



Dynamic clinical prediction models for cardiac surgery

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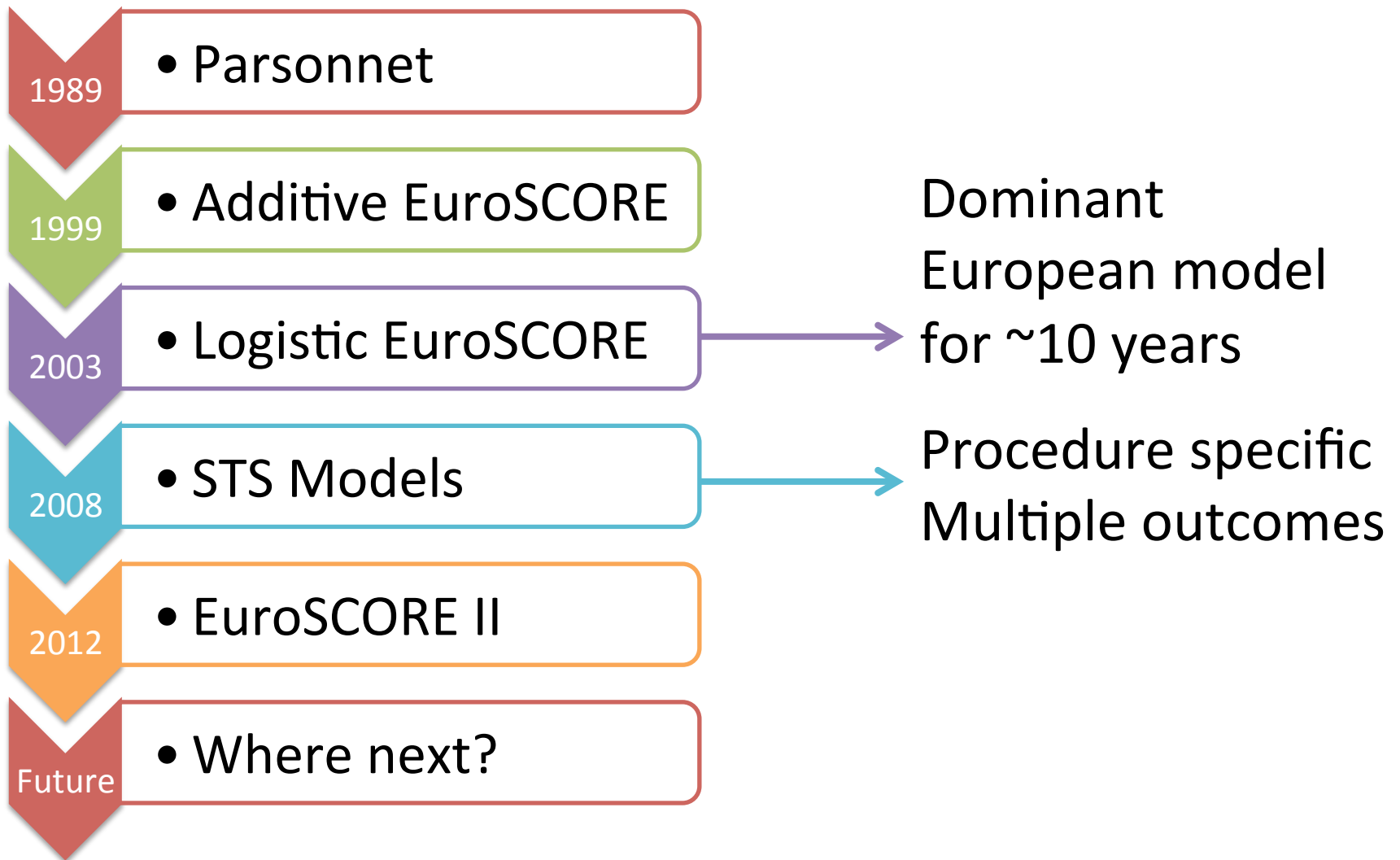
Dynamic clinical prediction models for cardiac surgery

Hickey GL¹, Grant SW², Caiado C³, Kendall S⁴,
Dunning J⁴, Poullis M⁵, Buchan I¹, Bridgewater B^{1,2}

