MyDiabetesIQ

machine learning for decision support & outcome prediction in diabetes

Chris Sainsbury
Consultant Diabetologist, Glasgow

@csainsbury

NHS Greater Glasgow and Clyde

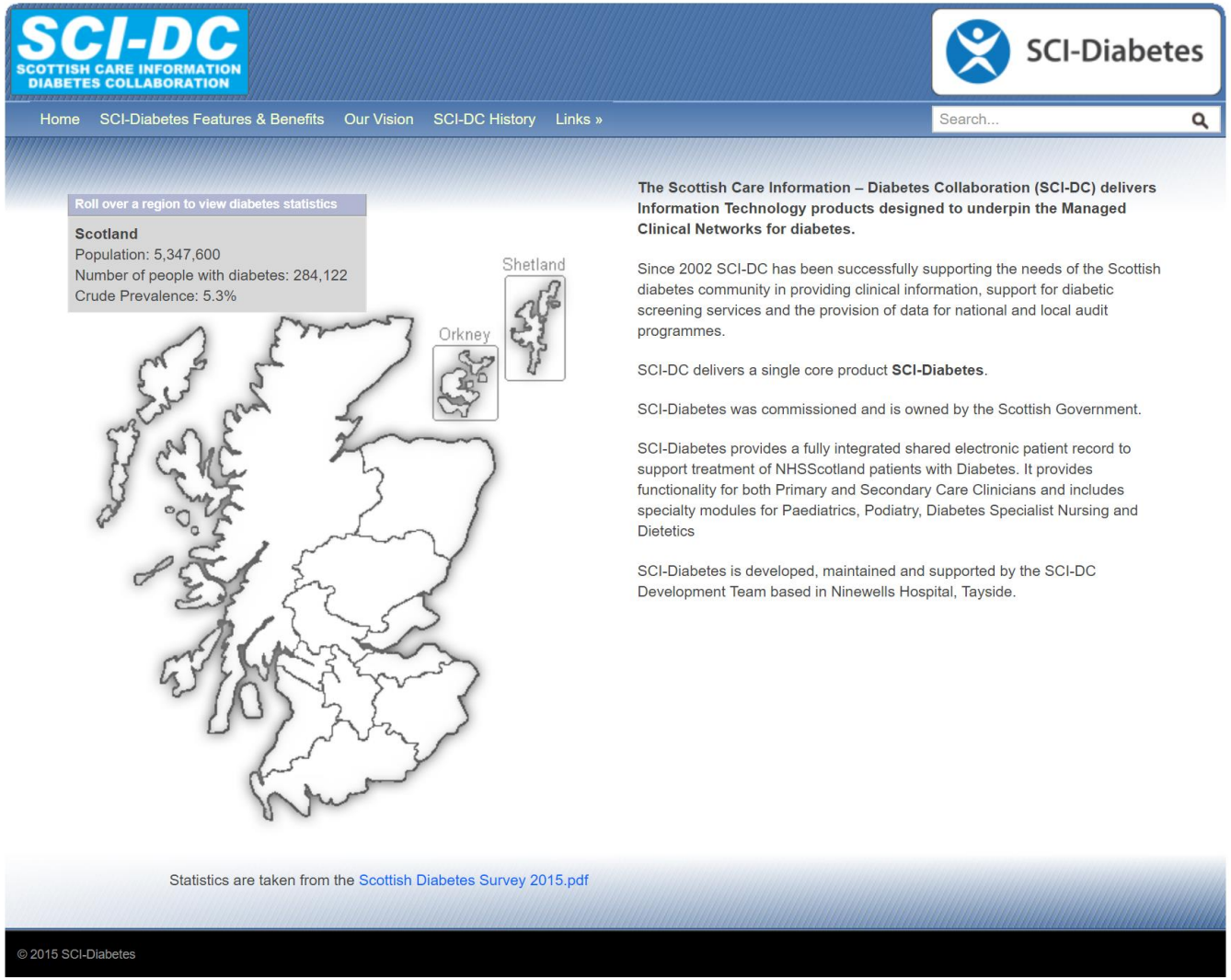
myway digital health

Innovate UK

SCI-Diabetes

c 300k patients with DM
c 500k historical patients

longitudinal data 1990 onwards:
biochemistry
phenotypic data
complications
mortality
prescribing data (encashment)



SCI-Diabetes

‘if we have one of the best datasets in the world, we should be able to build high quality algorithms to understand relationships within diabetes data…’

initial goals

i. suggest best next therapy / combination of therapies to achieve goals in multiple domains (hba1c reduction / blood pressure / mortality etc)

ii. predict complications (LLA, CV events)

iii. predict acute complications (hypoglycaemia etc)

iv. predict diabetes type at diagnosis, identify MODY etc

InnovateUK (Digital Health Technology Catalyst) 1M grant 2018-2021

what is the next best drug(s) for my patient?
virtual n = 1 drug trial

what drug should I prescribe to give this patient the best chance of having an HbA1c <60mmol/mol, with a reduction in blood pressure and BMI in 1 year?

