

# Using real-world data to predict response to high cost drugs in rheumatology

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# Speaker Disclosures

- I am not a mathematician.....
- My understanding of Greek is rudimentary



# Outline

- What is rheumatoid arthritis?
- Current treatment paradigms
- Introducing the BSRBR-RA
- Different approaches to assessing drug response
- Using the BSRBR-RA to predict response



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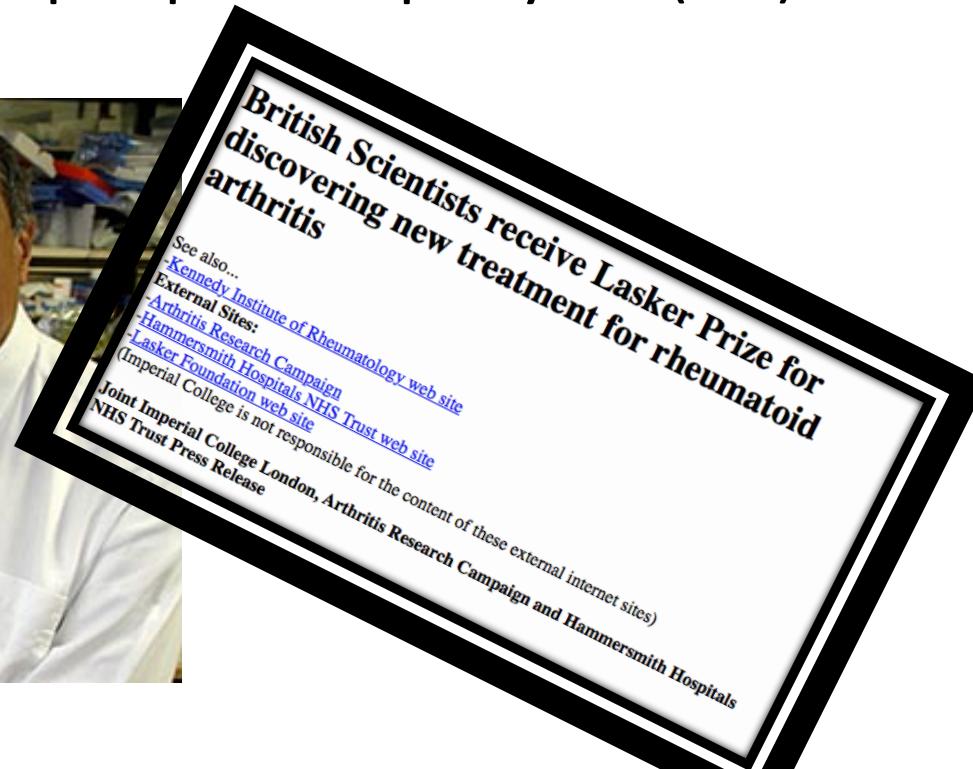
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# Anti-TNF

- Targeted monoclonal antibody at tumour necrosis factor (TNF)
- TNF key monoclonal antibody in the pathology of rheumatoid arthritis
- £3000 - £10,000 per patient per year (UK)

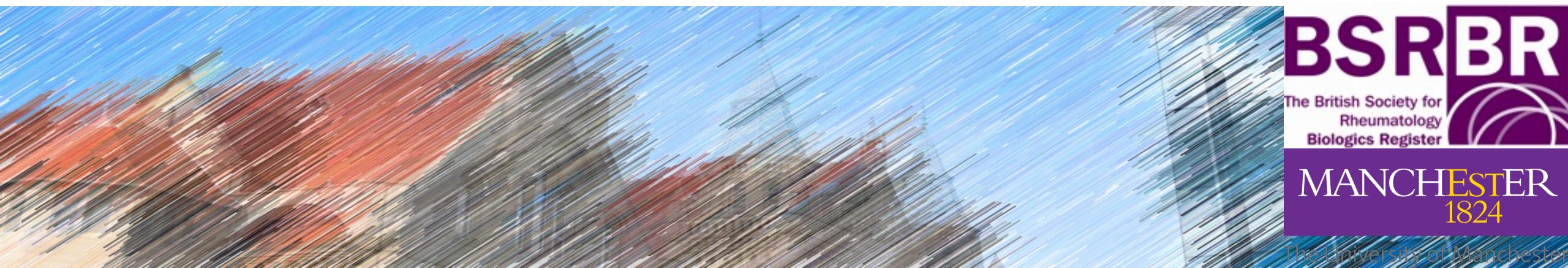


- 1. Humira (adalimumab), \$8.2 billion**
- Abilify (aripiprazole), \$7.9 billion
- Sovaldi (sofosbuvir), \$6.9 billion
- Crestor (rosuvastatin), \$5.9 billion
- 5. Enbrel (etanercept), \$5.9 billion**
- Harvoni (ledipasvir and sofosbuvir), \$5.3 billion
- Nexium (esomeprazole), \$5.3 billion
- Advair Diskus (fluticasone), \$4.7 billion
- Lantus Solostar (insulin glargine), \$4.7 billion
- 10. Remicade (infliximab), \$4.6 billion**

