Briefing Document.

The 2019 novel Coronavirus - forward view

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Crystallise

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Summary

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As of the 9th of February 2020, the novel coronavirus 2019 (2019-nCov) outbreak had been known to have infected 37,558 people, of whom 813 had died.

Background

Between the 29th January and the 9th February, the number of known cases has risen from 6,065 to 37,558 (WHO, 2020). About 15% of the identified cases are severe enough to require admission to an intensive care unit and approximately 2% of all currently known cases have died. As there is a median lag time of about 14 days between symptoms starting and death(Wang, Tang and Wei, 2020), the true case fatality rate for ***known*** cases will be higher. It is likely that the underestimation of deaths from novel coronavirus will be minor, but the underestimation of true cases will be much higher. A modelling study from the 31st of January estimated the true number of cases in Wuhan on the 25th of January as being nearly 76,000 compared to the 1,320 being reported (Wu, Leung and Leung, 2020).

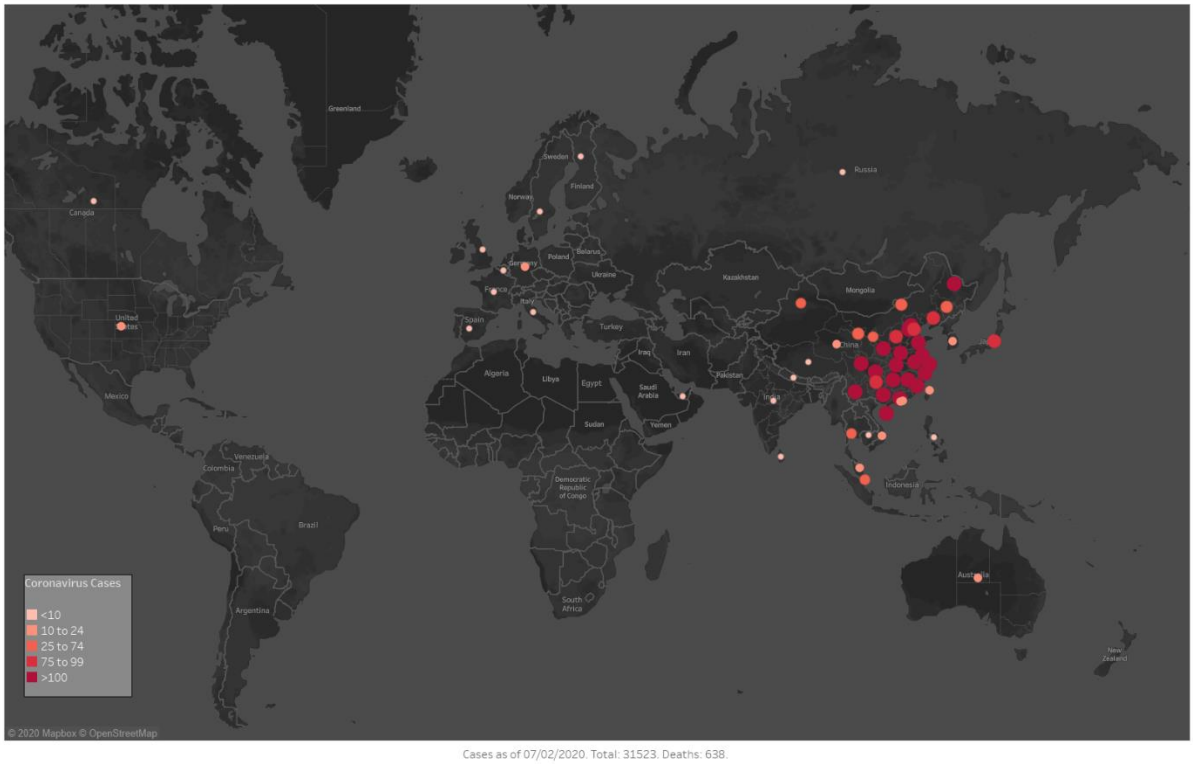

Figure 1 Bubble map of cases of 2019-nCoV showing the density of cases within China compared to the rest of the World.

The case-fatality rate of 2019-nCoV appears to be about 3%. This is much less than the 11% rate for the SARS outbreak of 2003 and the crude case-fatality rate of 34.5% for MERS(WHO, 2003, 2019; Wang *et al.*, 2020). However, 2019-nCoV does appear to be spreading faster than the 2003 SARS virus: within 5 weeks it has matched the number of cases 2003 SARS accrued over 7 months.