taking into account their individual history of:

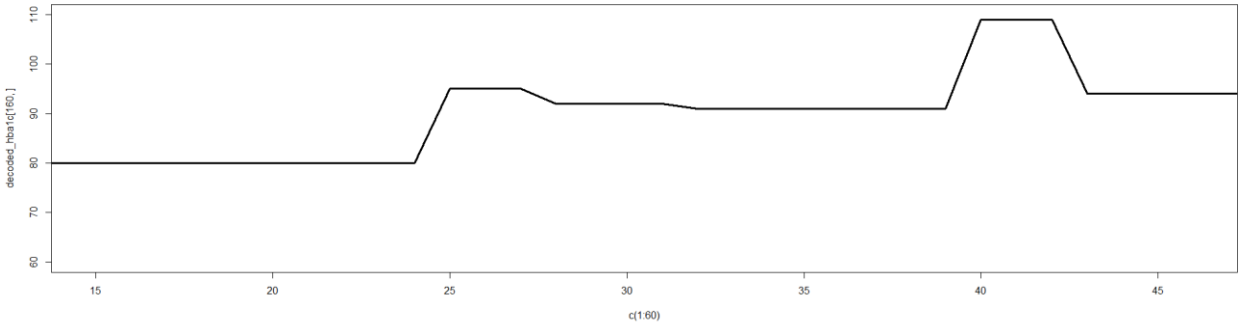
- HbA1c / BMI / blood pressure
- previously prescribed combinations of drug therapies
- how previous drugs have impacted on HbA1c / BMI / blood pressure
- sex
- age
- ethnicity