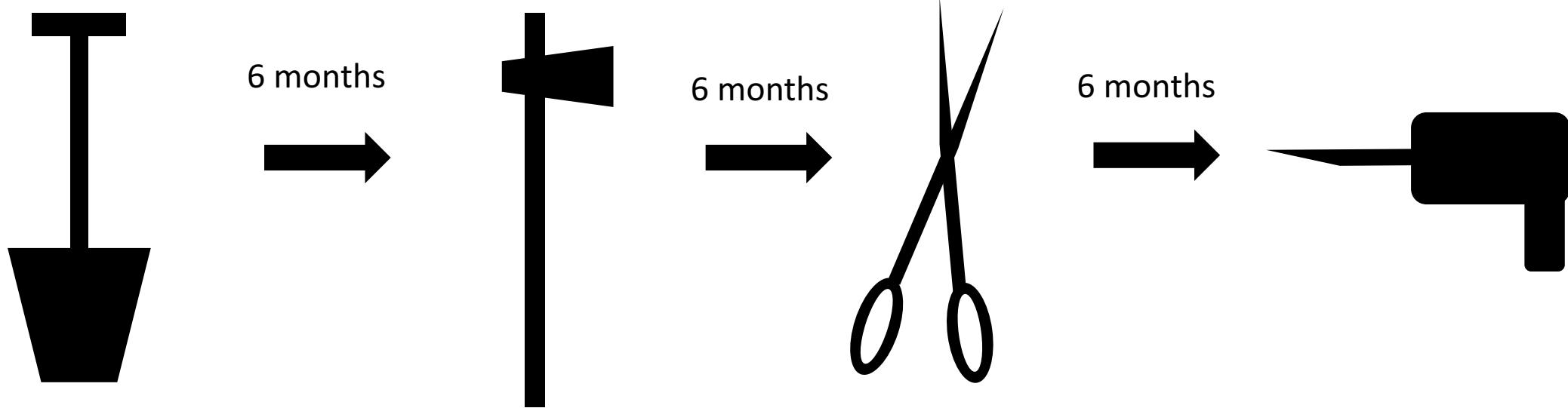
**TNF total 2015 = \$18.7 billion**

# The BSRBR-RA

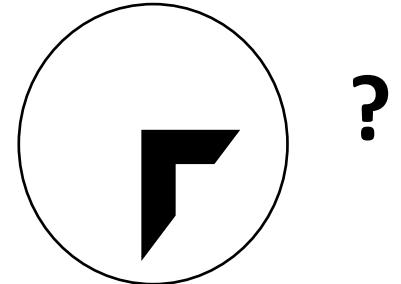
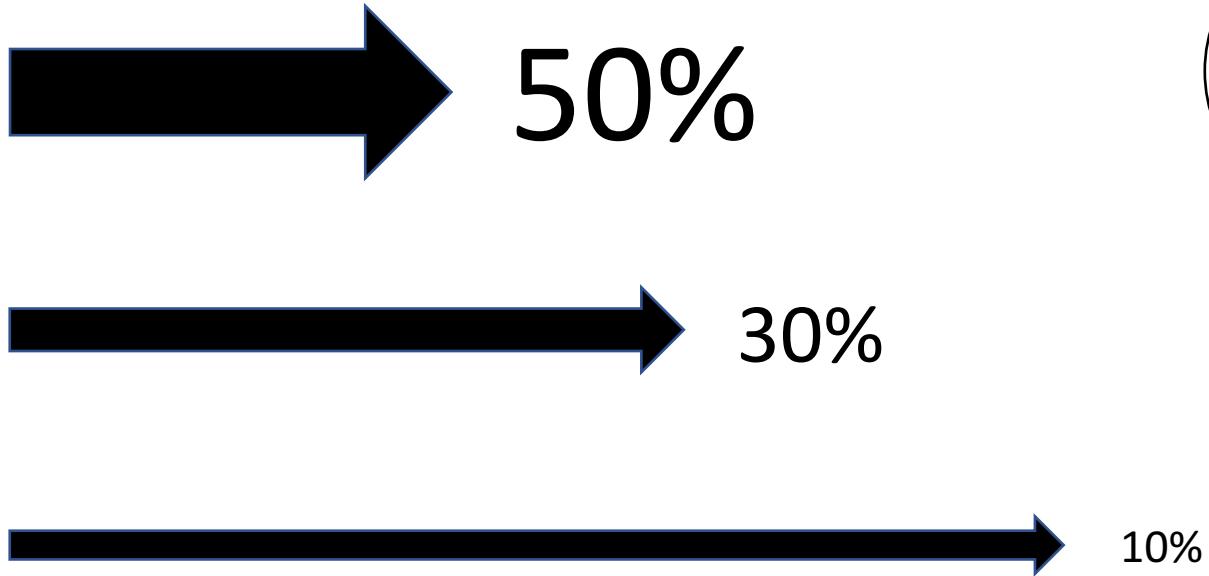
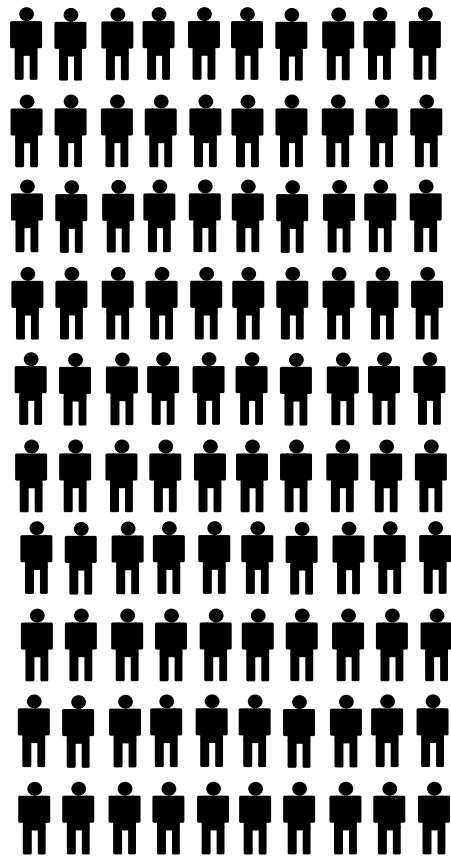
- Started in 2001 to monitor the safety and efficacy of anti-TNF agents
