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Paediatric Epidemiology 19/09/2010

Trends in paediatric pneumonia and empyema in England 1997-2006

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Disclosure

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- D Cliff supported by unrestricted grant from Wyeth Pharmaceuticals

Rise in Empyema Incidence

- First report of an increase in cases in 1997 in the UK

- Further reports from across the world over last 10 years

- No unifying explanation in literature for this phenomenon

Is the Rise in Empyema Related to Increases in Cases of Pneumonia?

Different relationships between pneumonia and empyema cases have been reported in the literature:

- Increase in both conditions but variable proportion due to differing rate and timing of rises (*Roxburgh 2008)*
- Increase in both conditions, increase in proportion of pneumonia to empyema (*Strachan 2009)*
- Constant proportion of pneumonia to empyema (*Bueno-Campaňa 2008)*
- Reduction in pneumonia admissions, increase in empyema admissions following the introduction of PCV-7 (*Li 2010, Grijalva 2010, Lee 2010)*

Aims

- To investigate trends in hospital admissions for pneumonia and empyema in England in patients < 16 yrs

- To investigate potential factors influencing the trends for both conditions

- To establish whether there is significant regional variation in admissions for both conditions

Methods

- Hospital Episode Statistics (HES) dataset containing details of all admissions to NHS hospitals in England
- Data obtained from April 1997 – March 2006 (introduction of ICD-10 1997; introduction of PCV-7 as routine 2006)
- Admissions per month per Strategic Health Authority (SHA) were calculated
- Mixed effects models used to investigate trends in:

  - pneumonia cases in each SHA in relation to weather, population size and time

  - empyema cases in each SHA in relation to weather, population size, time and cases of pneumonia

ICD – 10 Codes

Condition	Codes
Viral pneumonia	J100, 110, 120, 121, 122, 128, 129
Bacterial pneumonia	J13, 14, 150, 151 - 159, 160
Other Pneumonia incl. fungal & those unclassified by organism	J168, 170, 171, 172, 173, 178, 180, 181, 182, 188, 189
Empyema	J86, 869

124,478 pneumonia & 3040 empyema admissions in total

SHAs & Weather

SHA	Population / million
North East	2.5
North West	6.8
Yorkshire	5.0
East Midlands	4.2
West Midlands	5.3
East of England	5.4
London	7.4
South East	4.1
South Central	3.9
South West	5.0

For each SHA & month:

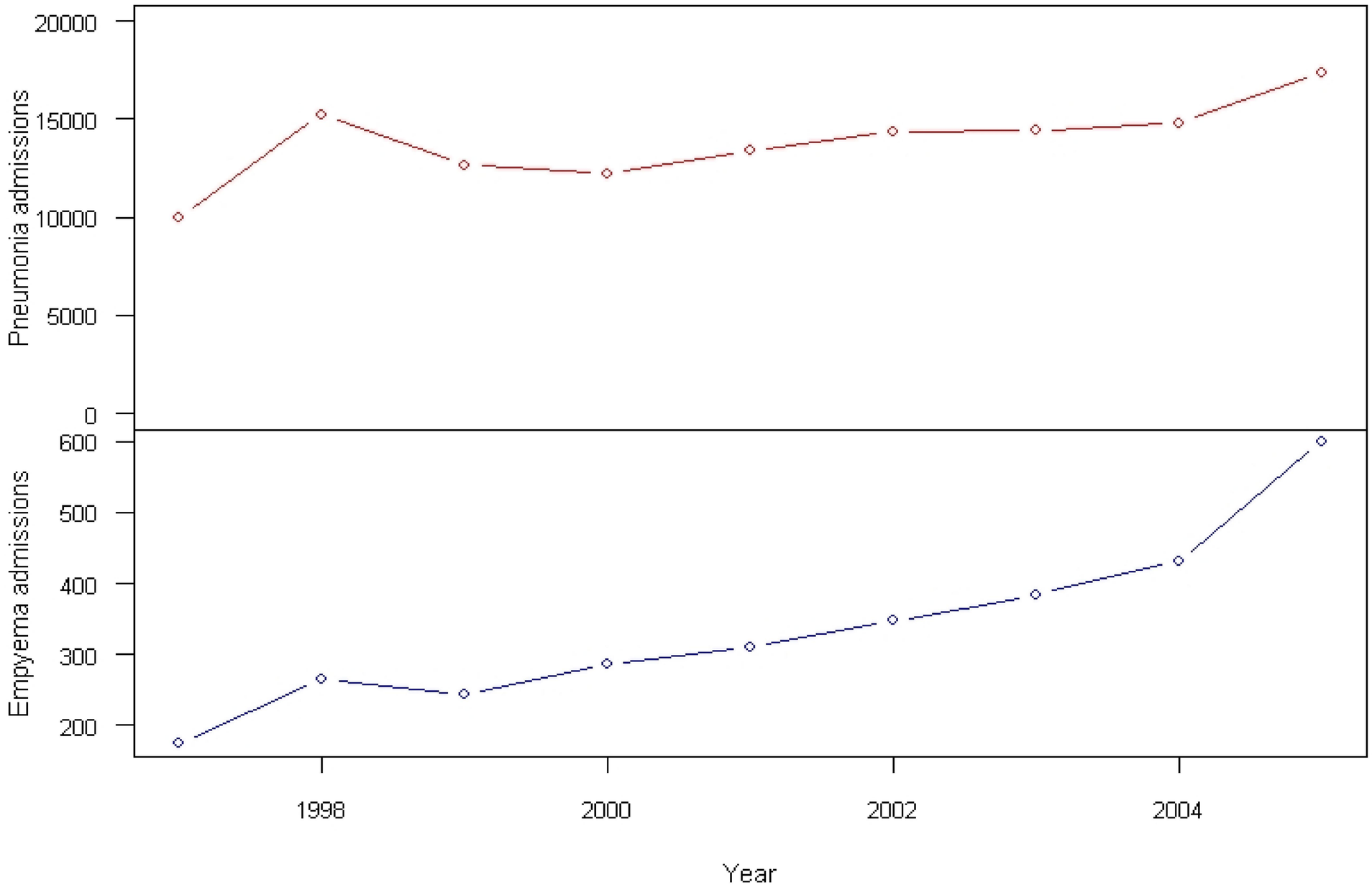
Mean max. temperature

Mean min. temperature

Total rainfall

Source: http://www.metoffice.gov.uk/climate/uk/stationdata

Summary Trends For Pneumonia & Empyema



Significant Predictors - Pneumonia

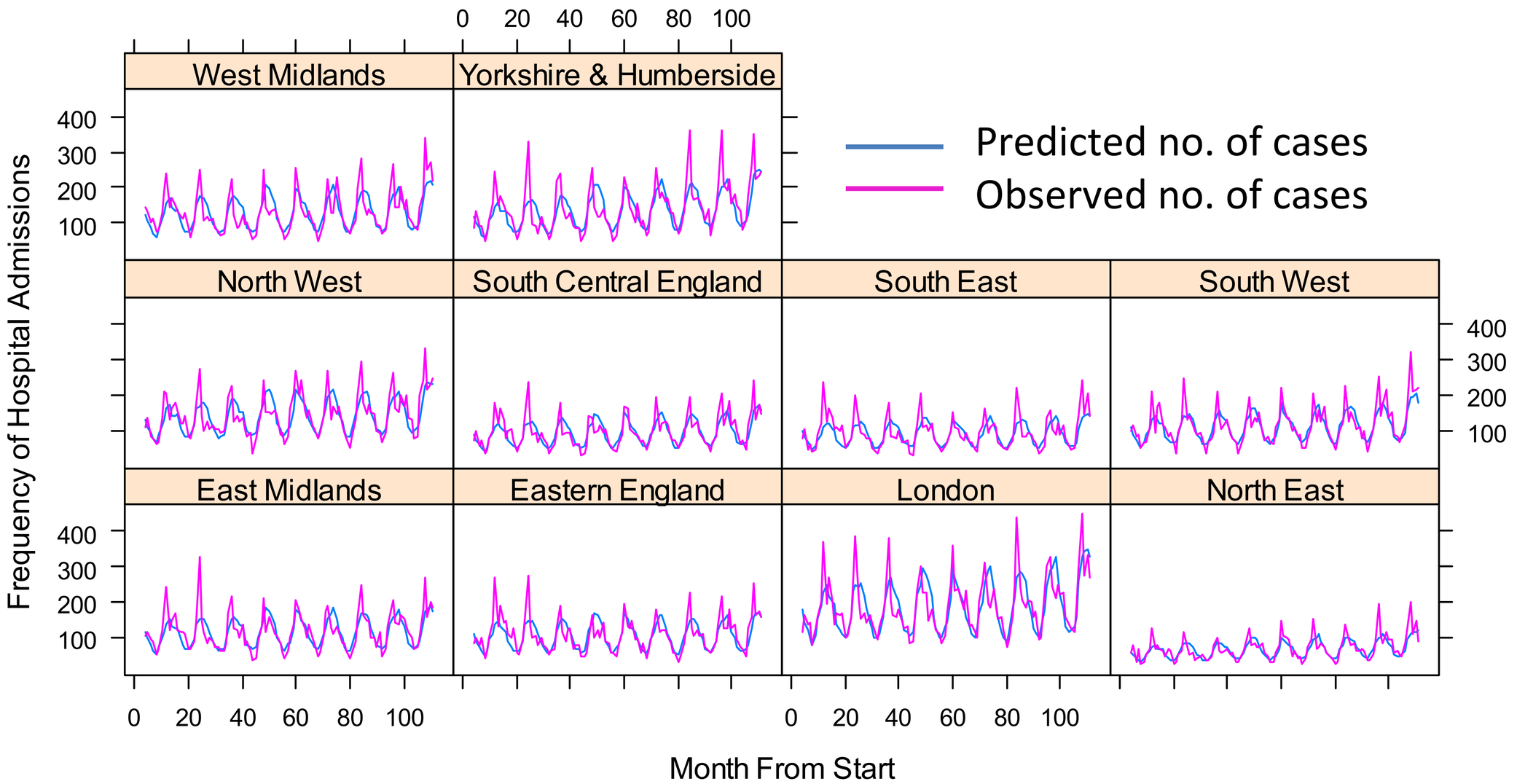
	Co-efficient	S.E	t - value	P-value
Month From Study Start	0.002	4×10^{-4}	4.50	0.00
SHA Population Size	1.9×10^{-7}	4×10^{-7}	5.28	0.00
Max. Temperature This Month	-0.06	0.003	-20.40	0.00
Max. Temperature Previous Month	-0.02	0.003	-4.77	0.00