time series

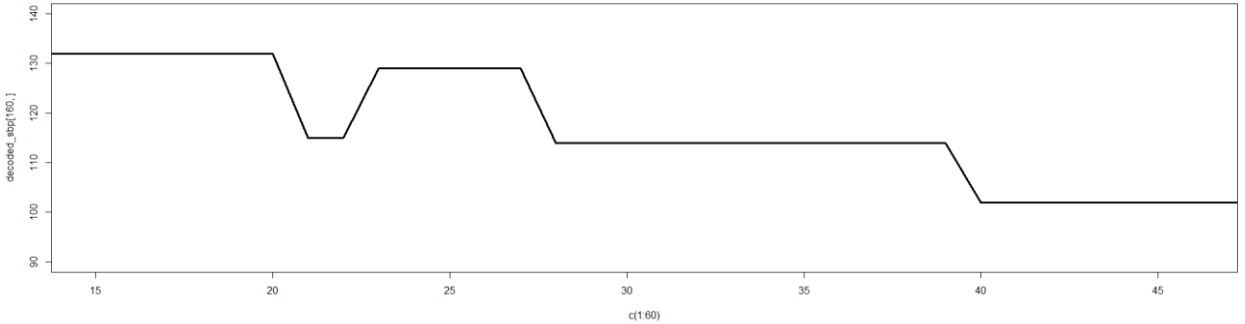
stable over time

managing time series data - 1

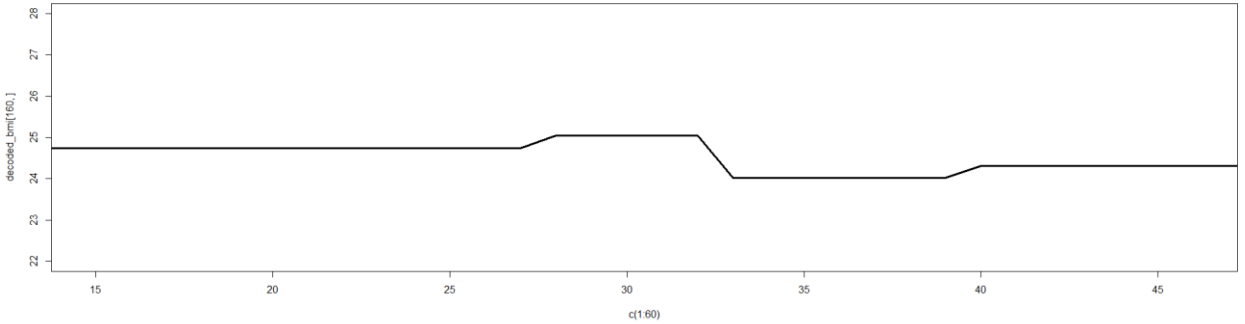
hba1c



sbp



bmi



time

Metformin_	nil	nil	Metformin_
nil	humanBasalInsulin_	humanBasalInsulin_	humanBasalInsulin
SU_	nil	nil	Metformin_SU_
nil	analoguePrandialIns	analoguePrandialIns	nil
analogueBasalInsuli	analogueBasalInsuli	analogueBasalInsuli	analogueBasalInsul
nil	nil	nil	Metformin_
nil	analogueBasalInsuli	nil	nil
Metformin_	nil	nil	Metformin_
nil	analogueBasalInsuli	nil	analogueBasalInsul
analogueBasalInsuli	analoguePrandialIns	analoguePrandialIns	analoguePrandialIr
DPP4_Metformin_S	nil	DPP4_Metformin_S	nil
nil	analogueBasalInsuli	analogueBasalInsuli	analogueBasalInsul
humanBDmixInsulin	humanBDmixInsulin	nil	humanBDmixInsuli
Metformin_	nil	nil	Metformin_
analoguePrandialIns	nil	analoguePrandialIns	analoguePrandialIr
analoguePrandialIns	analoguePrandialIns	analoguePrandialIns	analoguePrandialIr
Metformin_SU_	Metformin_SU_	nil	Metformin_SU_
nil	nil	analogueBasalInsuli	nil
nil	nil	nil	nil
nil	nil	nil	nil
nil	nil	nil	DPP4_SU_
analoguePrandialIns	analogueBasalInsuli	nil	analogueBasalInsul
analogueBasalInsuli	analoguePrandialIns	analoguePrandialIns	nil
Metformin_	nil	Metformin_	nil
Metformin_	Metformin_	nil	analogueBasalInsul
analoguePrandialIns	analoguePrandialIns	analoguePrandialIns	analoguePrandialIr
nil	Metformin_SU_	Metformin_	Metformin_SU_
Metformin_	analogueBasalInsuli	analogueBasalInsuli	Metformin_
nil	nil	nil	DPP4_
Metformin_SGLT2_S	nil	Metformin_SGLT2_S	nil
Metformin_	Metformin_	Metformin_	Metformin_
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Metformin_	Metformin_	nil	nil
Metformin_SU_	nil	Metformin_SU_	nil
analogueBasalInsuli	nil	analogueBasalInsuli	nil
analogueBasalInsuli	nil	analoguePrandialIns	nil
Metformin_SU_	Metformin_SU_	Metformin_SU_	nil
Metformin_	nil	Metformin_	nil
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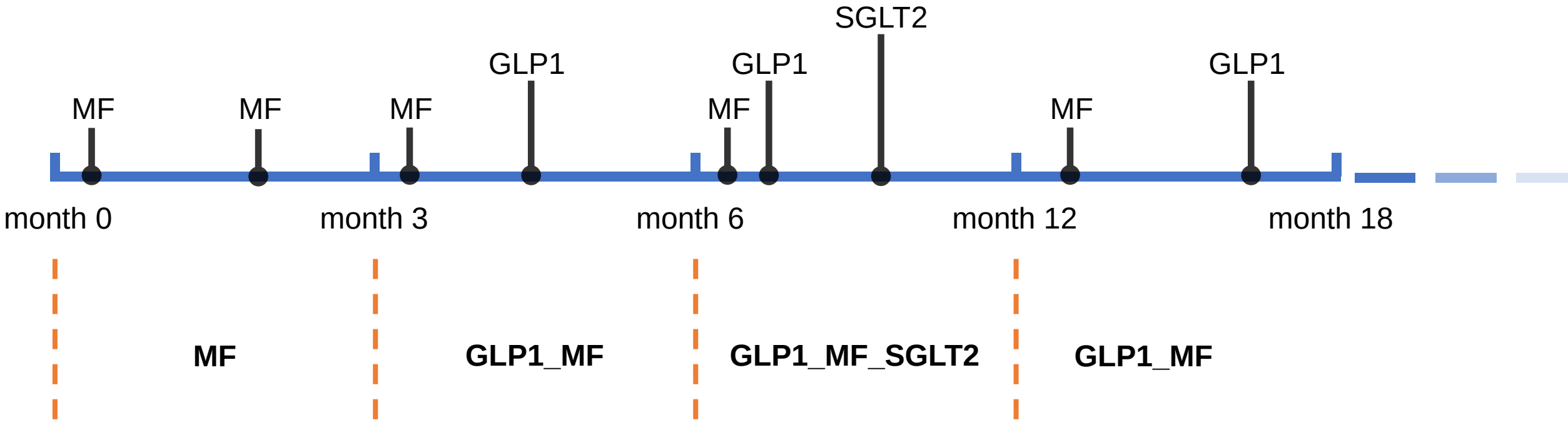
Metformin_SU_	Metformin_SU_	Metformin_SU_	Metformin_SU_
nil	Metformin_	Metformin_	nil
nil	nil	nil	nil
analoguePrandialIns	nil	nil	nil

managing time series data - 2
drug combinations as words - for natural language processing approach



