The association between the Referral to Treatment backlog and all-cause mortality in England

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Motivation

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- The NHS is under massive strain and many believe if the status quo continues, the backlogs are likely to contribute to worsening morbidity and mortality.
- The current state of the NHS will continue to engage politicians, policymakers and the general public for years to come.

Aims

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- To estimate the attributable risk of deaths due to NHS treatment delay.

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Health

England's hospital waiting lists rise to 7.57m

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Nick Triggle >
Health correspondent
@nicktriggle >

13 June 2024 · 155 Comments

In the news

‘National tragedy’: figures show large rise in people dying while on NHS waiting list

Figures obtained by Labour show an estimated 120,695 people died in England while awaiting treatment

Hospital bosses say deaths reflect a ‘decade of underinvestment’ that has left the NHS with too few staff and beds. Photograph: Victoria Jones/PA

More than 120,000 people in England died last year while on the NHS waiting list for hospital treatment, figures obtained by Labour appear to show.

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Record number of GP appointments to have four-week waits this year

Data shows the number of lengthy waits for appointments is set to be more than 17.6 million this year.

Alix Culbertson
Political reporter @alixculbertson

Sunday 15 September 2024 22:54, UK

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Hospital waiting list deaths double in five years

More than 120,000 died waiting for NHS treatment, as backlog hits all-time high

By Laura Donnelly, HEALTH EDITOR
31 August 2023 • 12:01am

Related Topics
NHS waiting lists, NHS strikes, NHS, Rishi Sunak, Labour Party, Wes Streeting

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The number of NHS patients dying while waiting for treatment has doubled in five years, new figures suggest.

More than 120,000 people died while on waiting lists last year, according to an analysis of health service data. The total is even higher than it was in lockdown, with health leaders saying the pandemic and NHS strikes have made clearing backlogs more difficult.

Waiting lists are at an all-time high despite Rishi Sunak's pledge to cut them as one of his five priorities ahead of a general election.

Matthew Taylor, the chief executive of the NHS Confederation, said: "These figures are a stark reminder about the potential repercussions of long waits for care. They are heartbreaking for the families who will have lost loved ones and deeply dismaying for NHS leaders, who continue to do all they can in extremely difficult circumstances.