Significant Predictors - Empyema

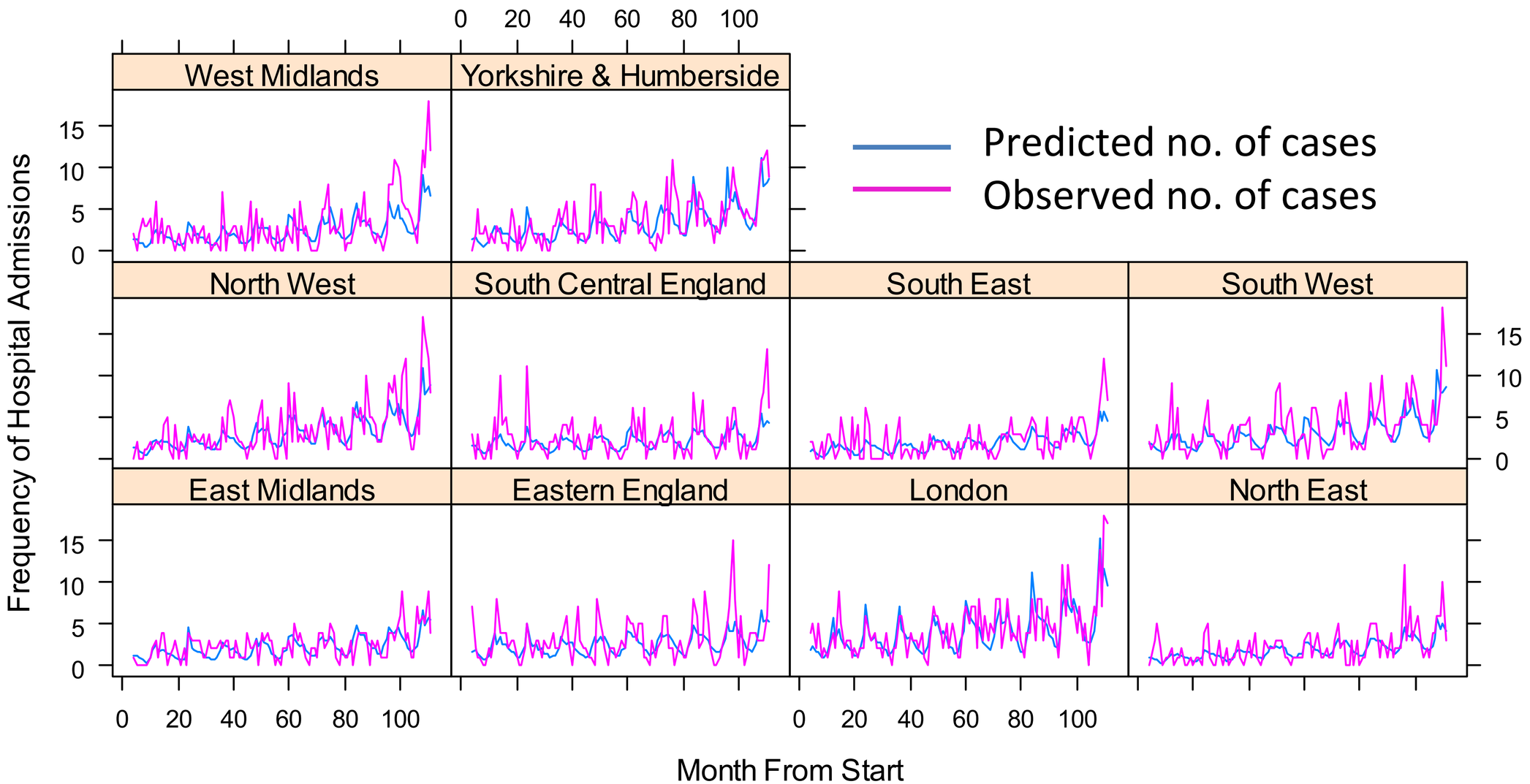
	Co-efficient	S.E	t - value	P-value
Month From Study Start	0.006	0.001	7.98	0.00
Pneumonia Admissions This Month	0.003	3×10^{-4}	8.89	0.00
Max. Temperature Previous Month	-0.04	0.004	-8.36	0.00