- Tracks the progress of patients with severe rheumatoid arthritis (RA), who are receiving biologic agents
- ~ 20,000 patients enrolled



# The Current Paradigm



# Point Response Rates



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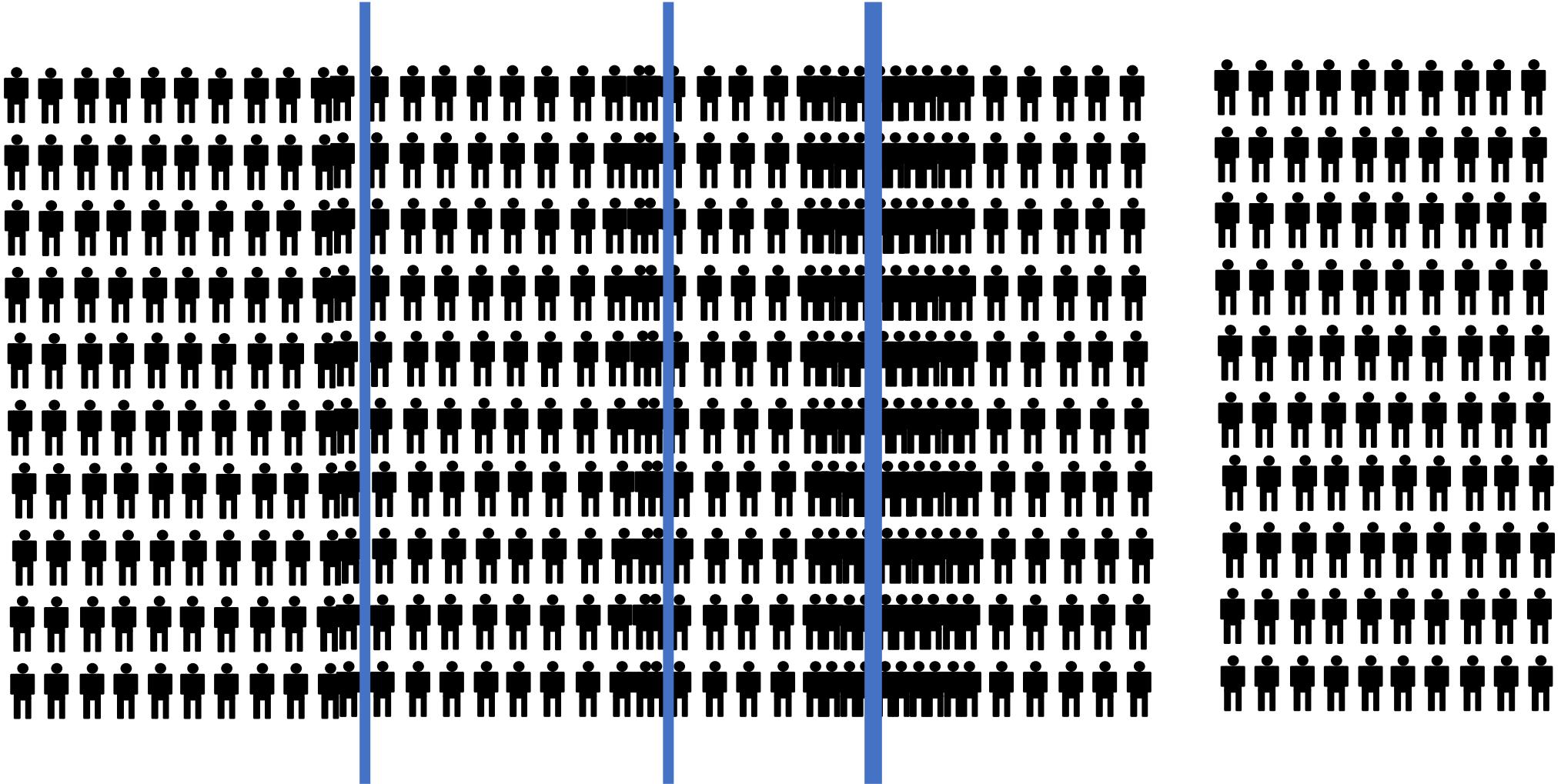
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# Threshold Analysis of Response