Waitlist growth month-by-month

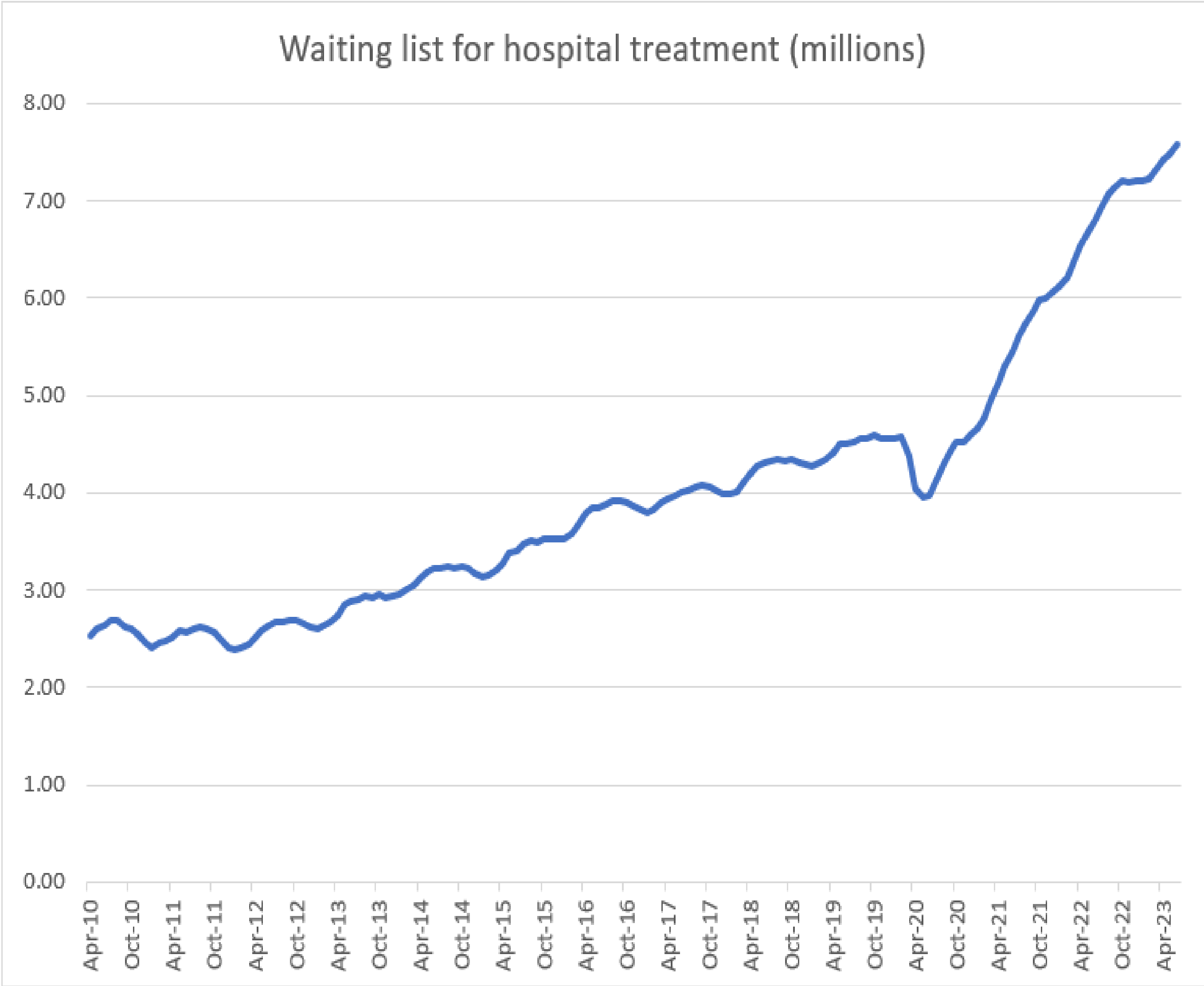

Figure: Median RTT wait time (weeks). Source: https://www.england.nhs.uk/statistics/statistical-work-areas/rtt-waiting-times/

