

# HOPE for Stroke

Delwyn Armstrong  
Head of Analytics  
Institute for Innovation and Improvement  
Waitemata DHB



Quentin Thurier  
Data Scientist  
Orion Health



# Health Outcome Prediction Engine

## Aim:

Develop prototype electronic clinical decision systems which makes health outcome predictions tailored to individual patients.

Peter Sandiford, Principal Investigator



# Health Outcomes Prediction Engine

**AAA  
Screening**  
Peter Sandiford

**PROMs**  
Jay O-Brien

**HOPE for Stroke**  
Delwyn  
Armstrong



## Why?

Patients and families want to know what to expect following a health event

Clinicians need to know most likely outcomes for this patient to plan care

Clinicians must rely on research and their own experience

## Why stroke?

Affects about 800 people in Waitemata per year

Important condition which impacts independence and quality of life

Large range in outcomes

We have large, relatively rich clinical dataset

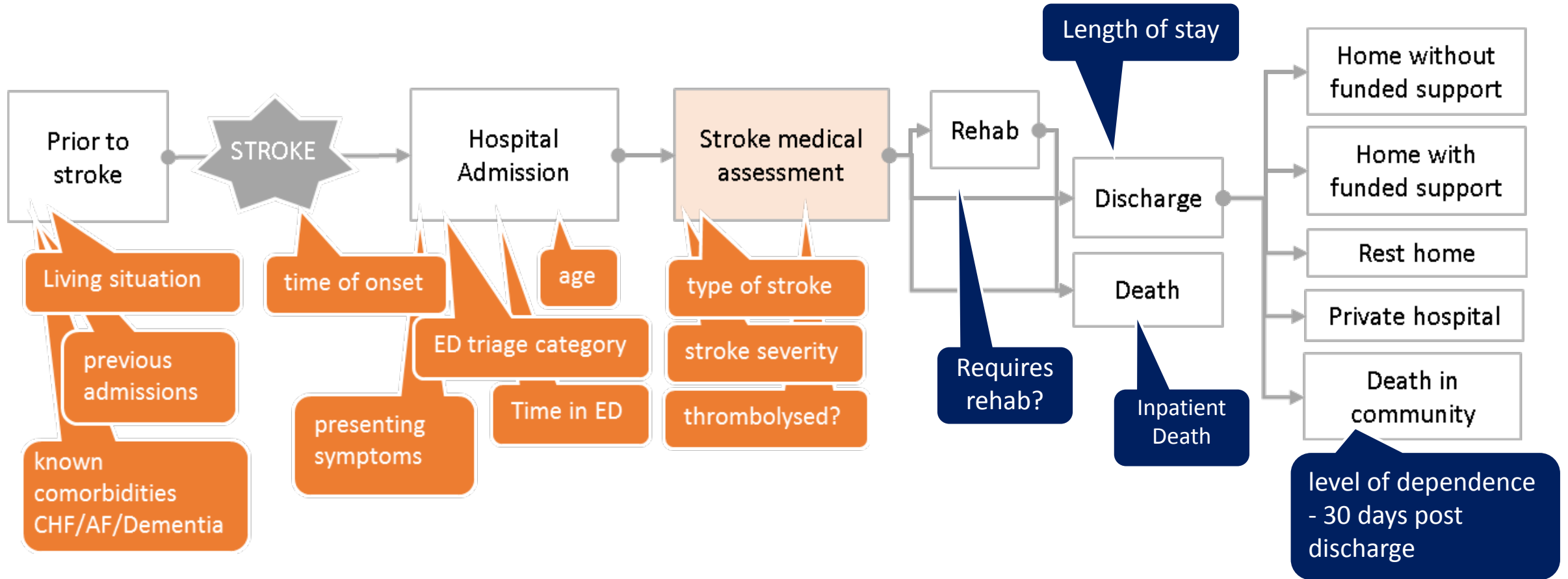
Relevant outcomes only known in local data

# Predictive analytics

- Using what we knew in the data about patient groups (patient attributes) and what we know happened to them (outcomes)
- Creating rules (algorithms) which explain the relationship between patient attributes and outcomes
- Applying rules to new patients to predict their outcomes

# Phase 1: Prepare Data

2800 strokes assessed in last 5 yrs



Phase 2:  
Develop  
Algorithms

- problem &  
approach

A wide predictive modelling project:

- Binary classification - rehab requirement
- Ordinal regression - level of dependence
- Regression - length of stay

A state of the art predictive modelling strategy:

