OBJECTIVES
Using an automated machine learning framework (AutoPrognosis) to build a model for predicting 3-year mortality in CF patients using data from the UK CF registry.

**Critical for many clinical decisions:**
- Establishing the optimal timing for referring patients for lung transplantation.
- Administering different types of treatments.

Our method: AutoPrognosis
- Automatically constructs ensembles of prognostic modeling pipelines, provides "clinical explanations" for the learned models, and can easily update its learned models as more data is collected over time.
- A prognostic modeling pipeline: data imputation, feature processing and classification algorithms.

PATIENT COHORT
**Inclusion criteria:**
- Enrolled in the UK CF registry with annual follow-up data available on the 31<sup>st</sup> of December, 2012.
- Adult patients who are over 18 years of age.
- Follow-up data on the 31<sup>st</sup> of December, 2015.

**Cohort statistics:**
- A total of 4,064 patients included.
- A total of 115 variables for each patient.
- Mortality rate was 9.4%.

DIAGNOSTIC ACCURACY
**How should diagnostic accuracy be evaluated?**
- Most previous works focused on AUC-ROC, but AUC-ROC can be deceptively large because true negatives can be trivially predicted + AUC-ROC does not account for imbalanced outcomes.
- Alternative: area under the precision-recall curve (average precision) focuses only on positive cases.

**Impact on lung transplant referral decisions**
- Operating point: fix the negative predictive value (NPV) at the one achieved by the "FEV<sub>1</sub> < 30%" criterion.
- Improvement in the positive predictive value (PPV) from 48% to 65%.

**Risk Factors**
Which patient variables best explain accuracy gains?
- Variable importance rankings depend on the diagnostic accuracy metric used.
- Oxygen therapy is the variable used by machine learning to improve precision.

**Conclusions**
- The area under precision-recall curve is a more appropriate metric than AUC-ROC for evaluating prognostic scores. This fact was overlooked by previous works.
- Our results indicate that competitive machine learning approaches significantly improve prognostic forecasting and will support optimized referral for lung transplantation.
- Incorporating variables related to gas exchange (Oxygenation) into predictive models in addition to spirometric variables can significantly boost the precision of lung transplant referral decisions.