Deaths vs monthly waitlist

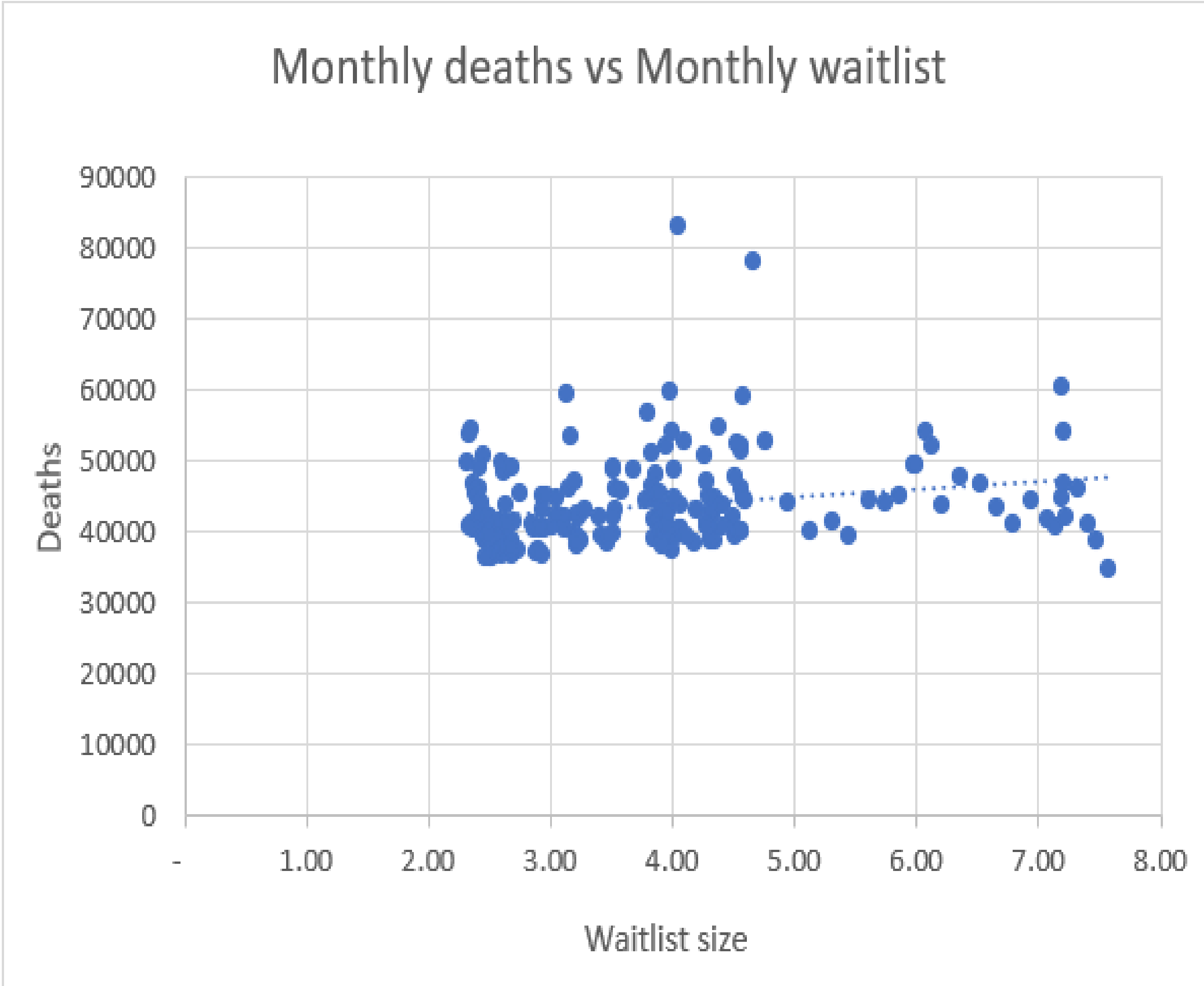

Figure: Deaths vs Waitlist. Source:
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- Data from Aug 1, 2007 - June 30, 2023

The Distributed Lag Non-linear Model (DLNM) (Gasparrini et al., 2010)

- Distributed Lag: The effects of a variable can be spread out over future time periods rather than just being immediate and concentrated at a single time point.
- Why DLNM?
  - Health impacts can persist for some time after "exposure" to delay in treatment.
  - DLNM captures both the delay-mortality relationship and its temporal structure.
- DLNM can be viewed as a special case of generalised additive models.

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- See e.g. Gasparrini, 2014

Model

$$Y_t \sim Poisson(\mu_t)$$

$$\log(\mu_t) = \alpha + cb + ns(time, 7df\ per\ yr) + DoW$$

- Y_s - daily death counts assumed to be overdispersed poisson dictributed
- α - intercept term
- cb - cross-basis matrix for the bi-dimensional functional space of predictor and lags produced by DLNM
- ns - natural cubic spline with 7 degrees of freedom per year to control for seasonal and long-term trends

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- Using a log link with overdispersed Poisson distribution for DLNM, we model $D_{x,t}$ as follows

$$\ln E(D_{x,t}) = \alpha_0 + v(t) + \sum_{l=0}^{L} s_l(T_{t-l}, l, \boldsymbol{n_l})$$

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- L : the maximum considered lag