Drug Sentence: MF, GLP1_MF, GLP1_MF_SGLT2, GLP1_MF

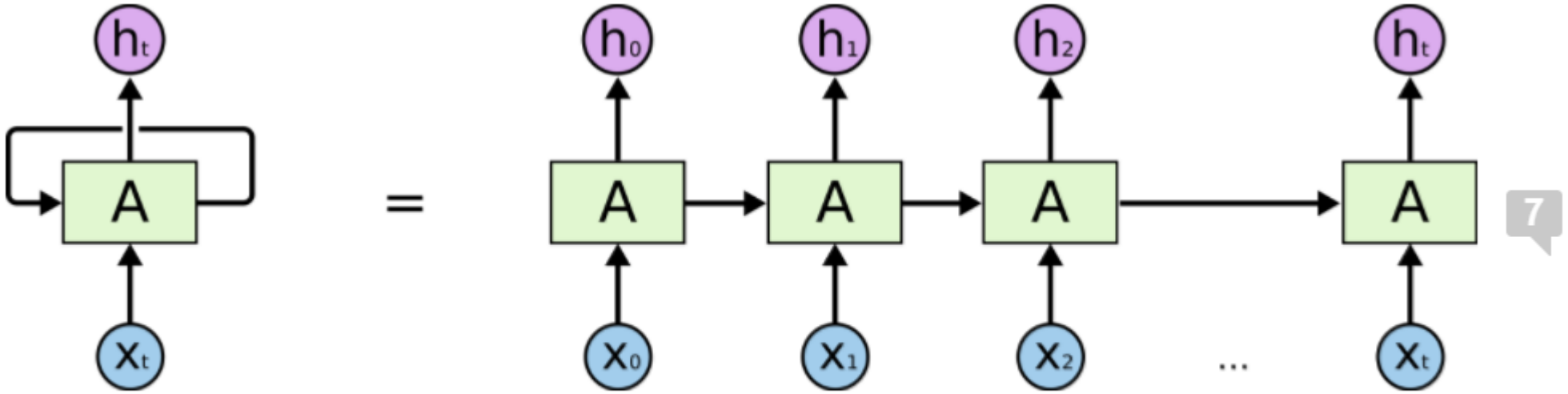
↓

Embedding, eg: 1, 2, 3, 2

↓

input into RNN / LSTM

Recurrent Neural Network (LSTM)



An unrolled recurrent neural network.

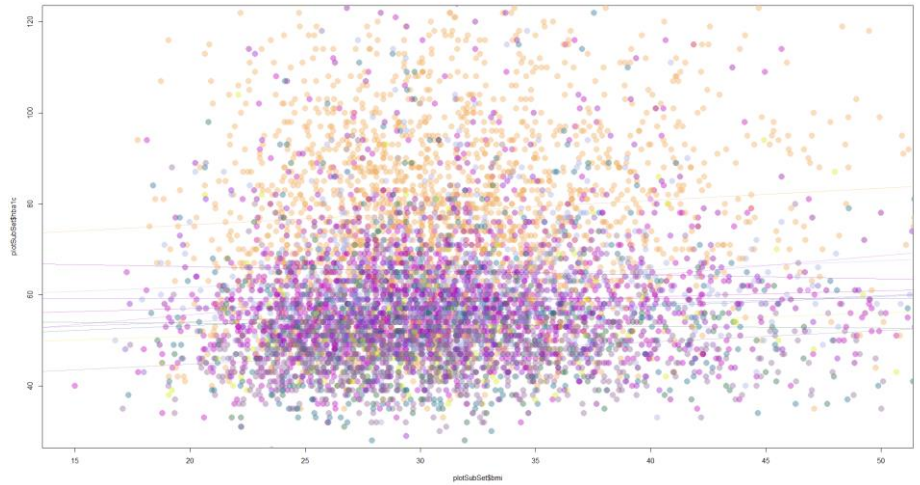
extracts information from sequence of input
multi-dimensional RNN will learn interactions between input sequences over time