45 % of the variation in the number of admissions of empyema can be explained by the final model ($R^2 = 0.45$)

Trend In Cases of Pneumonia By SHA

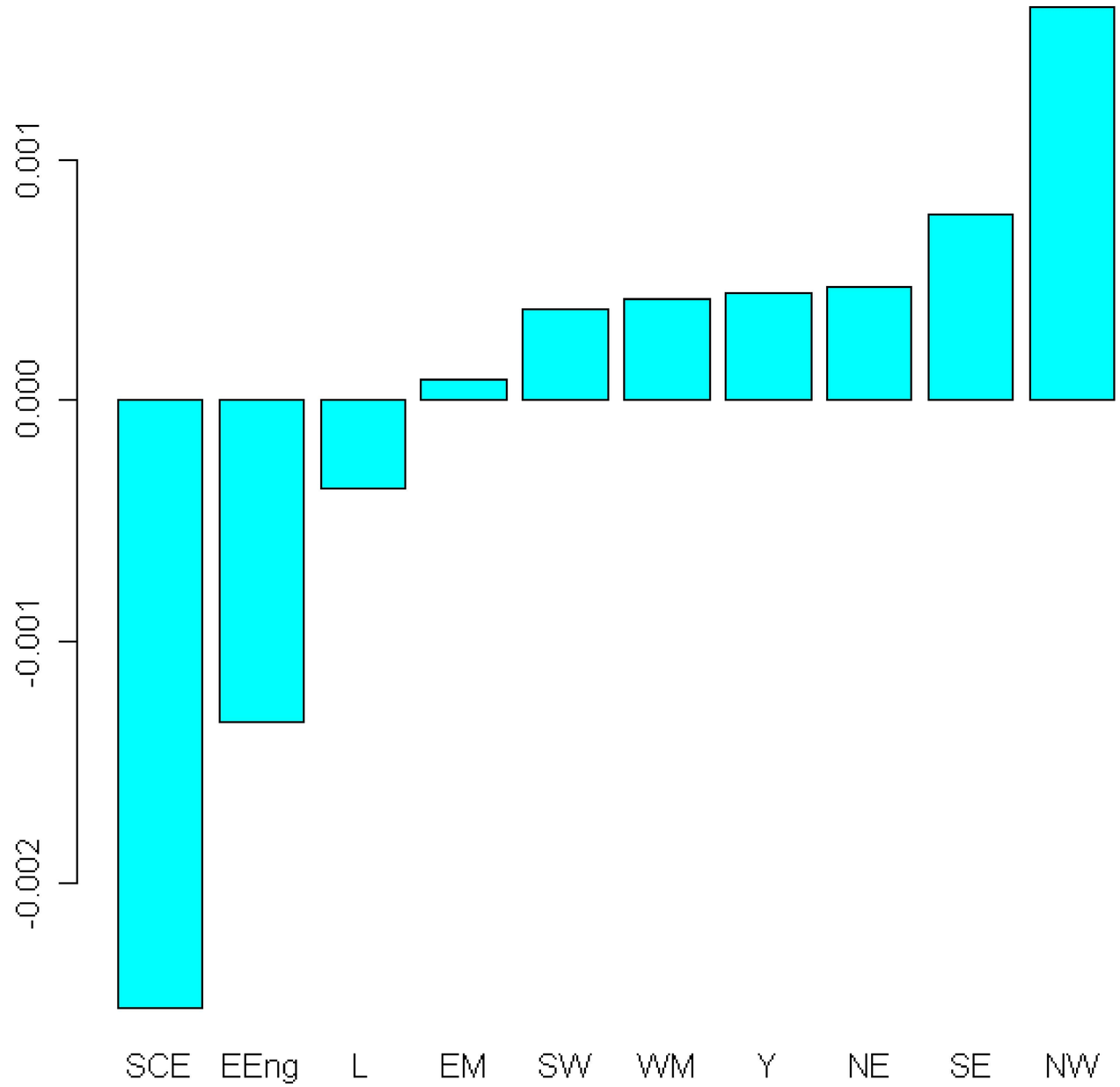


Trend in Cases of Empyema By SHA



Variation In Increase In Empyema Across Different SHAs

Relative Rate of Increase In Empyema By SHA



Conclusions

- Both conditions increased over the time period but the relationship was non-linear and varied geographically