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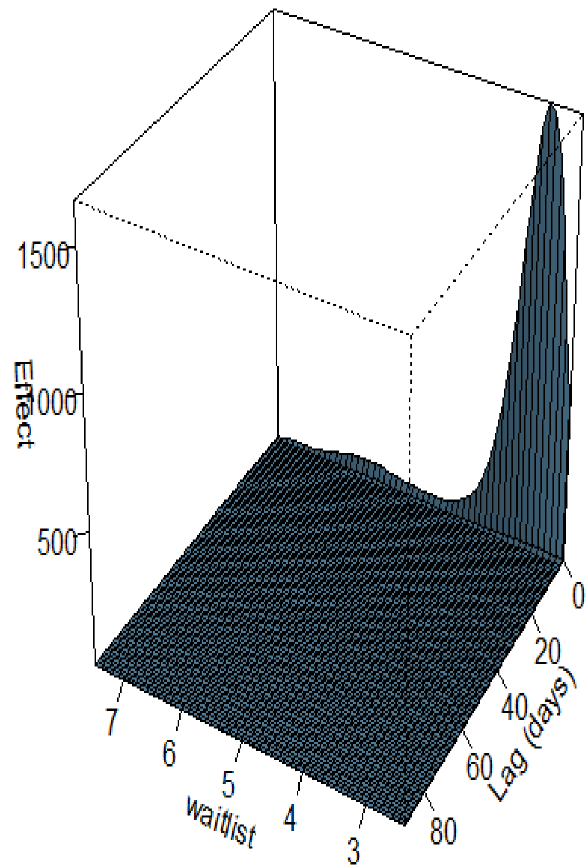
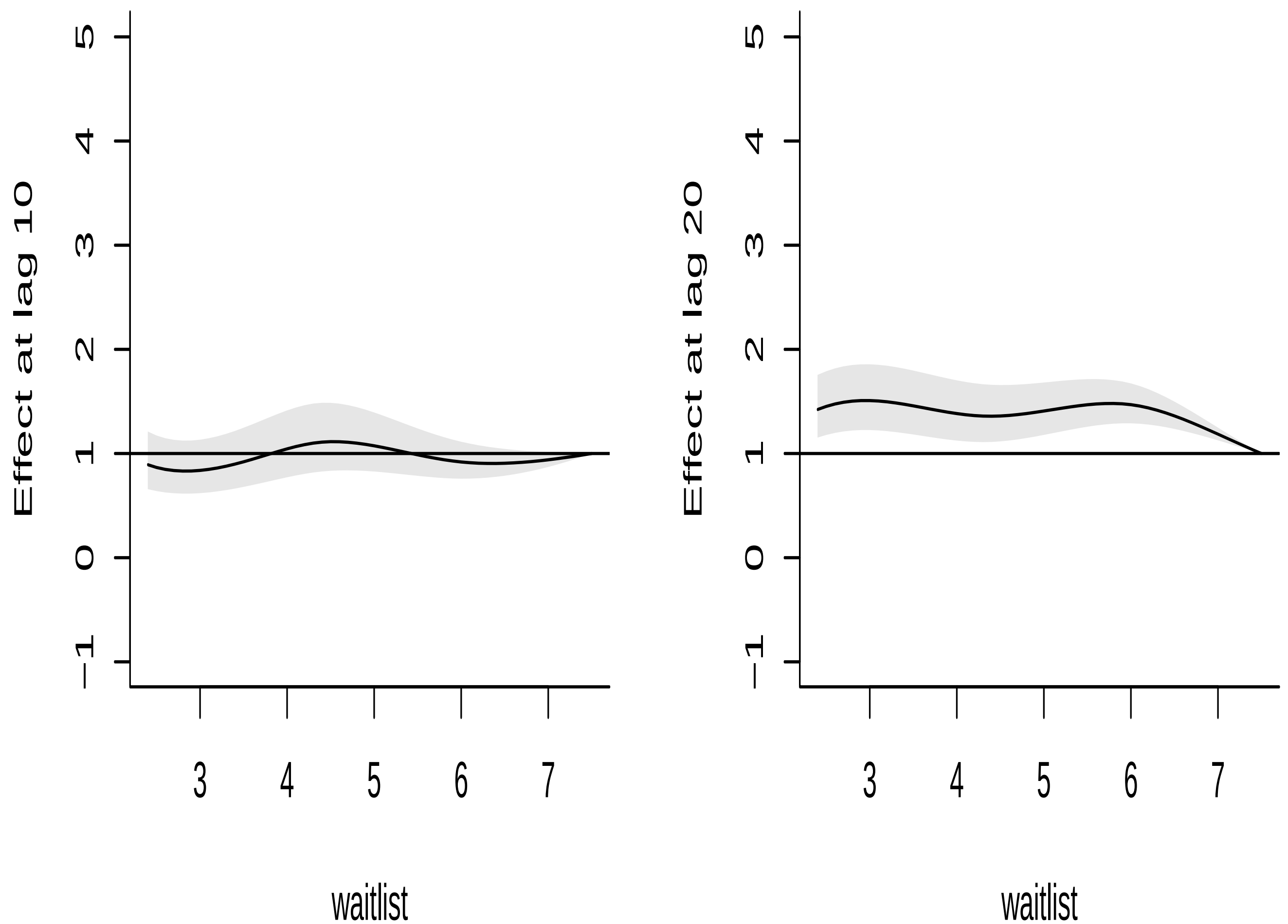
- The lag-response curve was modelled with a natural cubic spline with an intercept and three internal knots equally distributed in the log-space
- Assumed up to for up to 90 days of lag in line with literature
- We controlled for day of the week with an indicator, and for seasonal and long-term trends with a natural cubic spline of time with 7 degrees of freedom per year.

