The impact of firebreaks in Wales and Northern Ireland on reproduction numbers

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Rationale

We aimed to explore intensive lockdowns (firebreaks) in Northern Ireland (from 16th October 2020) and Wales (24th October to 9th November 2020), by analysing the reproduction number (R_t) before, during, and after the intervention. In order to identify any effect from these interventions, we estimated R_t with set breakpoints on the dates the interventions came into place and when they were lifted.

Methods

We estimated R_t separately from cases, hospitalisations and deaths (shown as a 7 day moving average in Fig 1A) from Monday 28th September using two different methods.

First we modelled R_t as piecewise constant with a single breakpoint at the start of respective intervention, and a breakpoint at the end of the intervention if applicable (figure 2B). Second, we modelled R_t using a weekly random walk with an additional breakpoints at the start of respective lockdowns and at the end if applicable. In the latter method, we left at least one week between the last random step and the firebreak breakpoint. No further breakpoints were included beyond the start of the firebreak until the end of the firebreak (9 November in Wales). In all estimates, we specified an R_t prior of mean 1.2 (SD 0.2).

We measured effect size as a multiplicative change in R_t.

Results

In Northern Ireland and Wales there was clear evidence of a reduction in R_t linked with the firebreaks across all data streams and methods.

In Northern Ireland, we observed comparable effect sizes for the change in R_t estimated from admissions and deaths (between 10% to 35%, bringing R_t to below 1), while evidence of an effect was slightly weaker in R_t from cases. In Wales, evidence for an effect was strongest among R_t estimated from cases (with 50% credible intervals ranging from 22-29%). The R_t estimates from admissions and deaths were again similar (4-33%). In both countries, R_t estimates from deaths provided the weakest support for an effect of the firebreak at the outer limits of credible intervals (all 90% credible intervals for deaths fell just below 1).

In general, we observed comparable results from either using breakpoints only on known intervention dates, or from allowing weekly change prior to known intervention dates. The more flexible approach appears to have produced slightly reduced effect sizes with reduced credible intervals.

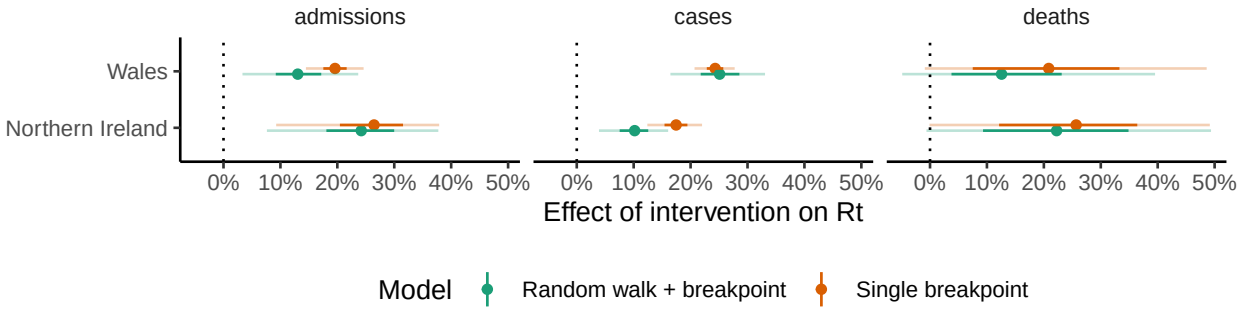

Figure 1. Effect size (multiplicative change shown as percentage) of breakpoint on R_t, on the start of the firebreak: 24th October for Wales, 16th October for N Ireland, median with 50% (darker) and 90% (lighter) credible intervals.

