Chronic disease management is challenging!
- Managing chronic diseases requires balancing multiple clinical outcomes of interest—taking into account both quality of life and treatment considerations.
- Multiple factors need to be considered during the decision-making process to help inform decisions around frequency of testing, intensity of treatment, and treatment burden.
- Patients require monitoring at infrequent intervals but over a very long duration—e.g., annual follow-ups over multi-year horizons.

Solution – Disease-Atlas: New deep learning model to simultaneously forecast multiple outcomes over time, incorporating uncertainty estimates to reflect model confidence.

Data Description
- Data obtained from UK Cystic Fibrosis Trust for a cohort of 10,980 patients with annual follow-ups between 2008 – 2015.
- Each patient associated with 87 variables.
- Joint predictions of death, 2 lung function scores, 9 comorbidities and 11 infections.

Performance Metrics
- FEV1 forecasts evaluated in terms of mean squared error (MSE).
- Mortality, comorbidity and infection prediction accuracy measured by the area under the precision-recall curve (AUPRC).
- Benchmarks used - deep neural networks (i.e. Long Short Term Memory Networks (LSTM)) and traditional statistical methods (i.e. landmarking & joint models (JM)).

Mortality & FEV1 Predictions

Comorbidity Predictions (AUPRC)

Infection Predictions (AUPRC)

Web App Available!
https://disease-atlas-online.herokuapp.com

Test Patient
In the following use cases, we consider the Disease-Atlas forecasts for a 27-year old male patient with follow-ups between 2009 - 2015.

Use Case 1 – Patient Monitoring

Use Case 2 – Prioritising Screening

CONCLUSIONS
- Large, high quality datasets provide opportunities for machine learning methods to predict future health events for people with CF.
- Translating predictive analytics into real-time decision support tools can facilitate personalized data-driven decision making in CF clinics—leveraging the individuals’ own data and associated risks.
- The methodology should also be validated on a different cohort.