- Temperature prior to admission is a predictor of numbers of admissions of both pneumonia and empyema
- Significant lag in effect of temperature on empyema
- Combination of time, pneumonia admissions and temperature only explains 45 % of variation in empyema admissions

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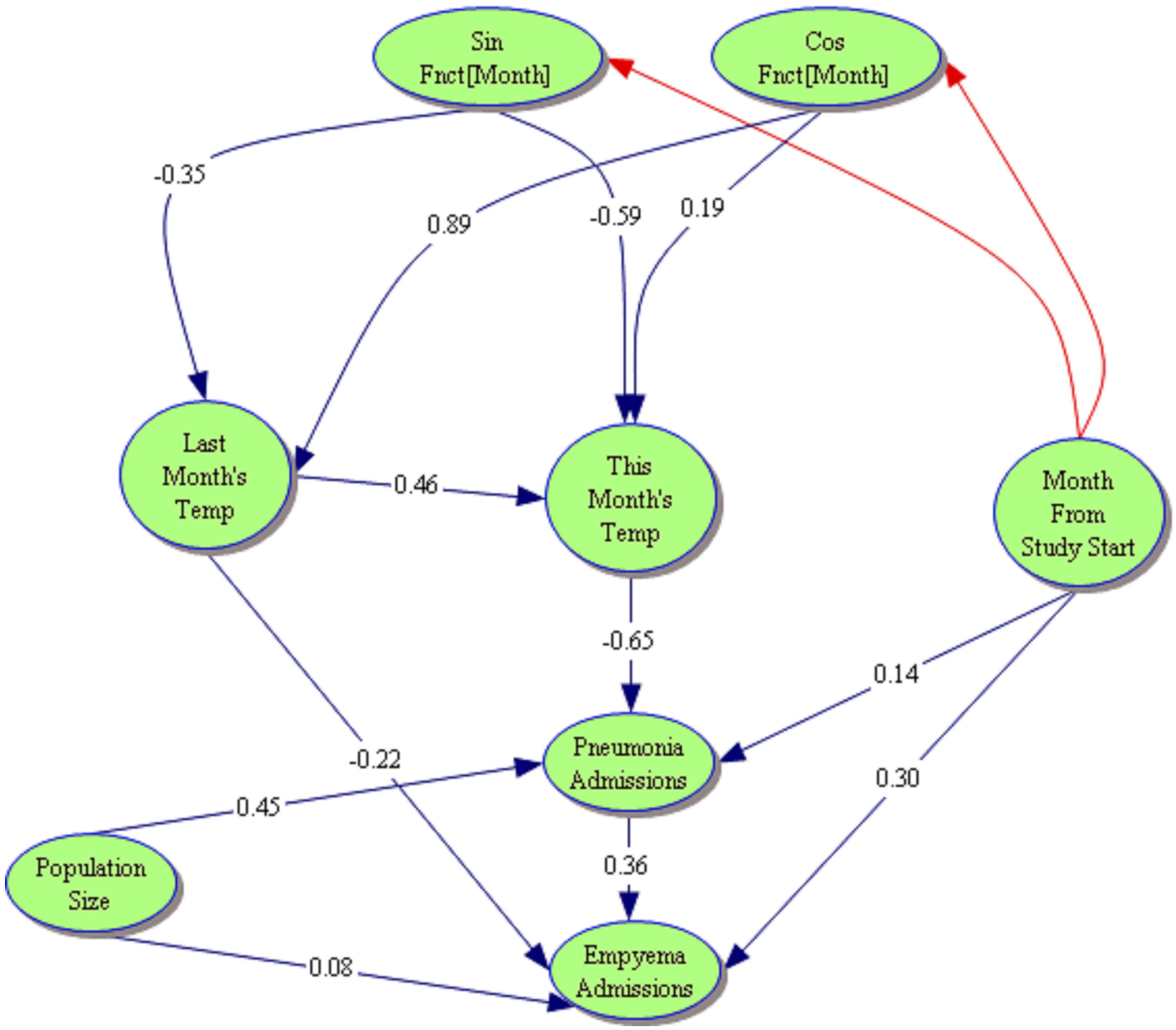
Reports of Increase In Incidence of Empyema