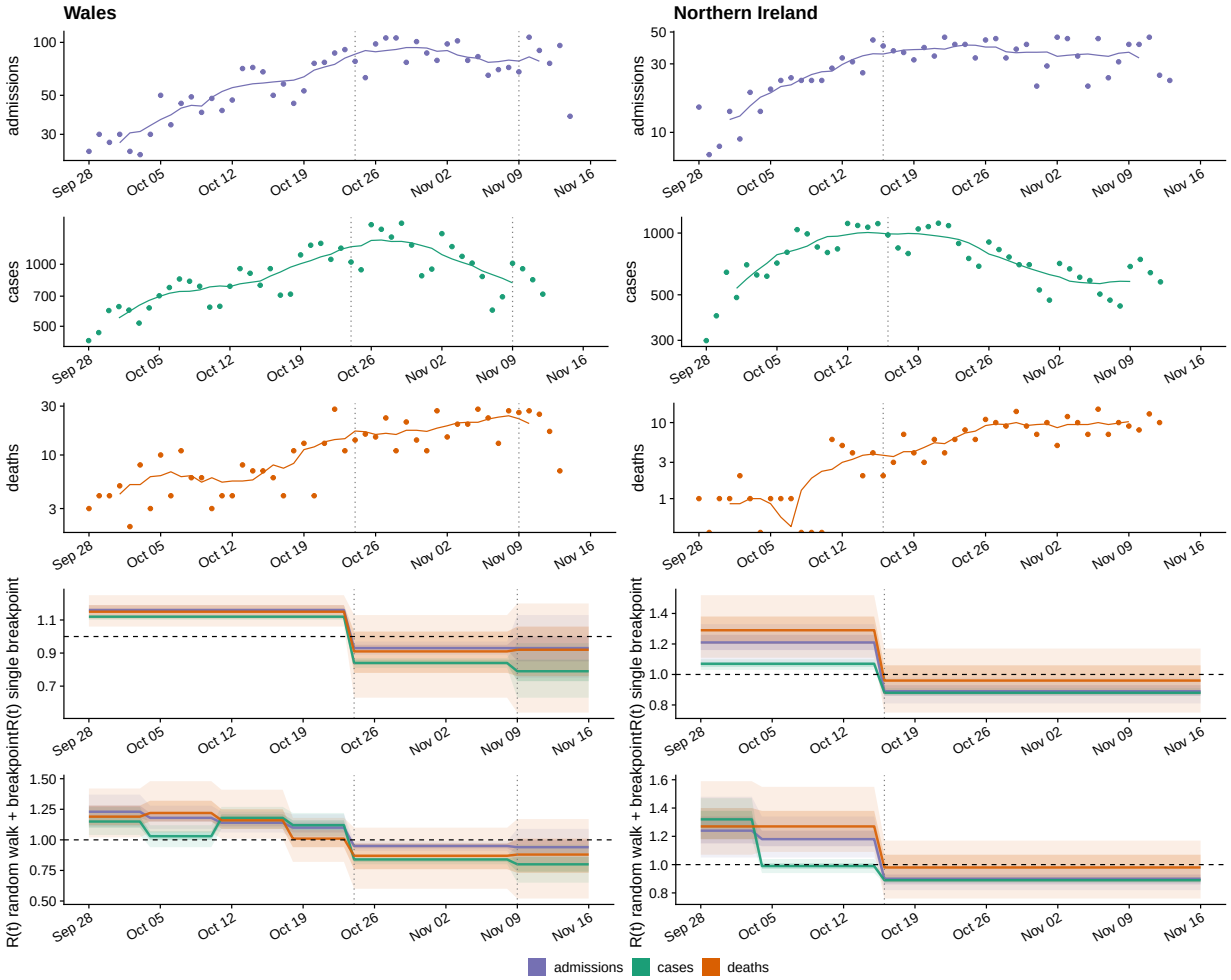

Figure 2. Top to bottom: Data for hospital admissions, cases, and deaths, in Wales and Northern Ireland. R_t modelled using a breakpoints at the beginning and end of the firebreaks: 24th October in Wales (firebreak); 16th October in Northern Ireland (firebreak). R_t including a random walk, with breakpoints each Sunday until the week before the firebreak, plus the firebreak breakpoints as above.