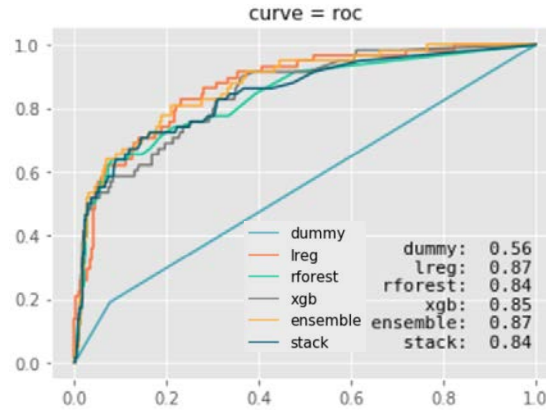
- Serialization of the whole workflow
- A large panel of models including random forest & gradient boosting
- Combining techniques such as stacking
- Bayesian optimization for fine-tuning



# Phase 2: Develop Algorithms

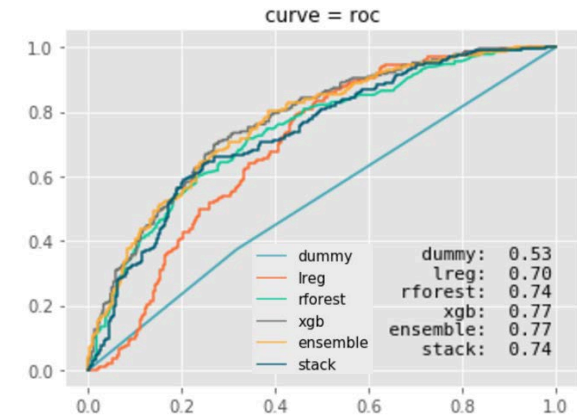
- models  
assessment

### Inpatient death

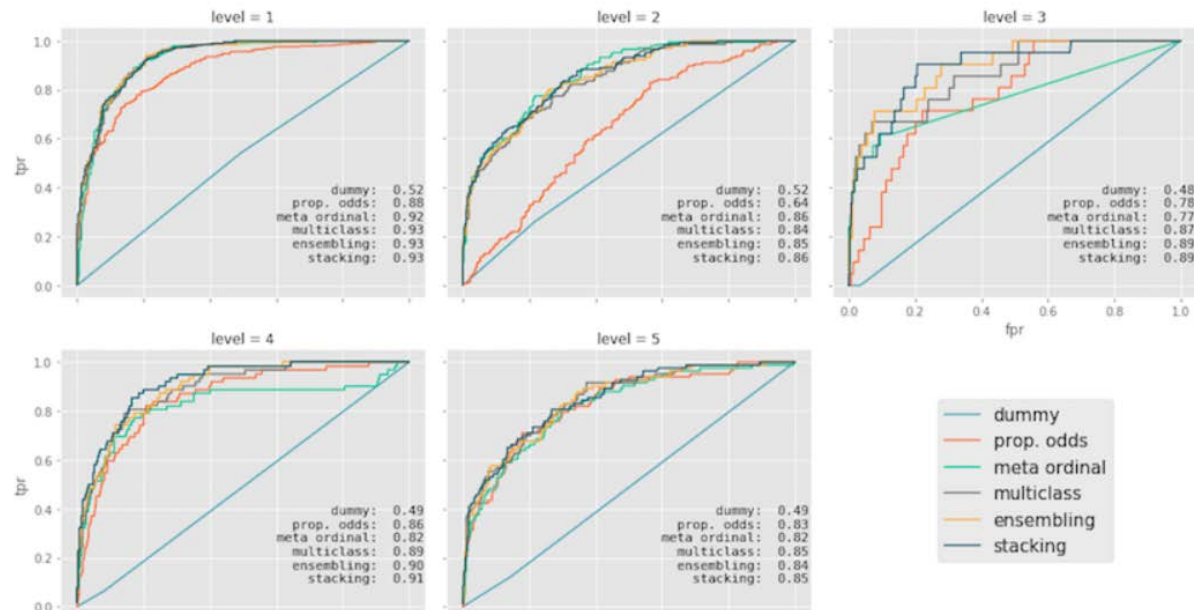


- Performance varies depending on the outcome
- Models combining is a performant strategy across all outcomes