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# How common is sustained remission?

Sustained Remission	%	N
Yes	15.7	2271
No	84.3	12165
Total	100.0	14436



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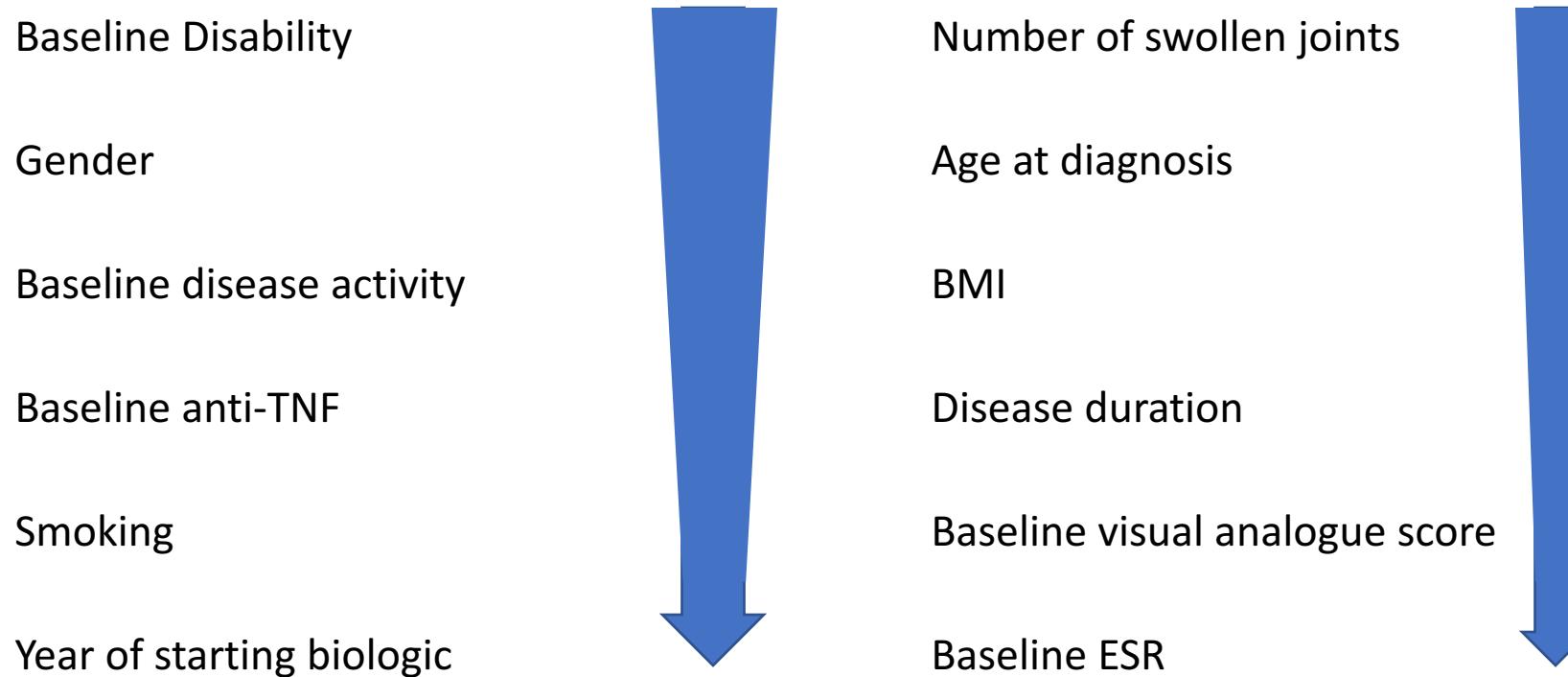
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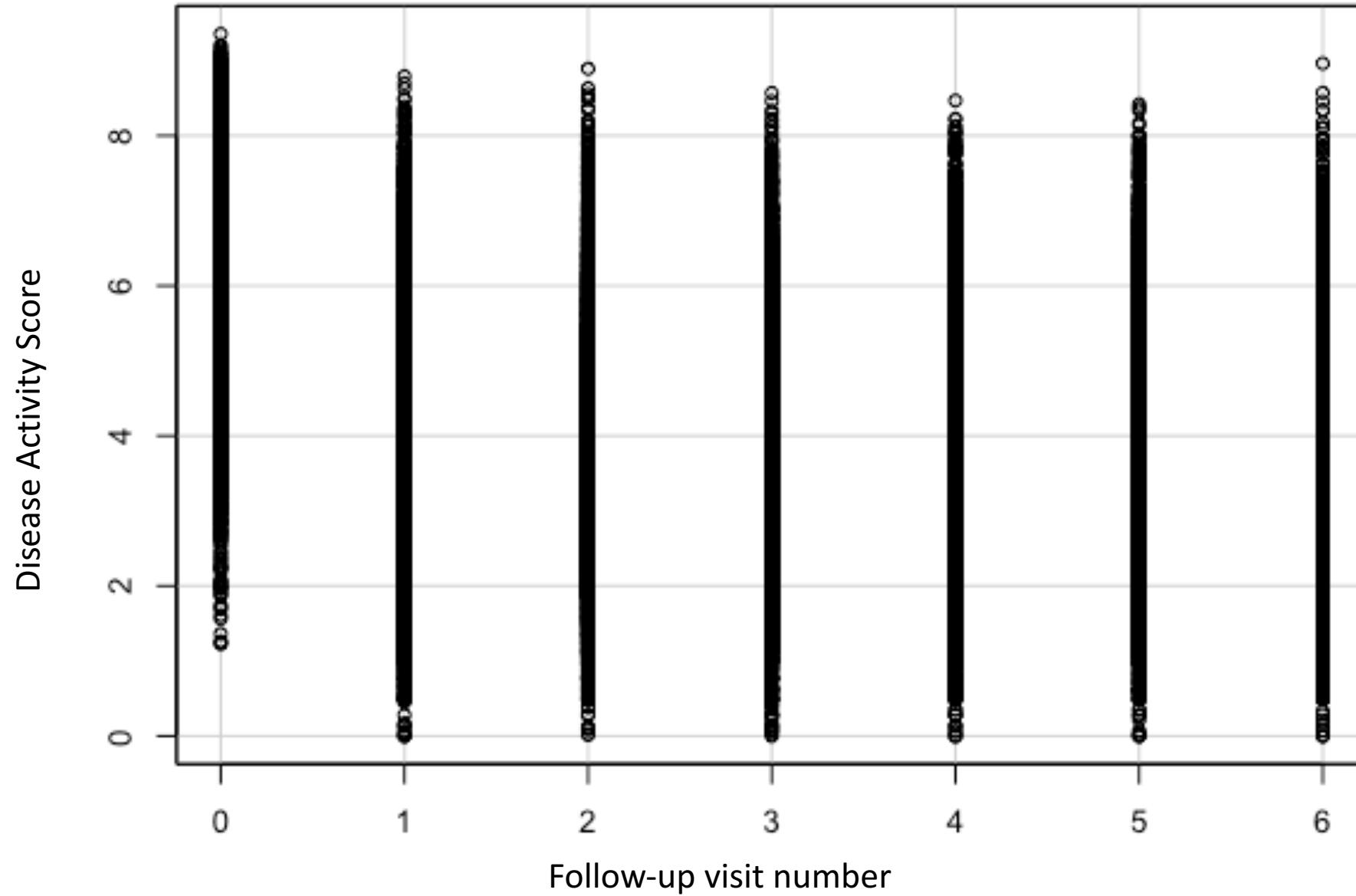
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# Sustained Remission in the BSRBR-RA

