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**From:** WOOLHOUSE Mark [/O=EXCHANGELABS/OU=EXCHANGE ADMINISTRATIVE GROUP (FYDIBOHF23SPDLT)/CN=RECIPIENTS/CN=9C4153BCEE124D7181397F6F48883523-MEJW]  
**Sent:** 13/03/2020 08:22:07  
**To:** John Edmunds [John.Edmunds@i&s]  
**Subject:** Re: never got your slides

John,

I don't quite get this. The interventions (grey bars on Fig 2?) seem identical in all scenarios. But it does look to keep ICU cases low, though that seems to be sensitive to the exact strategy used. Is it possible to plot cumulative numbers recovered as an upper limit to the level of herd immunity that results?

Not sure that this has any chance of flying at policy level though. Repeated interventions over a 2 year period not in the government play book. Yet.

mw

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**From:** John Edmunds <John.Edmunds@i&s>  
**Sent:** 13 March 2020 06:39  
**To:** WOOLHOUSE Mark <Mark.Woolhouse@i&s>  
**Subject:** Re: never got your slides

I wasn't sure exactly what could be handled, and set the trigger at 10 new cases per week per county in the runs that I showed you. This surely is manageable, no?

And, yes, we get to herd immunity, and the epidemic stops. Done more simulations looking at different triggers. There is a lot of uncertainty, but you can get to herd immunity without swamping the health service. It doesn't always work, but on average it does suppress the epidemic well, and achieve herd immunity eventually. See attached for triggers of 5, 10 and 15 cases per ICU and either a fixed 3 week lockdown or a variable one in which you only release the lockdown when you go back under the trigger point. Look at Fig 2 (ignore top 2 lines). Then each row is a run with the same  $R_0$  and random number seed, so you can compare the effect of the different triggers, going across, and uncertainty going down.

Found out last night that SPI secretariat deemed this not sufficiently interesting to put before SAGE today, which I am shocked about.

John

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**From:** WOOLHOUSE Mark <Mark.Woolhouse@i&s>  
**Date:** Friday, 13 March 2020 at 06:26  
**To:** John Edmunds <John.Edmunds@i&s>  
**Subject:** Re: never got your slides

John,

Do your simulations allow you to ask the question this way around?

If we limit cases to a number that the NHS can handle does that generate anything like sufficient herd immunity? Here, we are defining "number the NHS[S] can handle" as the surge capacity in ICU beds. From a back of the envelope calculation I think it might, just, but there are many substantial uncertainties of course.

mw

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**From:** John Edmunds <John.Edmunds@I&S>  
**Sent:** 12 March 2020 09:28  
**To:** WOOLHOUSE Mark <Mark.Woolhouse@I&S>  
**Subject:** Re: never got your slides

I agree. So let's try and do it properly instead of just reacting.

J

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**From:** WOOLHOUSE Mark <Mark.Woolhouse@I&S>  
**Sent:** Thursday, March 12, 2020 8:45:35 AM  
**To:** John Edmunds <John.Edmunds@I&S>  
**Subject:** RE: never got your slides

John,

What I was trying to say is that I think we are likely to end up with your scenario by default.

Neil's won't be allowed to proceed once they realise the toll on the NHS.

We'll end up with Steve's lock down but they will come to realise that is unsustainable.

And Graham suggested they won't formally adopt yours because of the prolonged time scale (probably true at this point in time). But it will end up looking much like the one you (and we) were modelling yesterday.

I can't see how else it can go unless the facts change significantly.

mw

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**From:** John Edmunds <John.Edmunds@I&S>  
**Sent:** 11 March 2020 22:17  
**To:** WOOLHOUSE Mark <Mark.Woolhouse@I&S>  
**Subject:** Re: never got your slides

You can't have a lockdown for months, let alone the years that Steve is suggesting. However, I agree there may actually be pressure for a lockdown. And they will work, temporarily. If that is the case, then let us use them wisely. My strategy makes the best use of them. Steve's, would lock us down now, with no depletion of susceptibles. This would be a disaster, when we have to release them.

I know it is my idea, so I don't want to sound too wedded to it. But I haven't seen anything better yet. It is the only one in which we don't overwhelm the health service, we achieve herd immunity but minimise the size of the epidemic.

J

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**From:** WOOLHOUSE Mark <[Mark.Woolhouse@I&S](#)>  
**Date:** Wednesday, 11 March 2020 at 22:06  
**To:** John Edmunds <[John.Edmunds@I&S](#)>  
**Subject:** Re: never got your slides

We were given the policy objective of flattening the peak. We can and have modelled that.

We've also said (well, most of us) that the degree of fine tuning needed to meet that policy objective optimally would be extremely challenging to achieve in practice. I've described it to the policy makers here as possible, but it would be good fortune as much as anything.

I also told them that the most likely outcomes are either that we'll see a peak that the NHS couldn't cope with, or we'll end up in the grip of severe BSIs with no way out.

Steven R is - as I read it - making a strong plea that if we err we should err the second way. I don't agree with his model-based argument, but as an operating principle I think he has a case.

My best guess (which I shared with Graham last week) is that HMG will be pressured into something approaching a lock down anyway, so Steve will get his wish.

So we reach a stand off: continued massive disruption or risk of a renewed epidemic. If they're still listening to modellers in 2-3 months time then they'll ask us to plot a way out of it. Hopefully we'll have some more solid data (especially serology) by then so we'll have some missing pieces of the puzzle to work with.

mw

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**From:** John Edmunds <[John.Edmunds@I&S](mailto:John.Edmunds@I&S)>  
**Sent:** 11 March 2020 14:26  
**To:** WOOLHOUSE Mark <[Mark.Woolhouse@I&S](mailto:Mark.Woolhouse@I&S)>  
**Subject:** Re: never got your slides

Any way you look at this, it is hugely disruptive with hundreds of thousands of deaths. But this aggressive management of the epidemic could reduce the epidemic overshoot, and keep hospitals in the game. It is massively disruptive, but not impossible. Italy has already had a shut down. When it gets awful here, there might even be a clamour for a shut-down. If we use that weapon carefully, we could actually save a lot of lives.

It does really extend the epidemic – as you point out – but that is sort of what you want to achieve.

J

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**From:** WOOLHOUSE Mark <[Mark.Woolhouse@I&S](mailto:Mark.Woolhouse@I&S)>  
**Date:** Wednesday, 11 March 2020 at 14:17  
**To:** John Edmunds <[John.Edmunds@I&S](mailto:John.Edmunds@I&S)>  
**Subject:** RE: never got your slides

Thanks. They turned up in the end – I think we're having server problems today. mw

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**From:** John Edmunds <[John.Edmunds@I&S](mailto:John.Edmunds@I&S)>  
**Sent:** 11 March 2020 13:03  
**To:** WOOLHOUSE Mark <[Mark.Woolhouse@I&S](mailto:Mark.Woolhouse@I&S)>  
**Subject:** Re: never got your slides

Apologies.

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**From:** WOOLHOUSE Mark <[Mark.Woolhouse@I&S](mailto:Mark.Woolhouse@I&S)>  
**Date:** Wednesday, 11 March 2020 at 12:58  
**To:** John Edmunds <[John.Edmunds@I&S](mailto:John.Edmunds@I&S)>  
**Subject:** never got your slides

mw