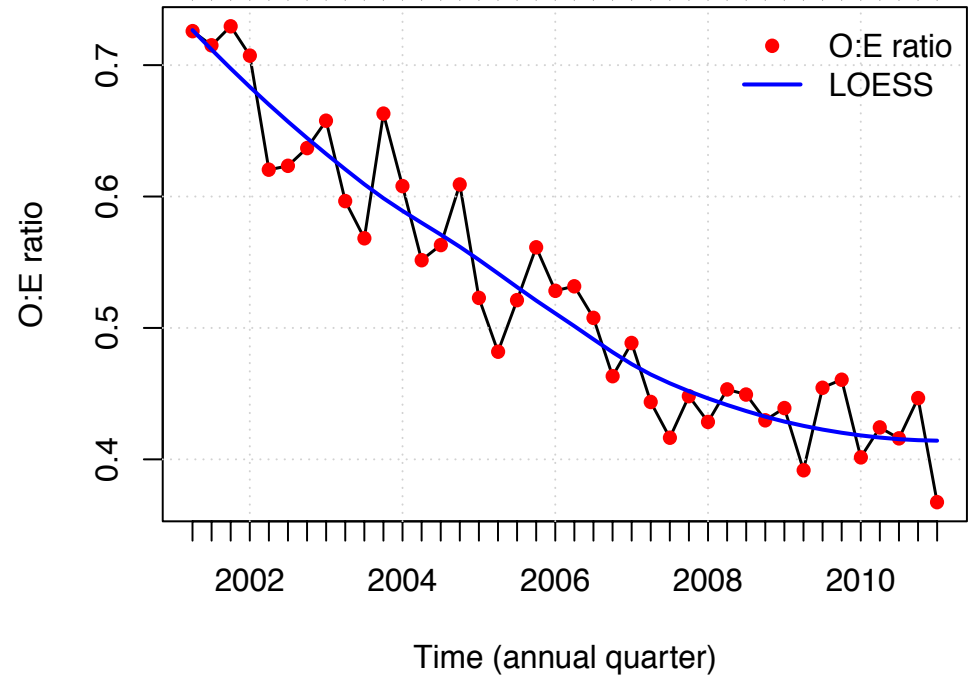
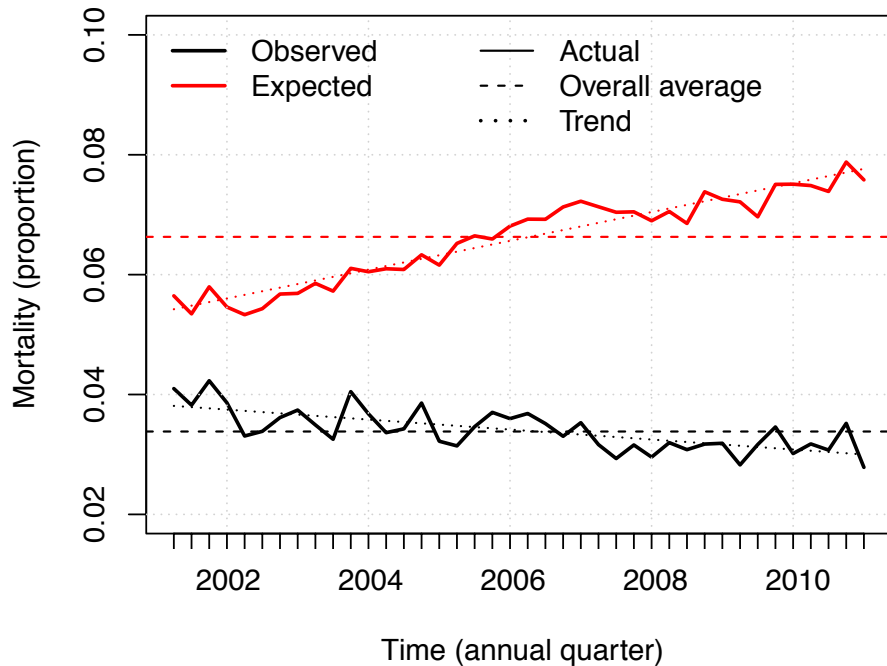
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History of clinical prediction models for cardiac surgery