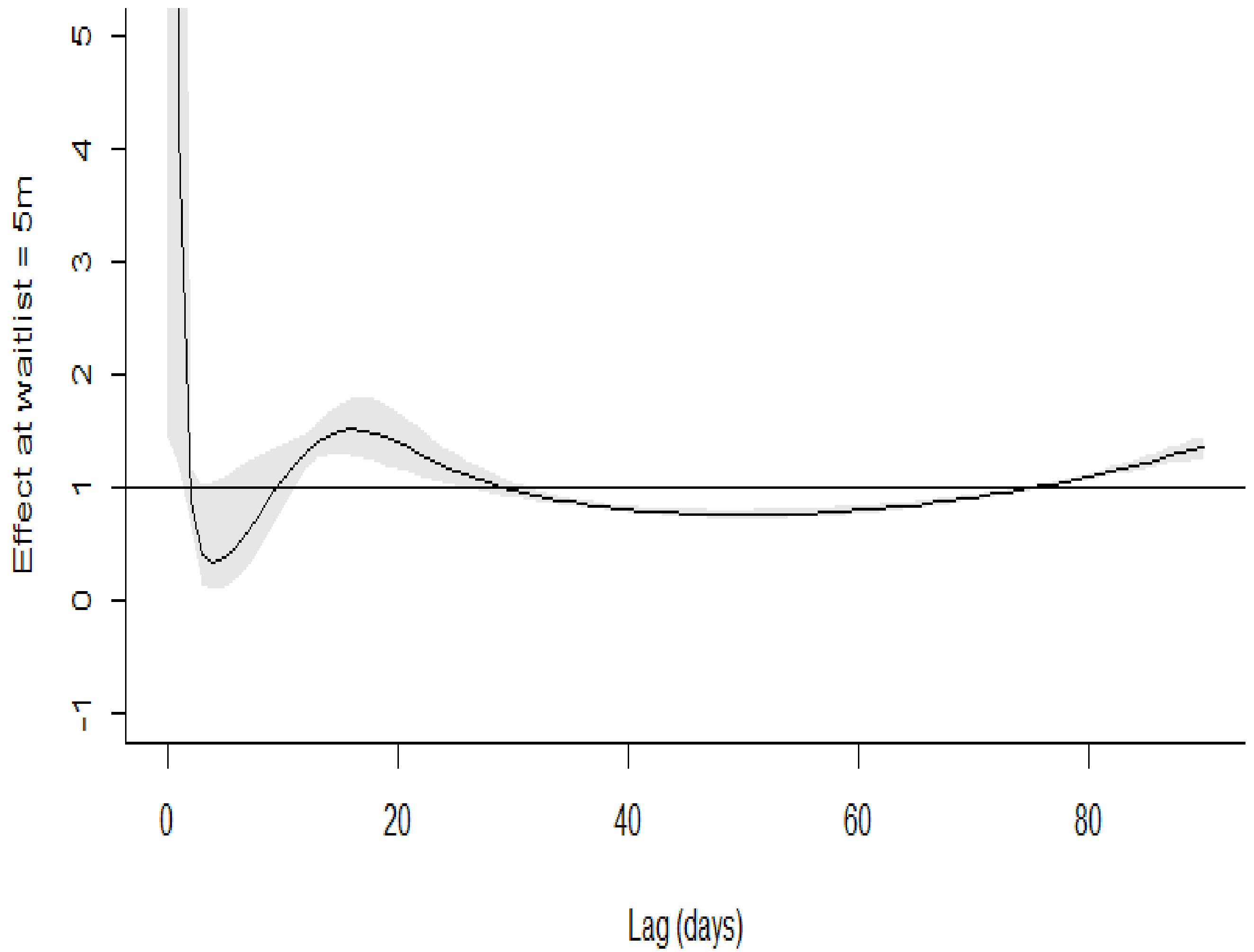
Lag-Exposure-Response



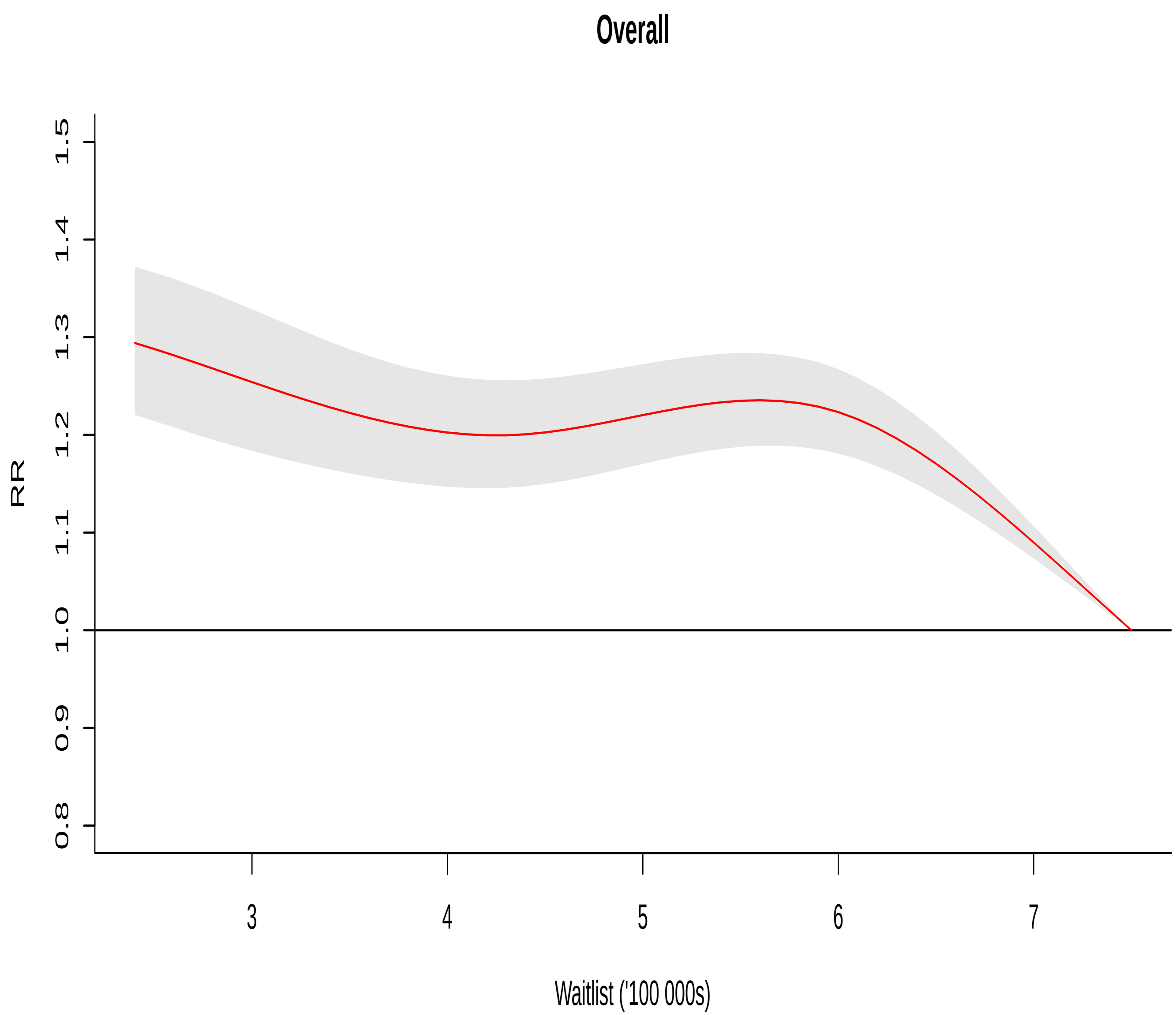
Lag effects


Effect at lag 10
−1
0
1
2
3
4
5
3
4
5
6
7
waitlist
Effect at lag 20
−1
0
1
2
3
4
5
3
4
5
6
7
waitlist

Effect by lag for specific waitlist



Relative Risks



Attributable fractions

- Let AFx be the attributable fraction for exposure x, then
- $AF_x = 1 - exp(-\beta x)$,
- where βx is the risk associated with the exposure, and it usually corresponds to the logarithm of a ratio measure e.g. relative risk, relative rate, etc.
- For binary variables reporting presence/absence of the exposure, formula simplifies $AF = (RR - 1)/RR$

Estimated AF = 15.7% (12%, 19%)

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- (Excessive) waiting lists may be contributing a non-trivial proportion of all-cause mortality in England.
- The shape of the RR suggests that beyond a certain point, the excess mortality risk from the treatment backlog wears off. Why?

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- Investigate ways to sense check RR shape and estimated AFs.
- Introduce other predictors, e.g. age, sex.
- Explore the lag structure.