Country	First Year of Rise	Source
Israel	1991	Wexler 2006
UK	1995	Rees 1997
Canada	1995	Finley 2008
Spain	1995	Deiros-Bronte 2006
USA	1995	Byington 2002
Australia	1996	Strachan 2009
Taiwan	1997	Hseih 2004
Spain	1998	Obando 2008
Scotland	1998	Roxburgh 2008
Belgium	2003	Van Ackere 2009
France	2004	Bekri 2007

ICD – 10 Codes

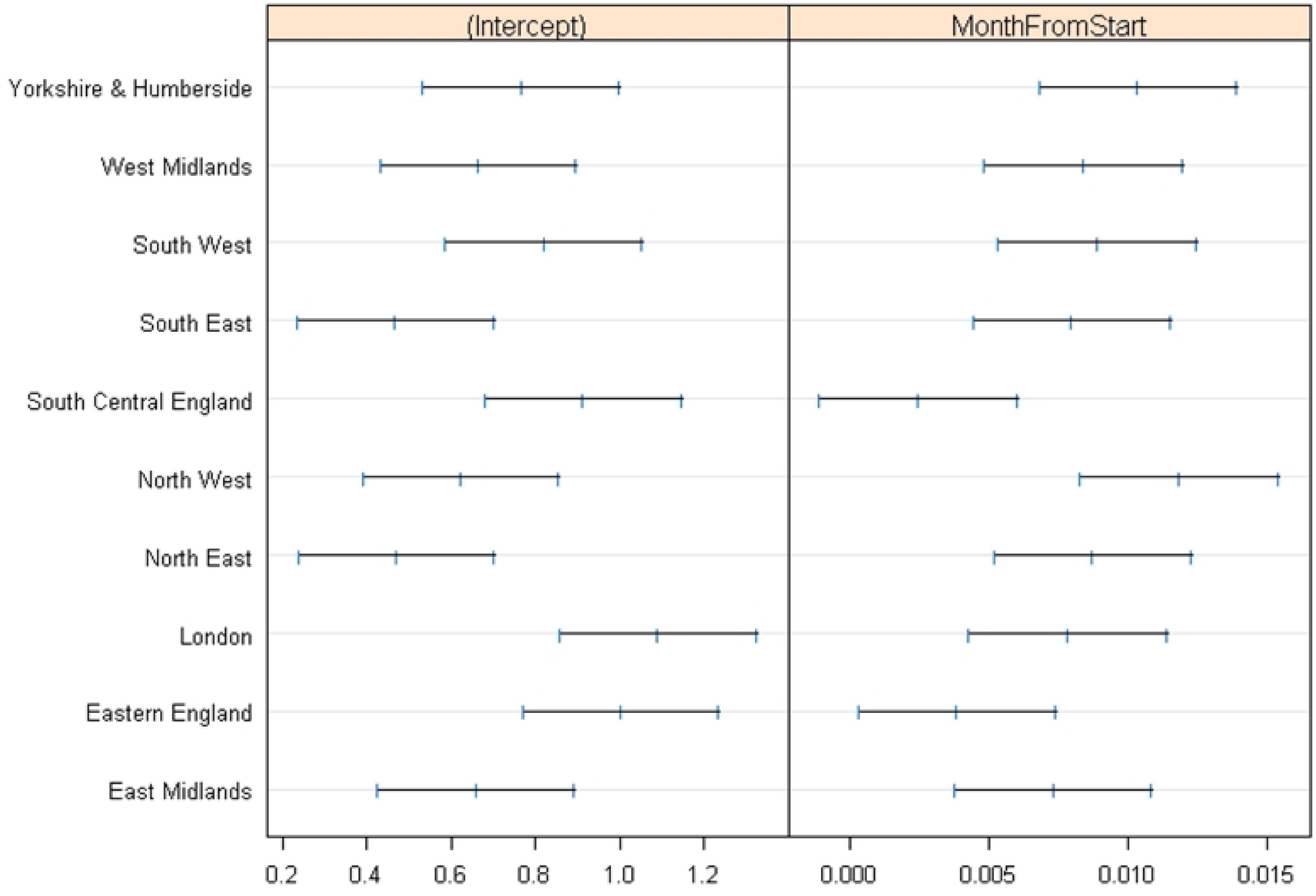
Condition	Codes	Detail
Viral pneumonia	J100, 110, 120, 121, 122, 128, 129	Influenza with pneumonia (virus identified); Influenza with pneumonia (virus not identified); Adenoviral; RSV; Parainfluenza ; Other viral pneumonia; Viral pneumonia, unspecified
Bacterial pneumonia	J13, J14, J150, J151 - J159, J160	Pneumonia due to: *S. pneumoniae*; *H. influenzae*; *K. pneumoniae;* Pseudomonas; Staphylococcus; Group B streptococcus; other streptococci; *E. coli*; other aerobic Gram-negative bacteria; *M. pneumoniae*; Other bacterial pneumonia; Bacterial pneumonia, unspecified; Chlamydial pneumonia
Other Pneumonia incl. fungal & those unclassified by organism	J168, J170, J171, J172, J173, J178, J180, J181, J182, J188, J189	Pneumonia due to other specified infectious organisms; Pneumonia in bacterial diseases classified elsewhere; viral diseases classified elsewhere; mycoses; parasitic diseases; other diseases classified elsewhere; Lobar; Bronchopneumonia; Hypostatic; Other pneumonia, organism unspecified; Pneumonia, unspecified
Empyema	J86, J869	Pyothorax without fistula; Pyothorax with fistula