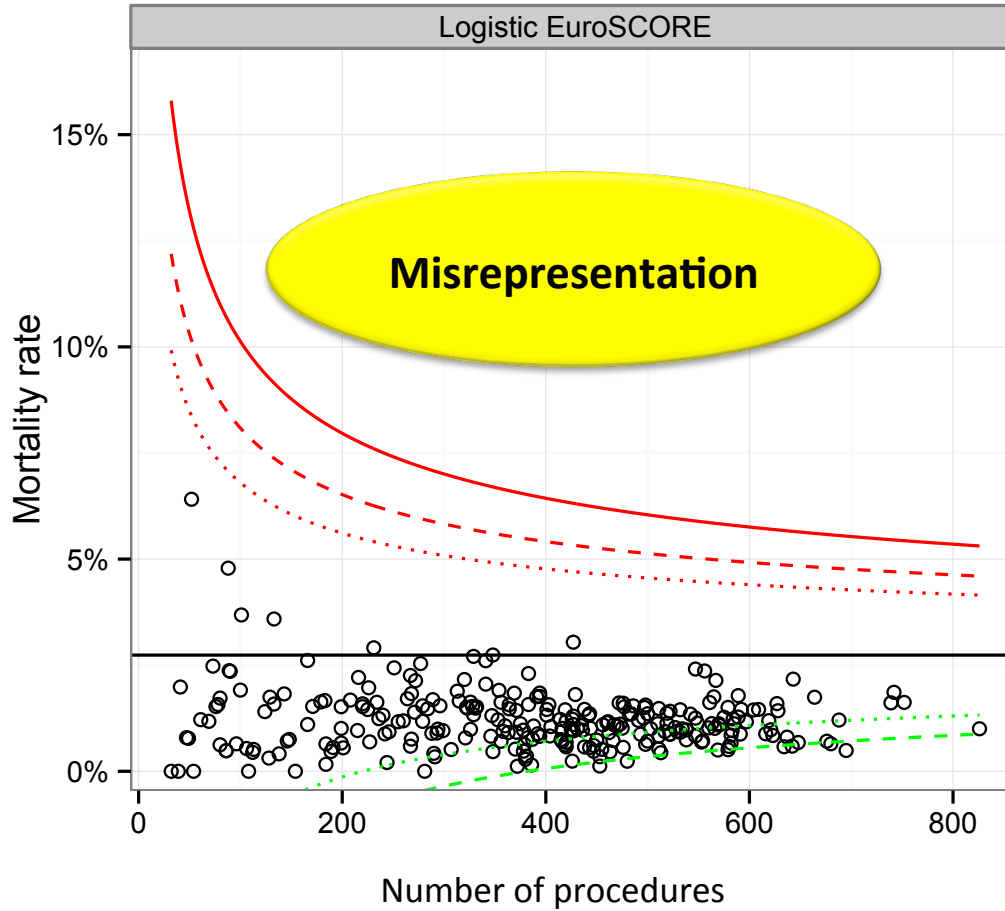


What's wrong with the *status quo*?



In April 2010, predicted mortality was **2.7 x** observed mortality

Consequences



Options ^a

Approach	Description
Do nothing	Develop a model (e.g. on 1-years data) and leave to run forever
Periodically refit model	Every, e.g. 1-year, independently refit the model
Rolling window	Fit model to a fixed window (e.g. 2-years) of data and then rolling the window incrementally (e.g. every 1-year)
Dynamic logistic regression	Exploit dynamic statistical models that can update in 'real time' (1-month) online

^a not an exhaustive list

'Nuts & bolts' of dynamic regression

- Described by **McCormick et al.** *Biometrics* 2012; 68:23-30 (with software)
- Assumes a **state-space equation**: $\beta_t = \beta_{t-1} + \delta$ for risk factors (cf. log odds ratios)
- As each batch of new data arrives, model updates estimate of β_t and its standard error using **Bayesian statistics**
- **Assumptions** made about δ and **approximations** in calculations