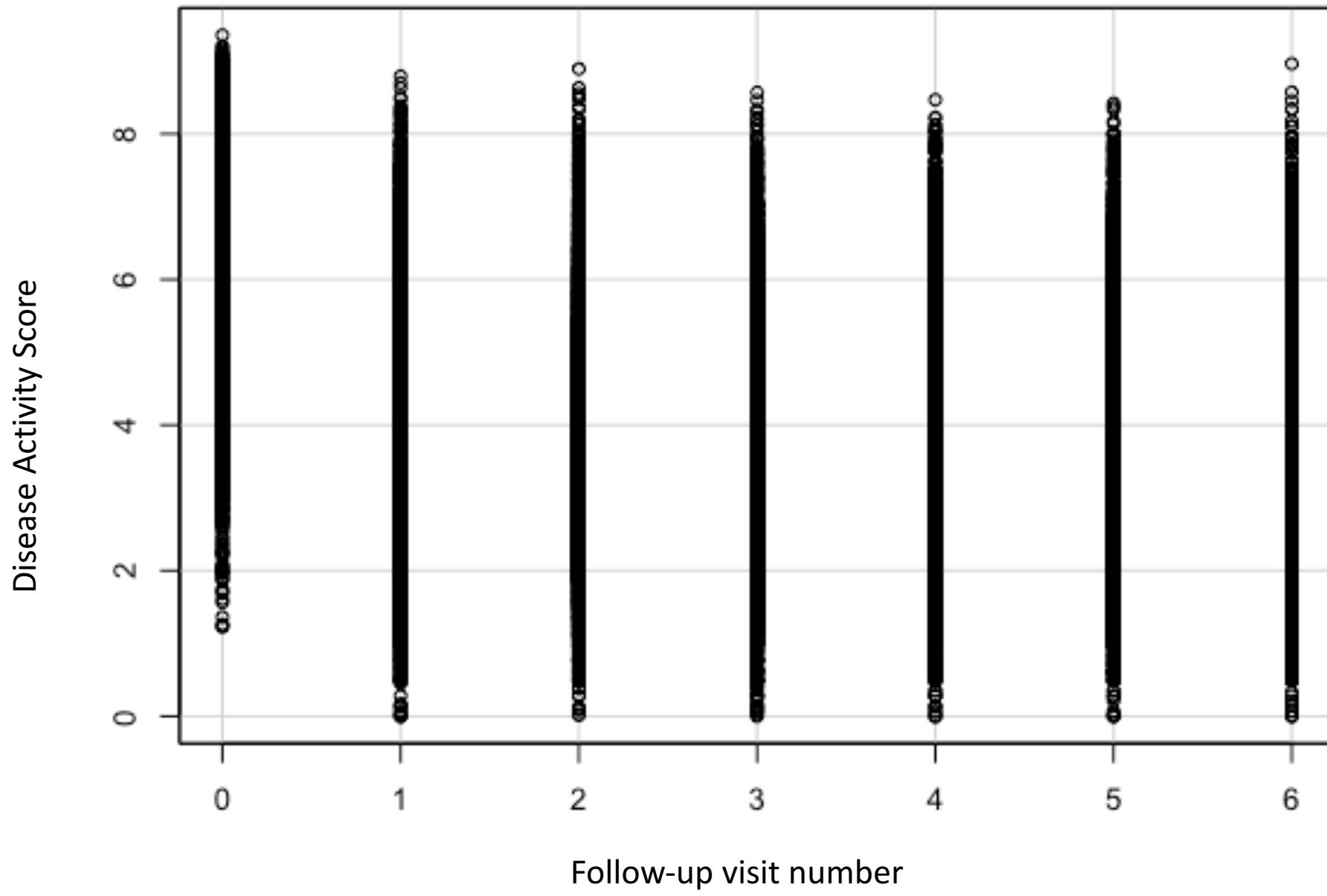
*A priori* variables selected: **Gender\***, **BMI\***, **TJC**, **disability\***, **disease duration\***, **age**, **VAS\***, **ESR\***, **DAS28-ESR\***, **Calendar year\***, **SJC\***, **STJR**, **anti-TNF type\***, **smoking\***, **steroid use**, **age at onset**, **age at diagnosis\***, **age at starting biologic**