Structural Equation Model For Empyema Admissions

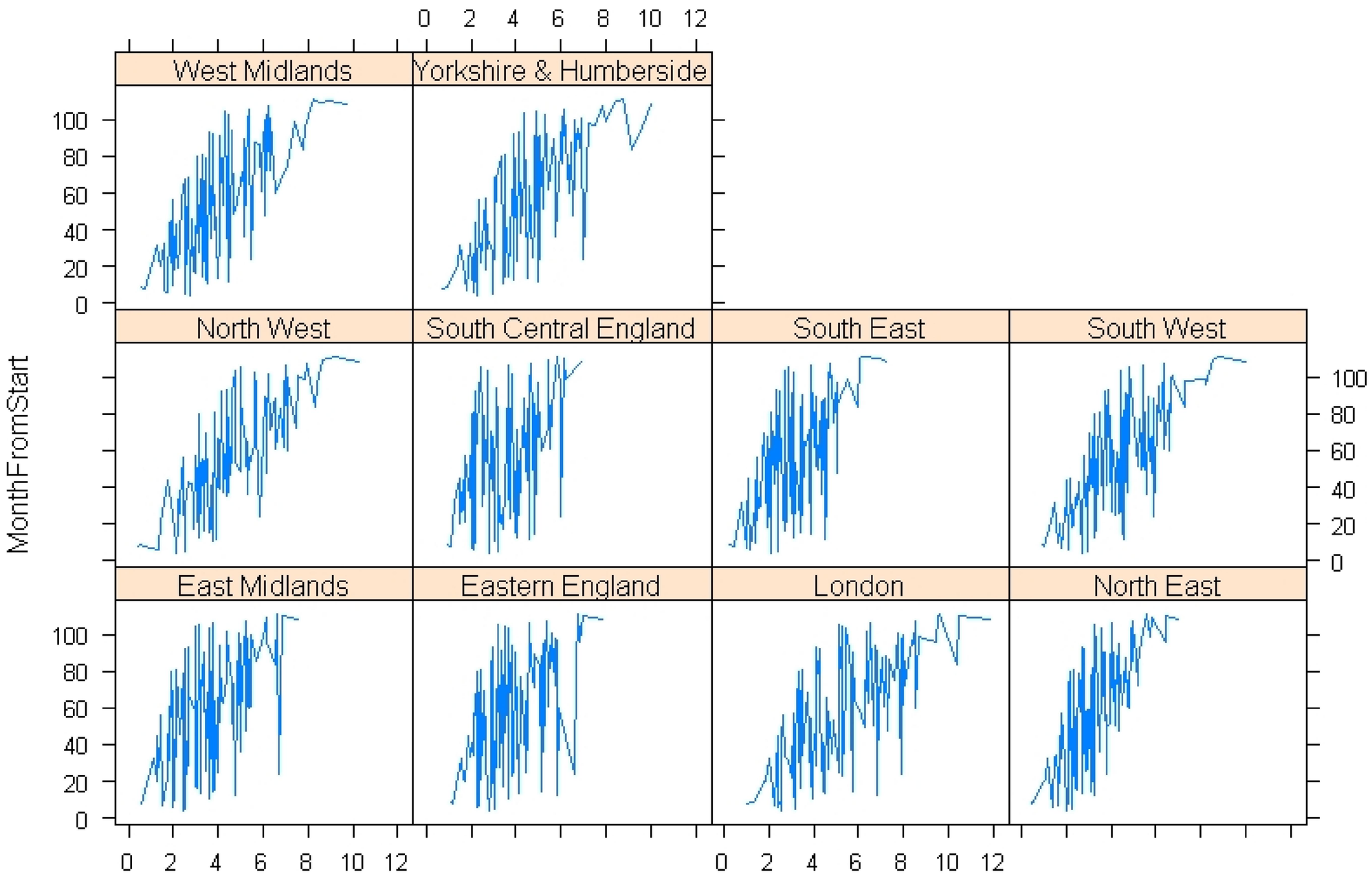


Chi Sq. model fit:	71.67
Chi Sq. baseline model:	6265
CFI:	0.99
TFI:	0.98
RMSEA Est.	0.079
(90 % CI	0.062-0.097)
SRMR	0.016