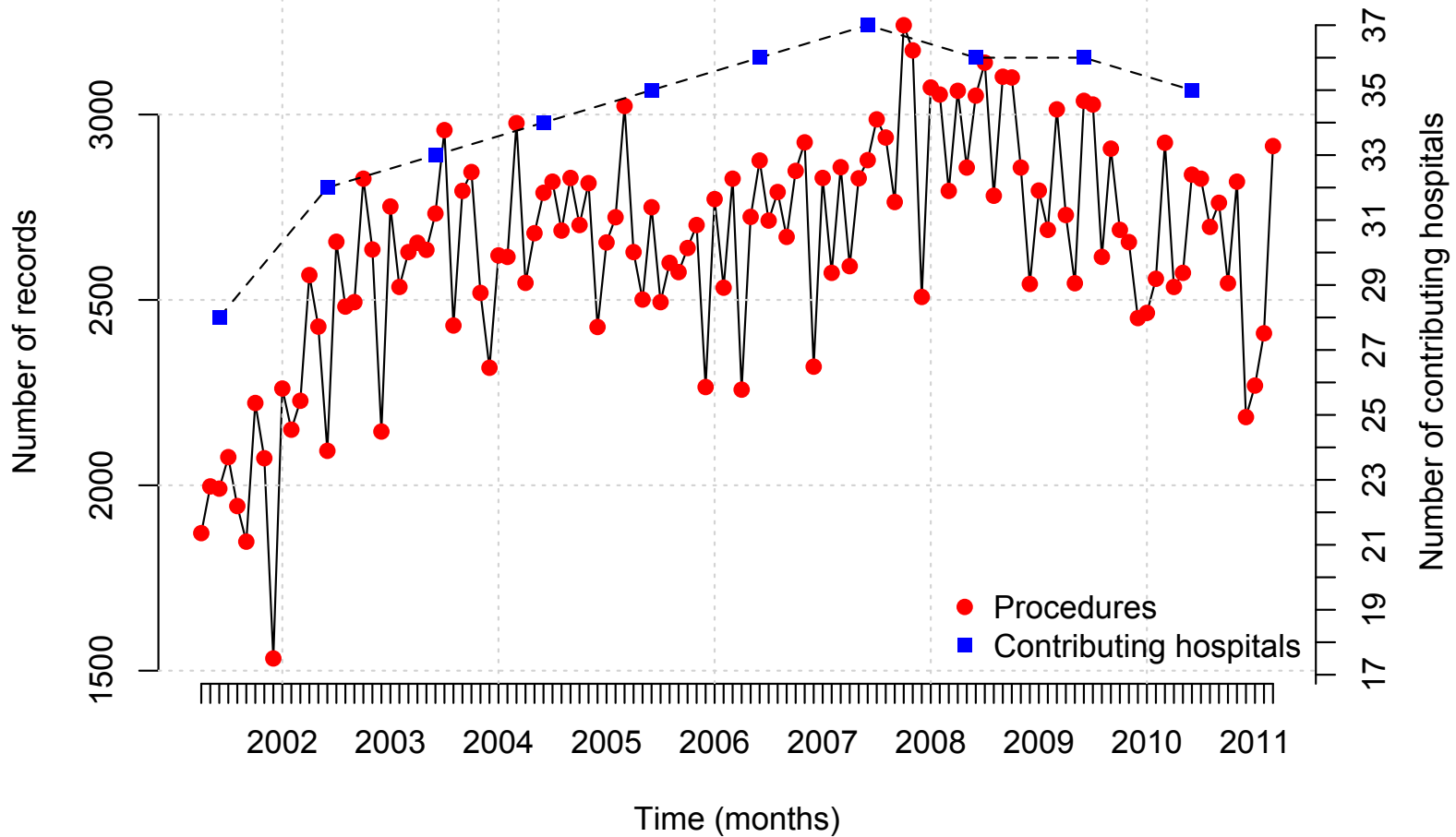
Strategy

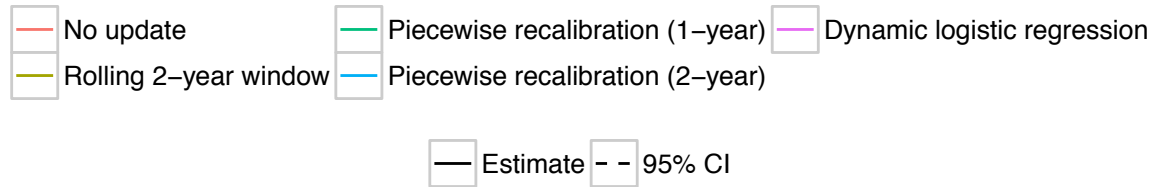
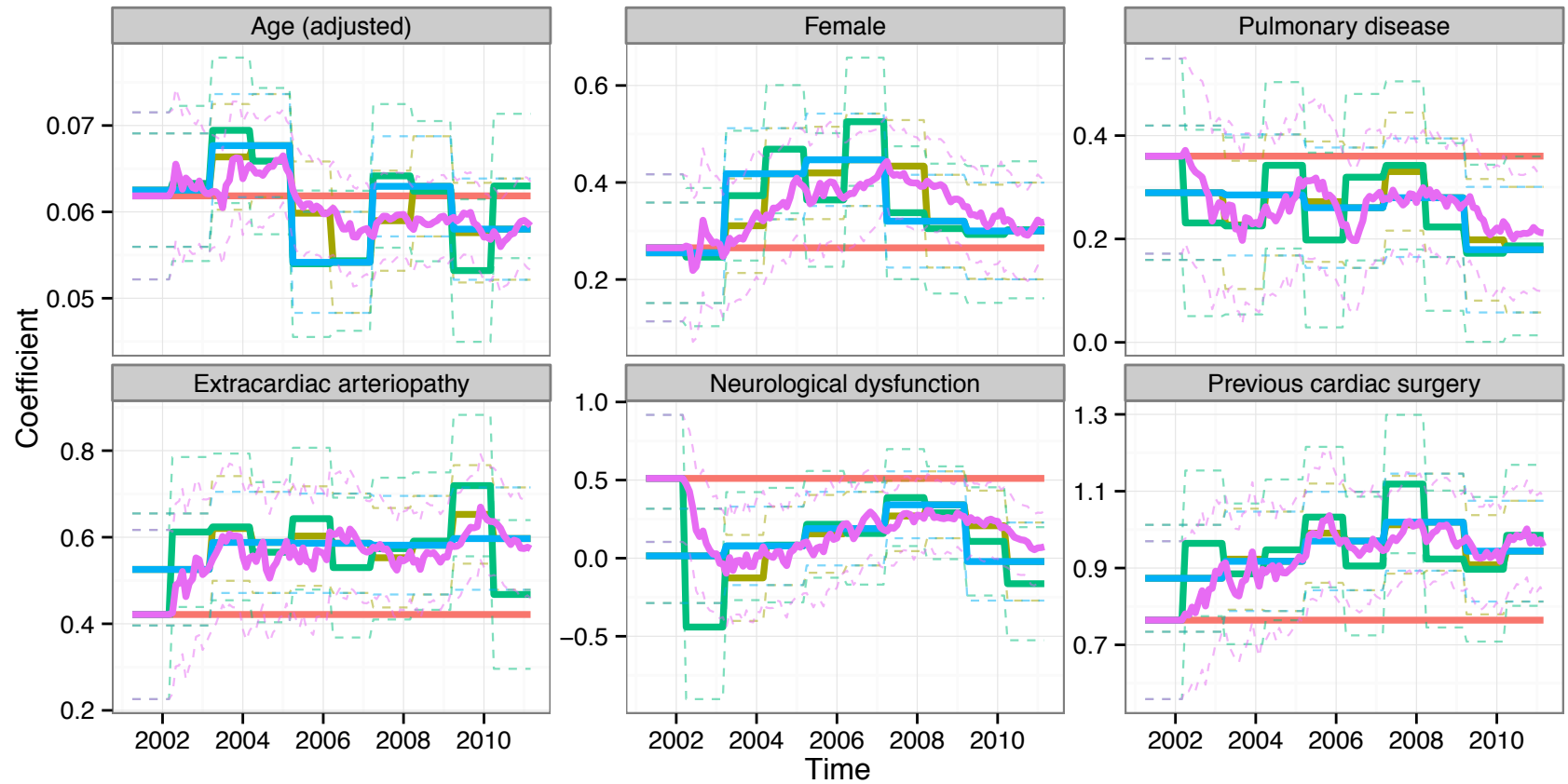
- Focus on **EuroSCORE** risk factors
- Train all 3 models on 2001-02 clinical registry data for all adult cardiac surgery
- ‘Update’ models on 2002-11 clinical registry data
- Monitor model coefficients