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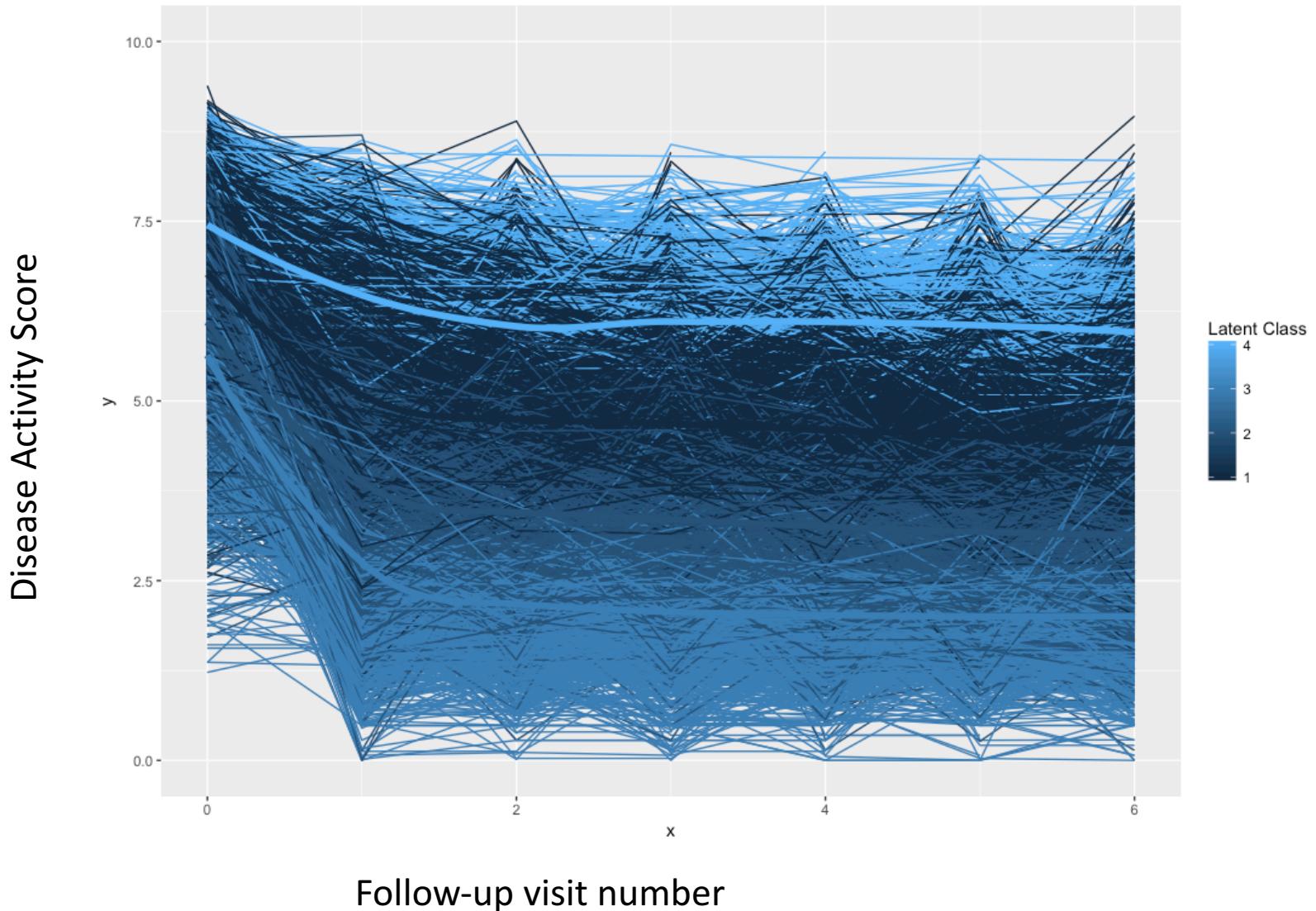
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# Trajectory analysis using LCMM



