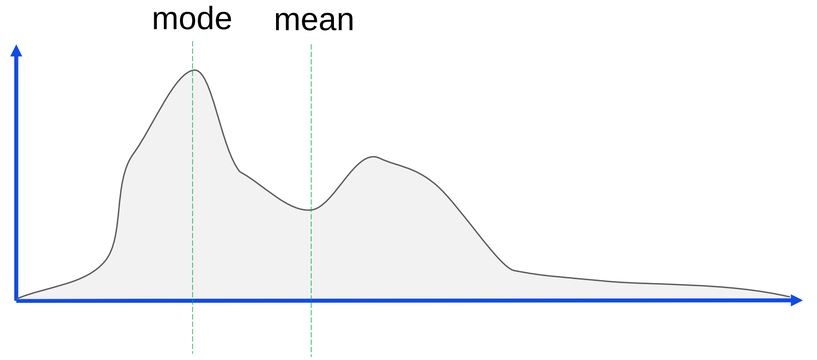


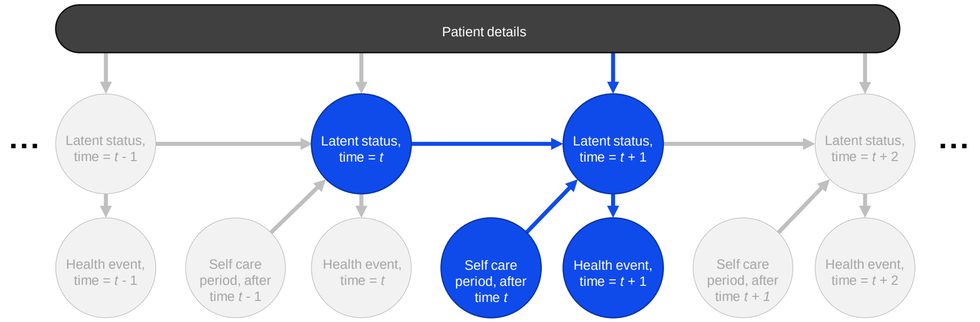
Modelling patient journeys



Advantages of the approach

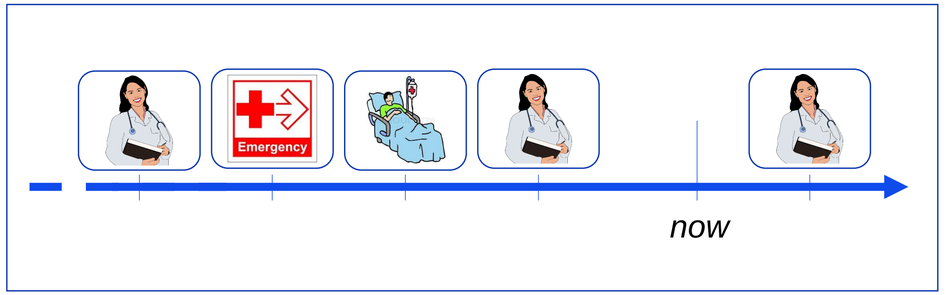
- a model defines a probability distribution over sequences of health events... averages are well defined (mean, mode, median, …)
- prediction is a built in feature, with quantified uncertainty
- can apply to individuals and populations
- what-if analysis can be layered on top
- patient pathways can be extracted from the model
- formulated to discover underlining, hidden health status
- can train the model on large-scale Lumos data

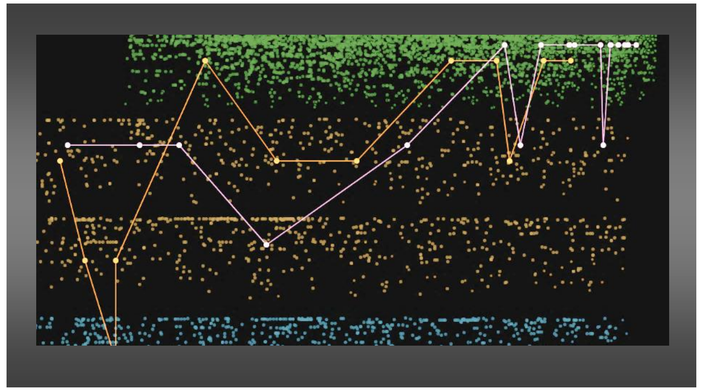


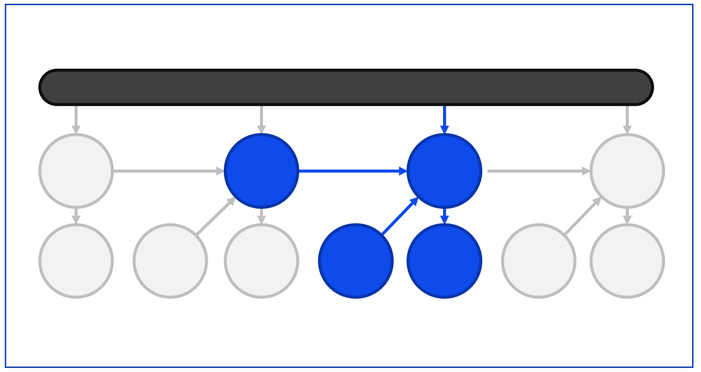


Summary

- Previous data mining work demonstrated the importance of **sequences of events** when understanding patient journeys.
- Previous visualisation work demonstrated the need to condense thousands and millions of patient journeys into **succinct summaries with valid statistics**.
- New extensive data assets exist, capturing patient journeys, especially **Lumos**.
- Collaborative commissioning needs **data-driven insights** into patient journeys for patient pathways.
- Patient Journey Modelling is set to break new ground in extracting insight about patient journeys.







Thank you