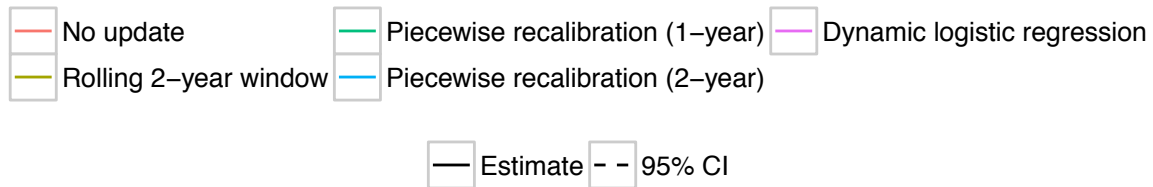
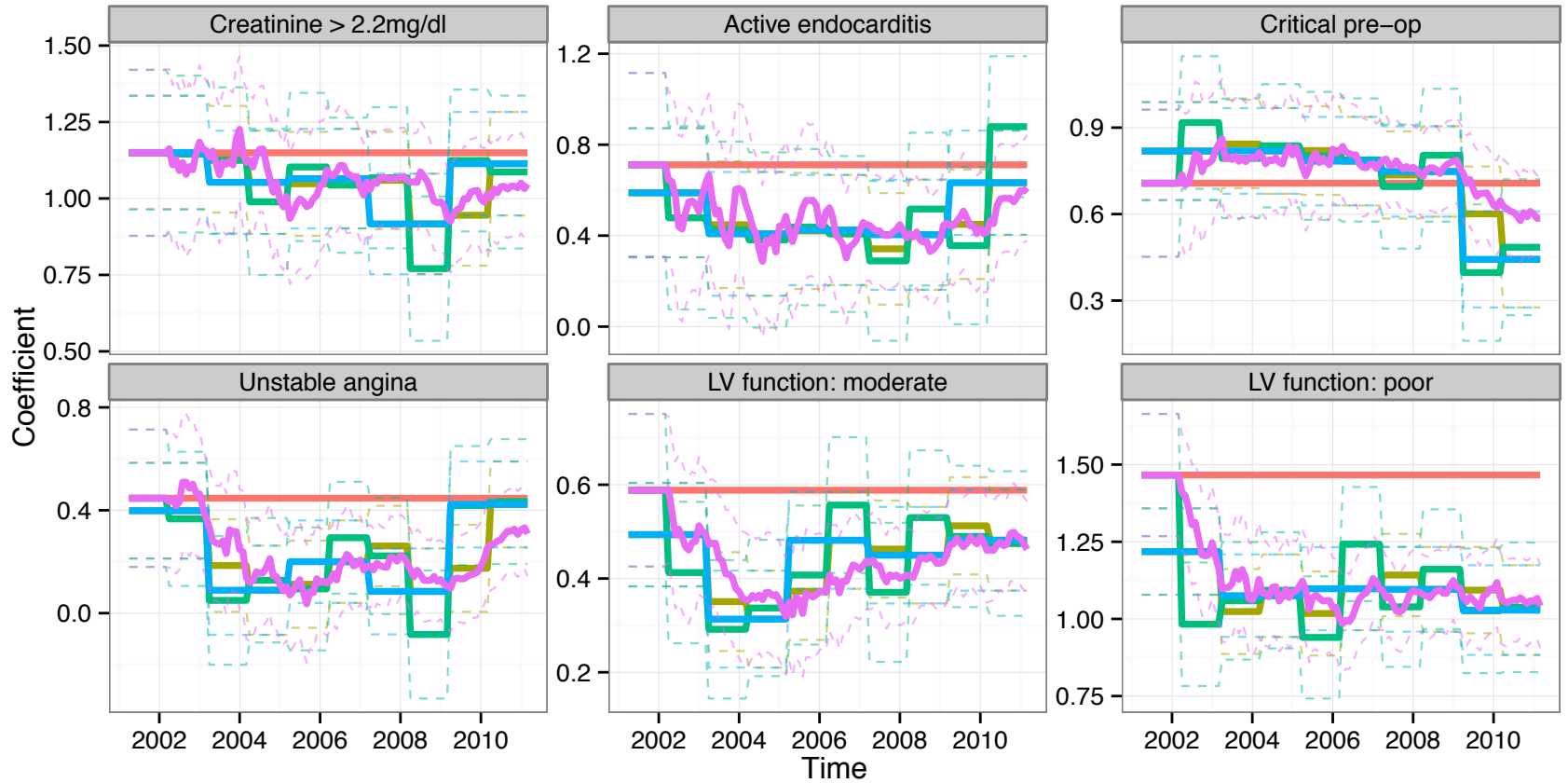