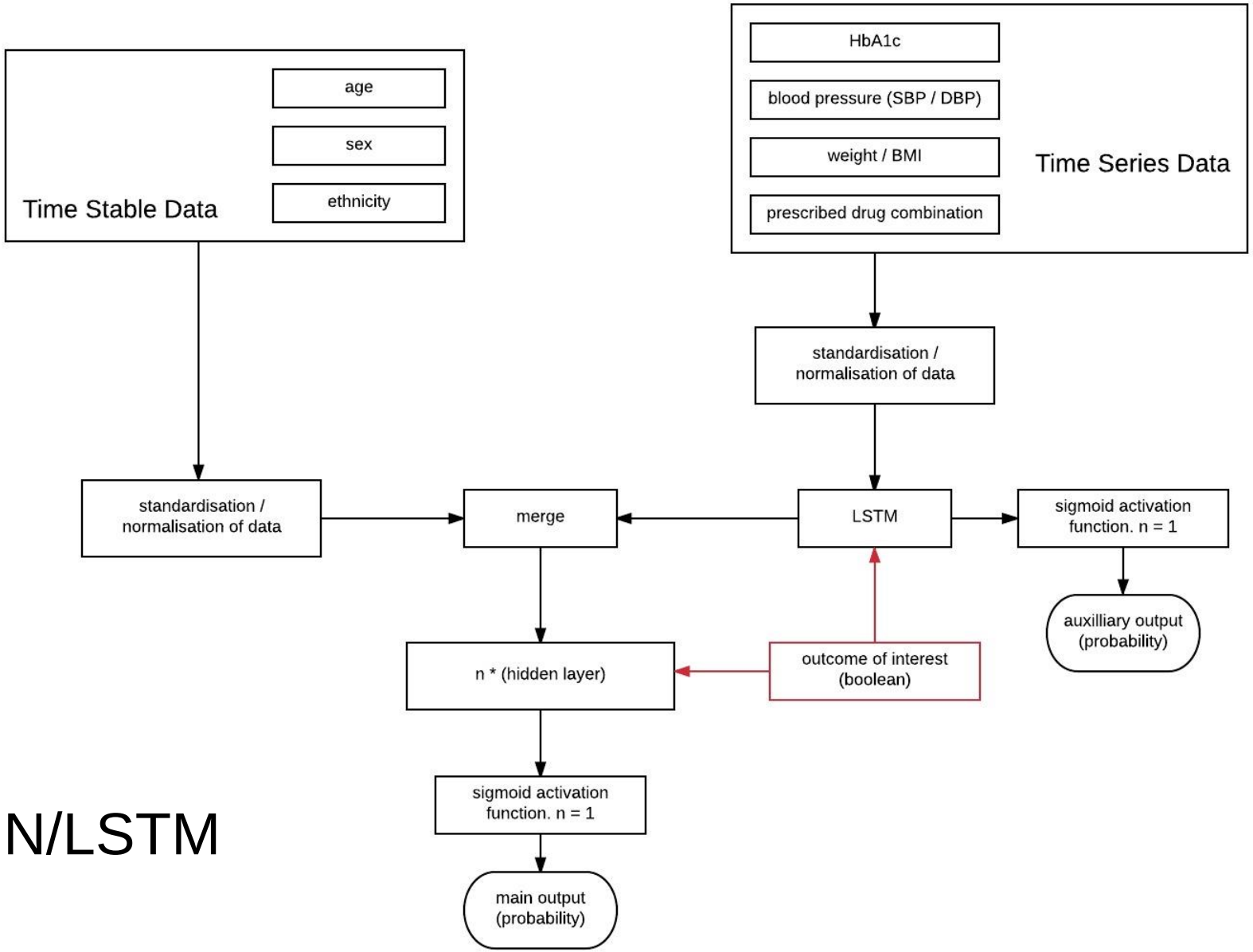
widely used – eg 30% google energy consumption running RNNs

environments used:

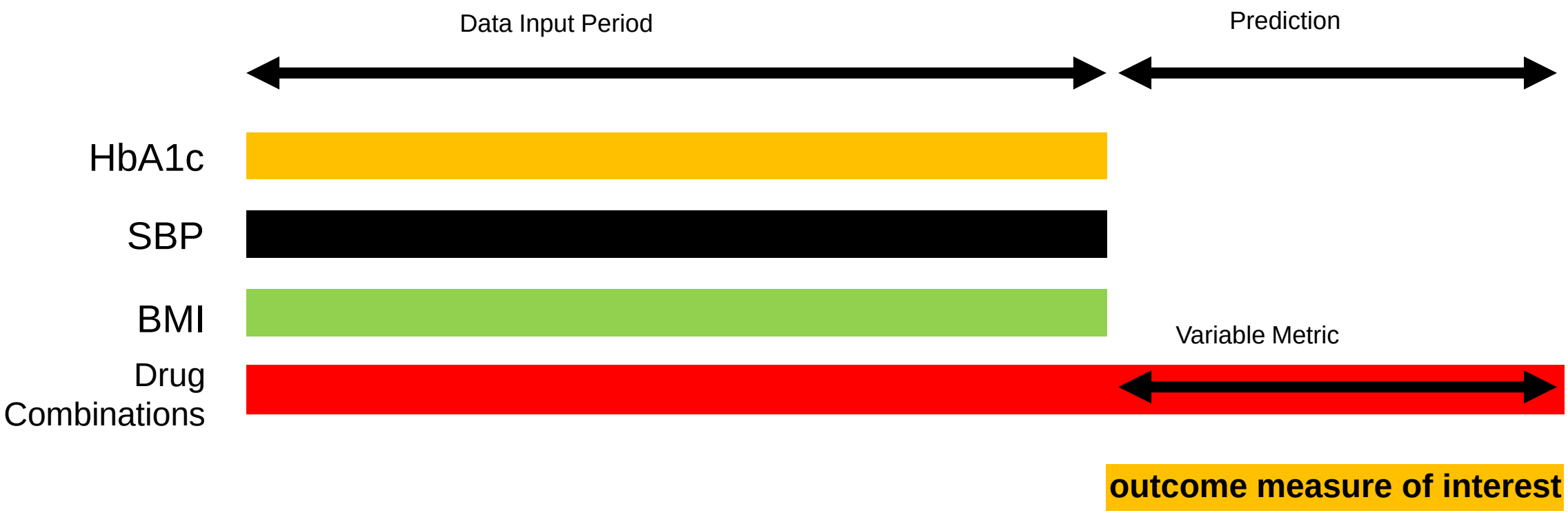
SCI diabetes data input

visualisations etc





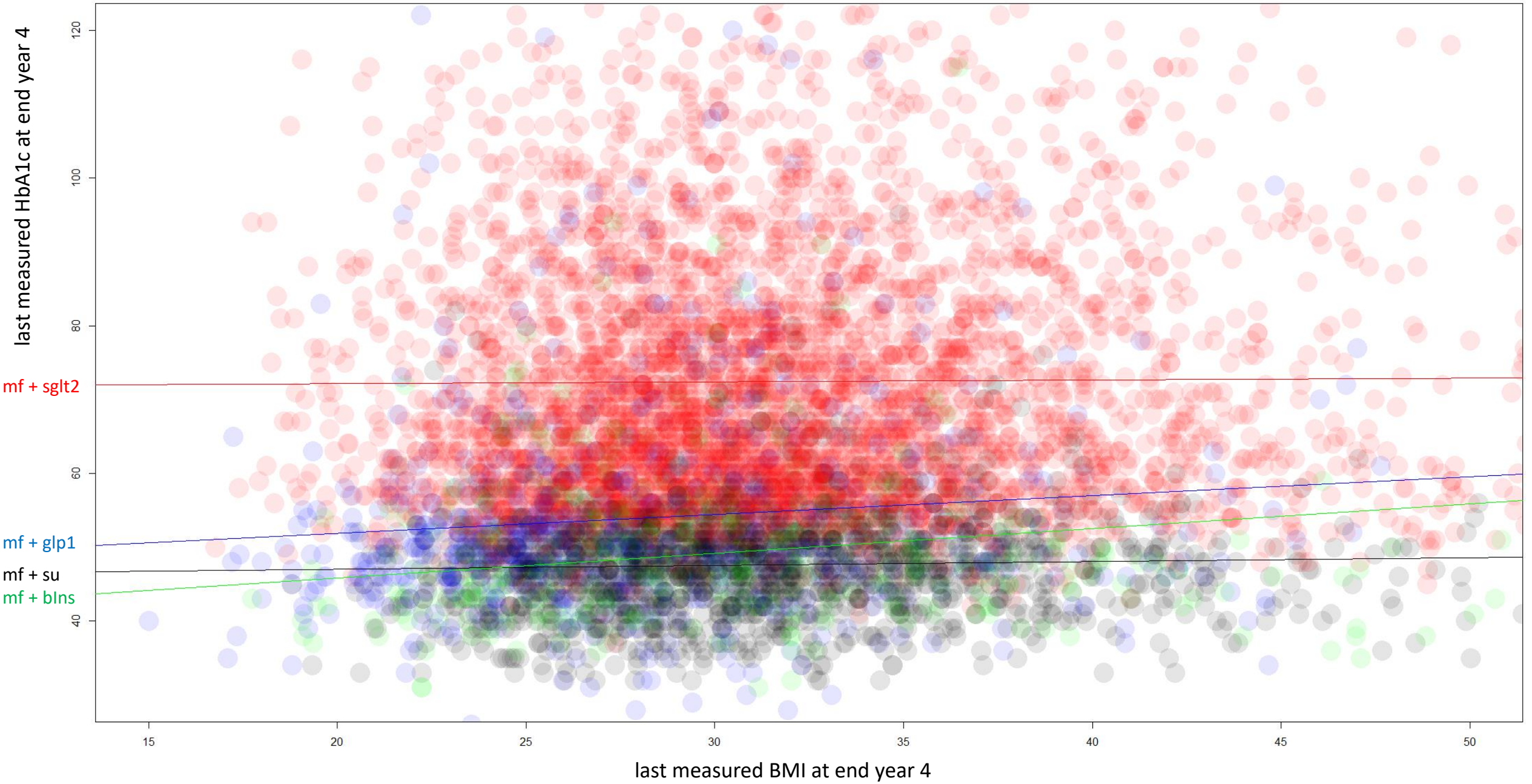
schematic of RNN/LSTM based classifier



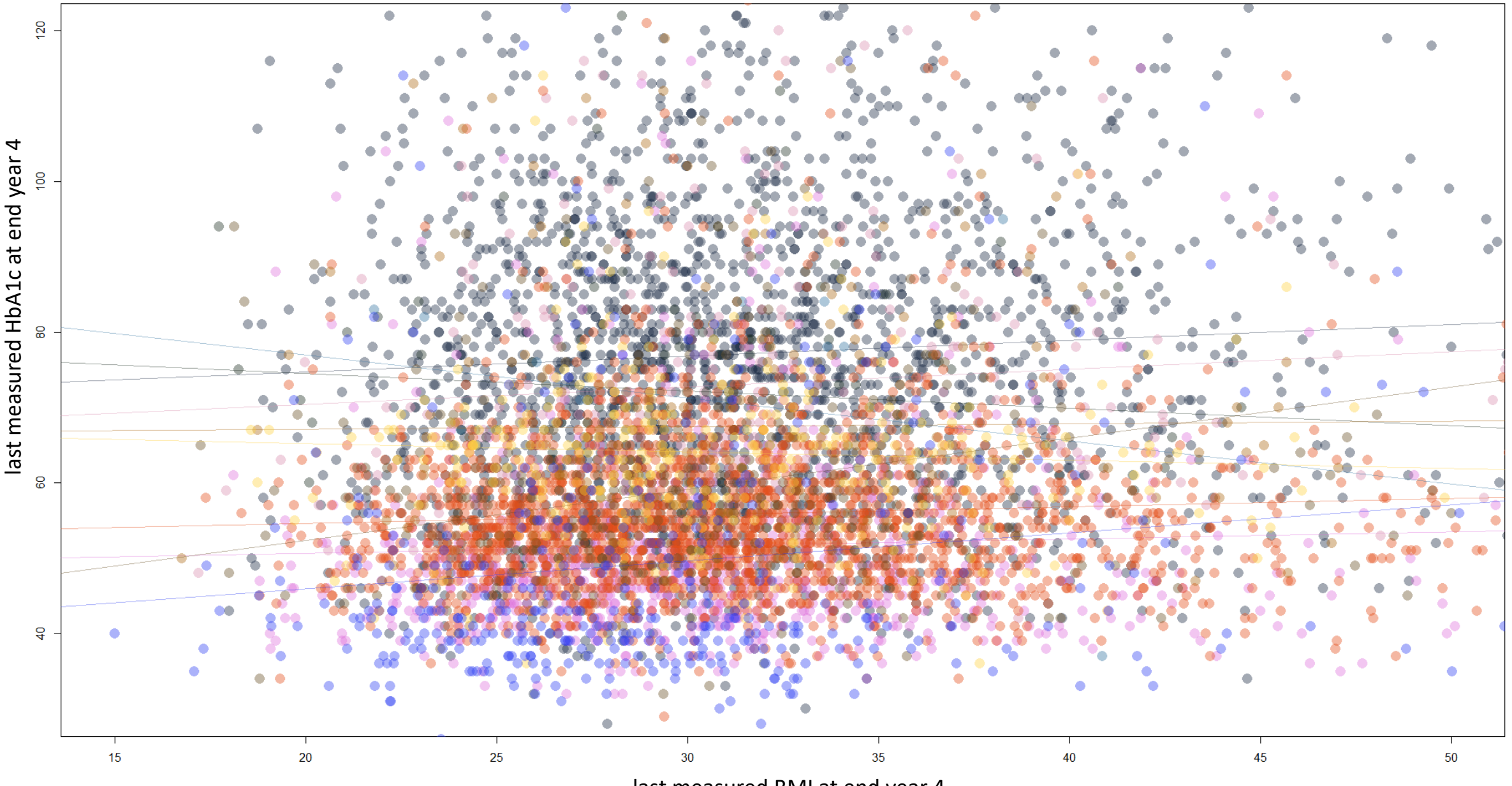
virtual n = 1 trial approach

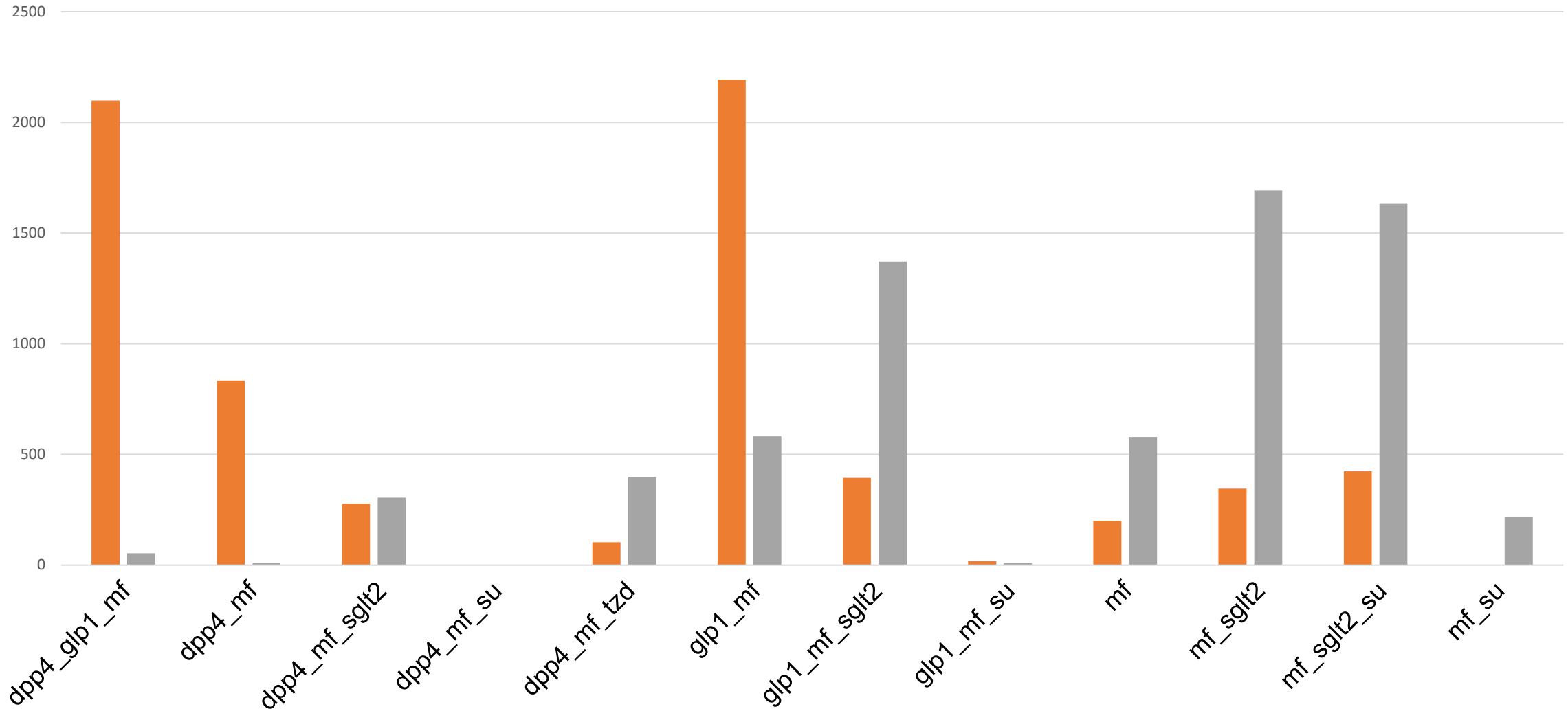
predict response

simple problem: which of 4 combinations most likely to reduce hba1c by 10mmol/mol?



more complex problem: which of 16 combinations most likely to reduce hba1c to <60mmol/mol without causing weight gain?

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1000
500
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dpp4_glp1_mf
dpp4_mf
dpp4_mf_sglt2
dpp4_mf_su
dpp4_mf_tzd
glp1_mf
glp1_mf_sglt2
glp1_mf_su
mf
mf_sglt2
mf_sglt2_su
mf_su
best combination to achieve HbA1c <60mmol/mol, with reduction in BMI
best combination to achieve HbA1c <60mmol/mol, with reduction in SBP

aims

simple system end 2018 (hybrid ML / rules based)

CE marking

development within SCI diabetes dataset, but with validation in external datasets

NHS Greater Glasgow and Clyde

myway digital health

Innovate UK