Automatic Adjudication of Symptom-Based Exacerbations in Bronchiectasis Patients

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- 141 patients with bronchiectasis enrolled in a multi-centre trial prospectively scored their own symptoms on 0–4 scales for
  - Sputum volume
  - Sputum purulence (colour)
  - Dyspnoea (shortness of breath, coughing).
- Each patient-day assessed clinically as *exacerbation* or *no exacerbation*.
- Two types: Event-based (EBE) and Symptom-based (SBE).
  - Ascertainment of EBE requires contact with clinician.
  - SBE was determined from patient diary data via a complicated, "by-hand" coding process.

Goal, Data

Goal

1. Replace the laborious manual adjudication of SBEs with a statistical model that estimates EBE status from symptom diaries.
2. Assess the association between the new definition of SBE and patient-reported quality of life (St George's Respiratory Q'aire).

Example Data

			Symptoms			
Pat.	Day	EBE	Sput. Pur.	Sput. Vol.	Dysp.	SBE
1	0	0	1	1	1	↑
1	3	1	3	3	4	↑
⋮	⋮	⋮	⋮	⋮	⋮	Adjudicated
1	17	1	2	1	5	↓
1	19	0	1	0	0	↓
⋮	⋮	⋮	⋮	⋮	⋮	↓

Method

1. Split data into training and hold-out sets.
2. Build a "retrospective" prediction model (GLMM, logit link) for EBE_t using
   - training set
   - symptom scores
   - observed EBE status at times $t \in (t - \delta, t]$.
3. Estimate dichotomization threshold using ROC curve.
4. Convert to a "prospective" model (GLMM, logit link) for EBE_t using
   - retrospective design
   - predicted EBE status at times $t \in (t - \delta, t]$.
   - threshold from retrospective model
5. Re-estimate threshold.
6. Estimate predictive performance on the hold-out set.

Results, Discussion

Predictive Performance for Exacerbations

Dataset	Model	c (used)	c (Opt.)	Sens. (%)	Spec. (%)
Training	Retro.	0.093	0.093	90	92
	Prosp.	0.093	0.048	76	88
	Prosp.	0.048	0.048	83	83
Hold-out	Prosp.	0.048	—	90	79

Association with Patient Reported Wellbeing

- As a classifier of wellbeing (dichotmous), our model has
  - sensitivity $= 0.09$
  - specificity $= 0.64$
- Future work!