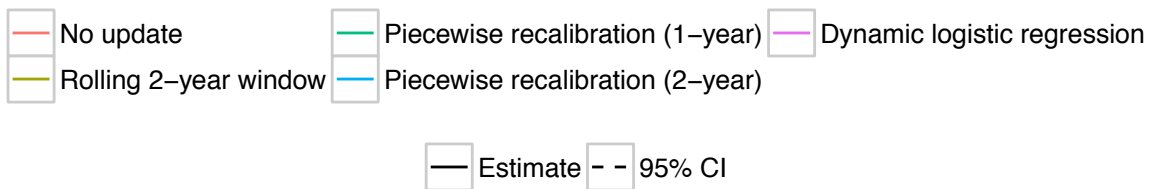
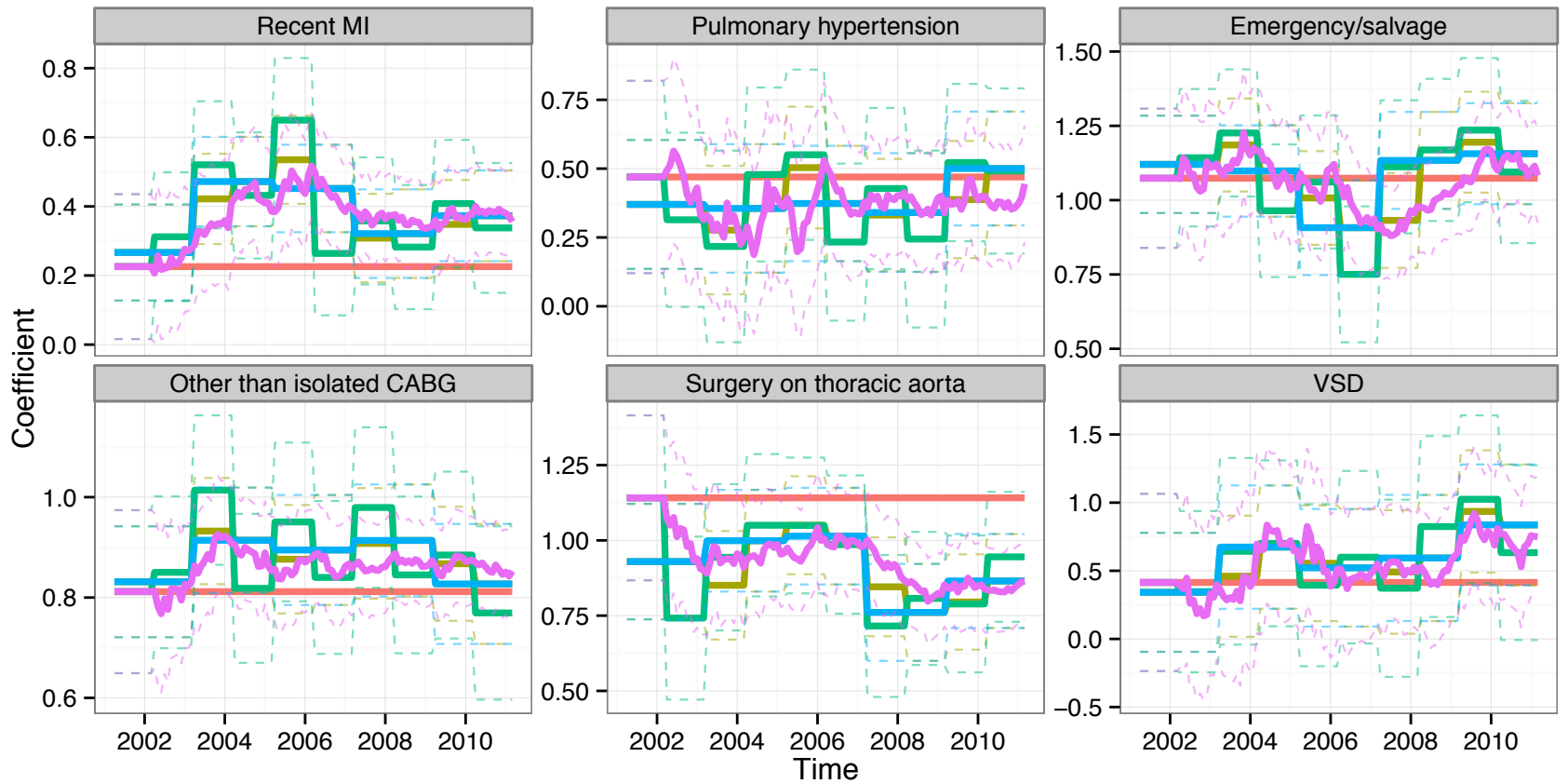
Results