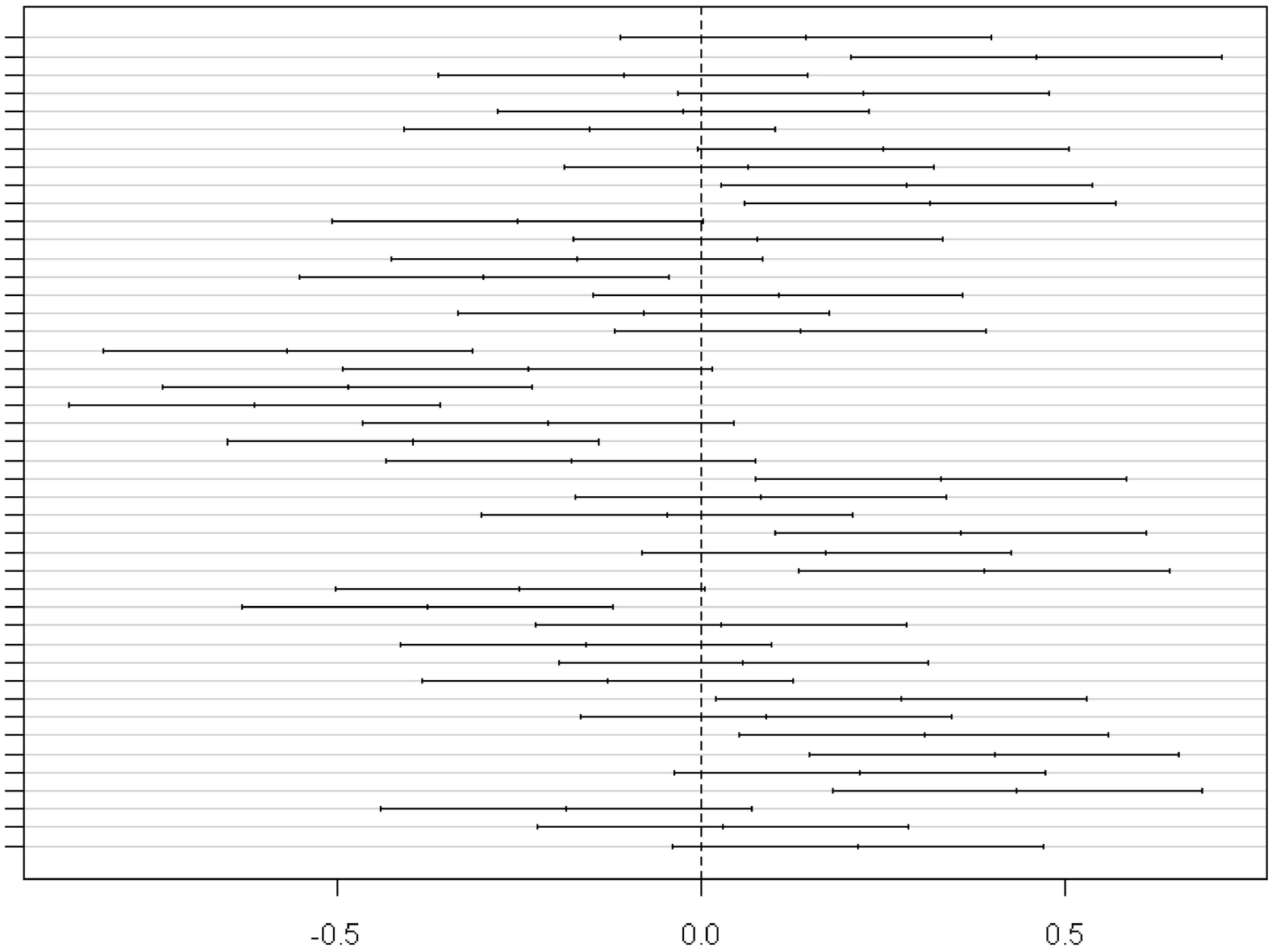
Intervals Plot



Fitted values over time



Tukey plot



Plot of inter-relationships of different SHAs relative rate of increase in empyema