### Rehab requirement

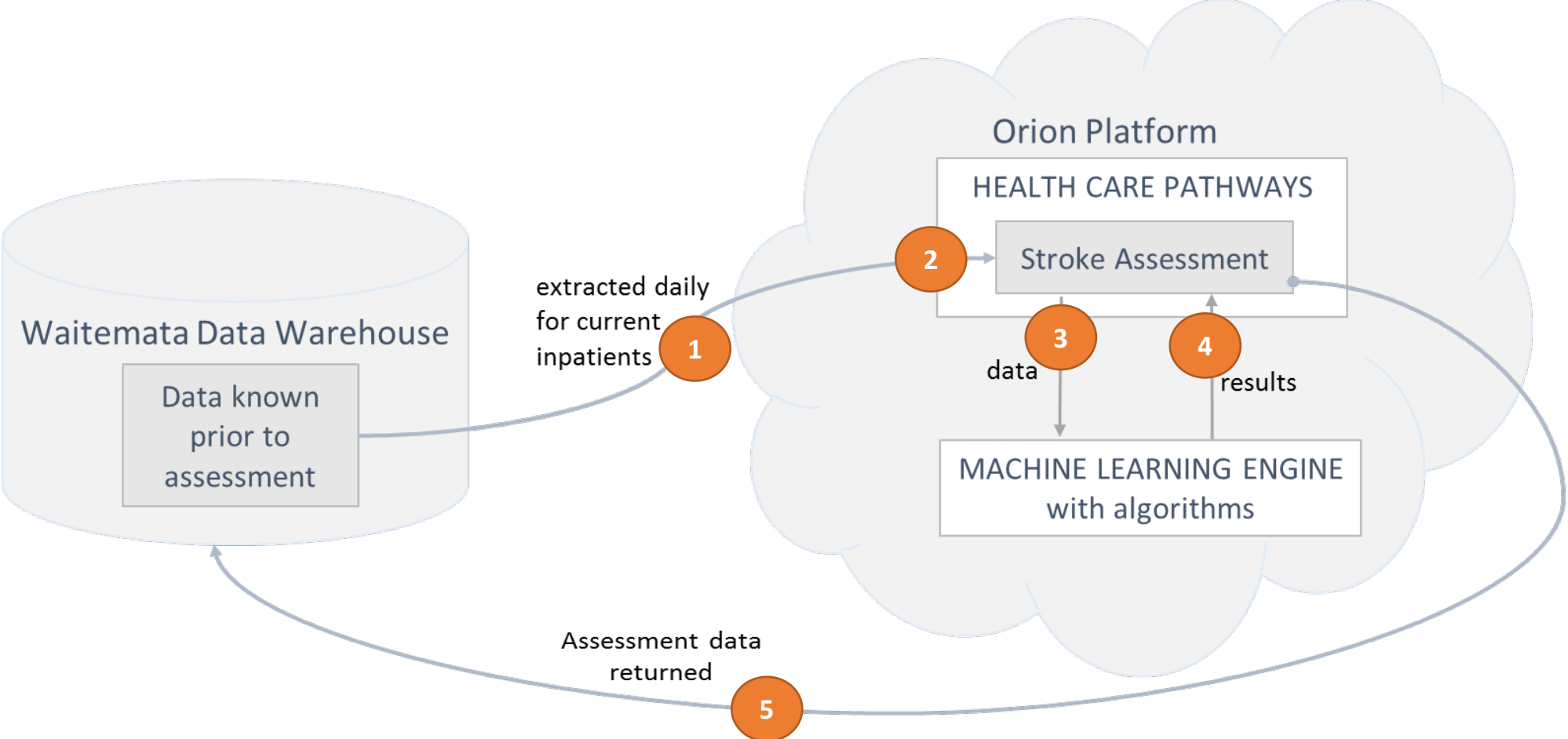


### Dependence level 30 days post-discharge



# Phase 3: Develop system –

Outcomes  
delivered  
to clinical  
workflow



# Phase 3: Develop system

stroke  
assessment

## Stroke Assessment

Onset Date Time 27-Aug-2017 10:15

Referral Date Time 27-Aug-2017 12:30

Referral Mode  Globals  Triage nurse  Other ED  Medical ward  Other

Living Situation \*  Own home  Rest home  Private Hospital

## Stroke Team Contact

First Contact Date 28-Aug-2017

Stroke Type  Ischaemic  ICH  Other stroke  SAH  TIA  Not stroke

Doctor Nicholas Child

Nurse Sue Bennett

NIHSS 21

Oxford  LACS  PACS  POCS  TACS  N/A

Stroke Unit Input  Yes  No  Inappropriate

Thrombolysis Date

Thrombo DHB  WDHB  ADHB  Other

Reason Not Thrombolysed Timeframe wrong - pre hospital

## Clinician Prediction

What is this patient's most likely outcome at one month?  Own home  Rest home  Private hospital  Death

How strong is your confidence in this prediction?  Strong  Moderate  Weak

+ Add

clinician  
prediction

## Health Outcome Prediction Engine

### Inpatient Death

**The most likely outcome for this patient is returning home without home cares**

**There is a strong likelihood of this outcome.**

**This is no change of dependency level for the patient.**

engine  
predictions

Chance of returning home without home cares 59%

## Stroke Project

Nick Child, Stroke Lead Physician, Waitemata DHB

Delwyn Armstrong, Head of Analytics, WDHB

Quentin Thurier, Data Scientist, Orion Health

Kevin Ross, Director of Research, Orion Health

## Thanks to

Peter Sandiford, Director of Health Gains, WDHB

Robyn Whittaker, Assoc. Prof UoA & Innovation Lead, WDHB

Kate Reid, GM NZ, Orion Health

Mark Rainford, Orion Health

Stuart Bloomfield, CIO, Waitemata DHB