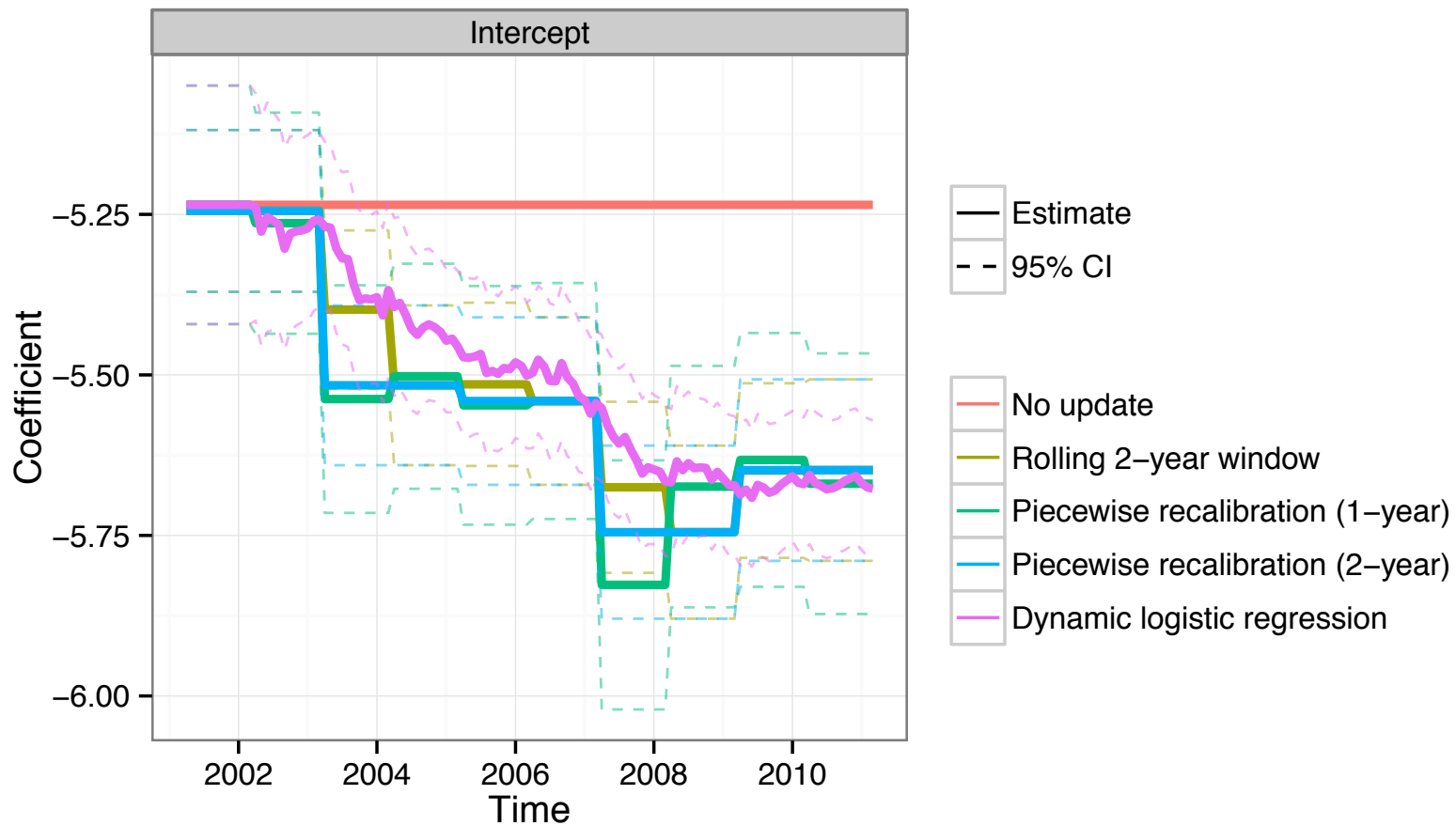
- 316,713 records
- 37 different hospital
- 120 months of clinical data (10 years)











Conclusions

- Doing nothing is **not an option**
- A patient today does not have the same risk as 10 years ago
- Is it sensible to wait for **EuroSCORE III**?
- Dynamic regression is more **methodologically complex** and would require **concerted effort** to implement