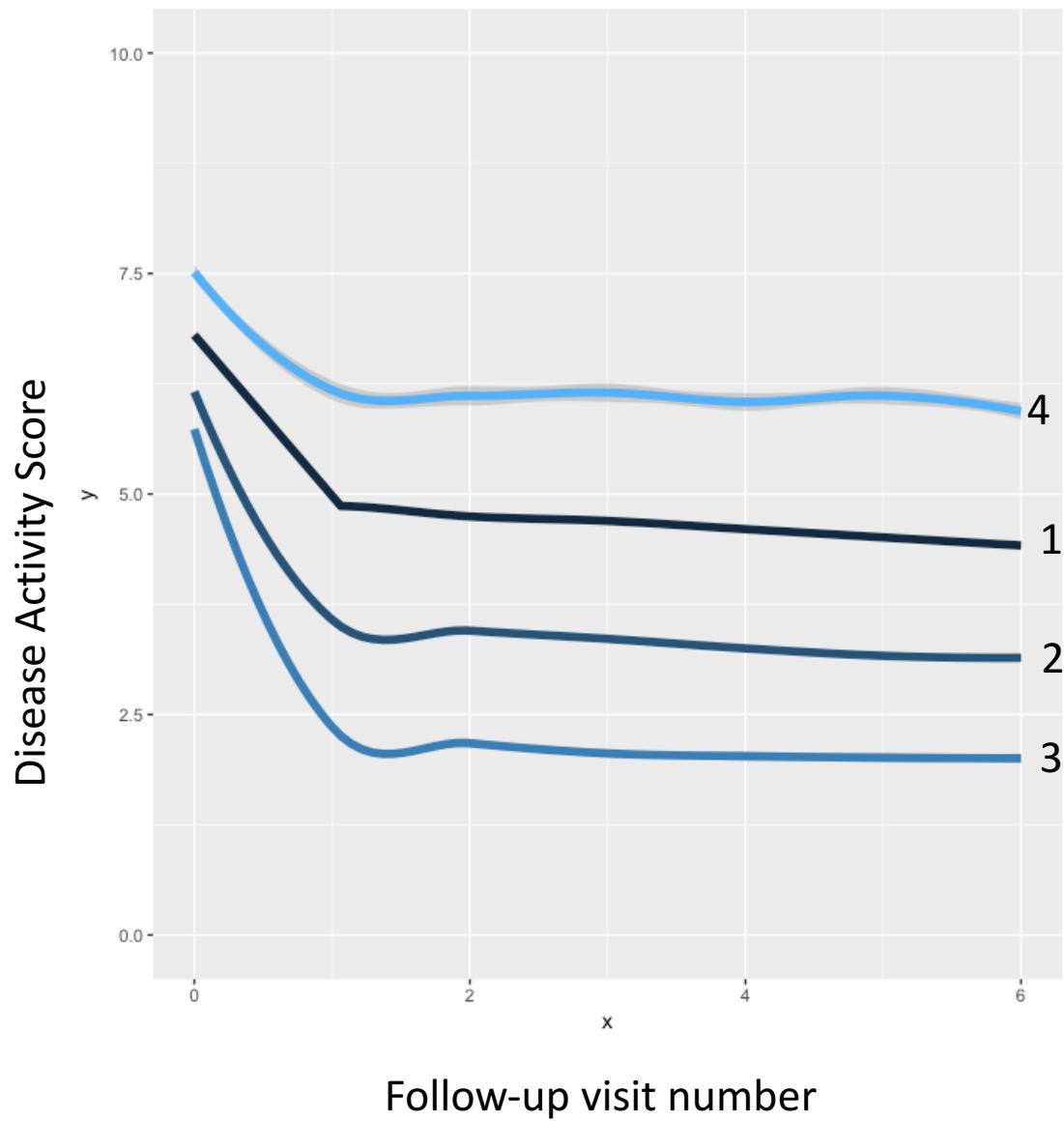
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Latent Class  
4  
3  
2  
1

### Class 3

- Gender
- Disability
- DAS28-ESR
- BMI
- VAS
- ESR
- Biologic drug
- Smoking
- Year started drug

### Class 2

- Gender
- Disability
- DAS28-ESR
- BMI
- Tender joint count
- ESR
- Biologic drug
- Year started drug

### Class 1

- Gender
- Disability
- DAS28-ESR
- ESR
- Year started drug

	Class 1	Class 2	Class 3	Class 4
N	7332	5253.	1400	451
%	50.79	36.39	9.7	3.12



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# Next Steps

- Split cohort into two (early/late enrollers)
- Use associations from trajectory analysis → build a predictive model of likely response to anti-TNF based on the individual patient
- Use Bayesian modelling → allow model to be reactive over time
- Add in predictors for other drugs → personalise treatment → chose drug with the best chance of success first time
- Combine with other healthcare databases + machine learning





# Thank You



# Acknowledgments



## Supervisors:

Prof Shaddick  
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Dr Pauling



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