The current numbers of cases and deaths are shown in Table 1.

Table 1 Numbers of cases and deaths from the 2019-nCoV, from the WHO situation reports to the 7th February 2020. (WHO, 2020)

Date	Cases	Deaths	Severe Cases
12-Jan-20	41	1	
20-Jan-20	282	6	51
21-Jan-20	314	6	51
23-Jan-20	581	17	95
24-Jan-20	846	25	177
25-Jan-20	1,320	41	237
26-Jan-20	2,014	56	324
27-Jan-20	2,798	80	461
28-Jan-20	4,593	106	976
29-Jan-20	6,065	132	1,239
30-Jan-20	7,818	170	1,370
31-Jan-20	9,192	213	1,527
01-Feb-20	11,953	259	1,795
02-Feb-20	14,567	305	2,110
03-Feb-20	17,391	361	2,296
04-Feb-20	20,630	425	2,788
05-Feb-20	24,554	492	3,219
06-Feb-20	28,276	565	3,859
07-Feb-20	31,535	638	4,826
08-Feb-20	34,886	724	6,101
09-Feb-20	37,558	813	6,188

Methods

We have applied the same methods as described in the Briefing Report of the 29th January. We have updated the log-linear projection to compare rates based on the intervening week of data and examined the change in the rate of growth. We explored a number of scenarios applicable to SIR modelling to try and identify a best-fit scenario.

Results

The first observation is that the rate of growth has slowed down between the 29th January and the 7th February (Figure 2).

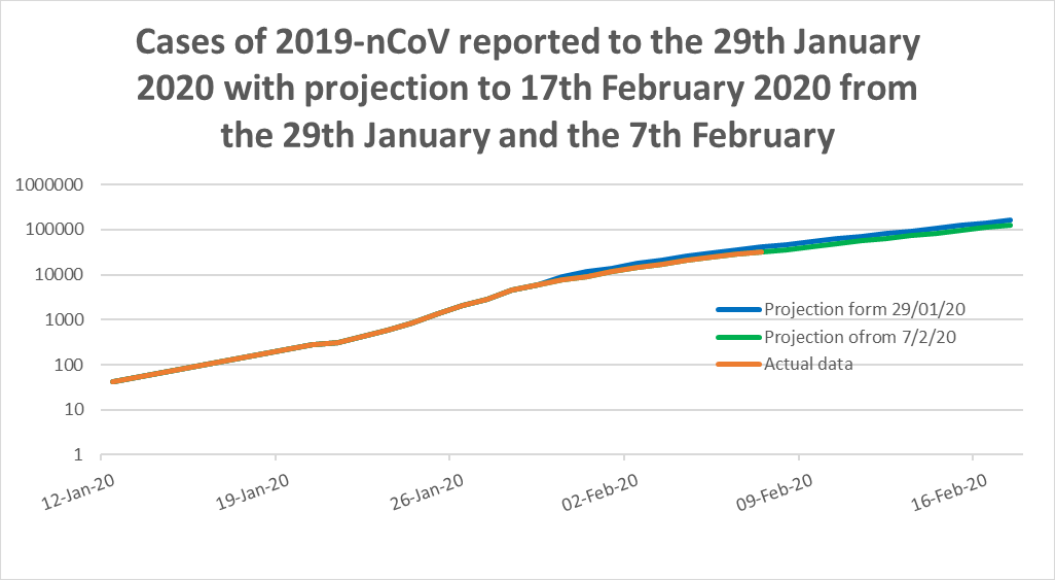

Figure 2 The recorded number of cases up to the 29th January 2020 with a log-linear projection to the 17th February(WHO, 2020).

If we plot the rate of change of the numbers of cases and deaths we can see that there has been a slowing down of the rate of increase in cases and deaths (Figure 3). There could be different causes for this slowing down:

1. A result of the strict public health measures imposed in China to reduce the spread of infection.
2. There may have been a back-log of identified cases that is diminishing over time.
3. It could be that there has been a slowing down in the increase of capacity to identify cases.

With regard to the SIR modelling, we have explored a wide range of scenarios and expanded the modelling to include exposed, asymptomatic, mild and severe disease compartments, however we were unable to fit a model to the data available. Given the time lag arising from the incubation period and the significant gap between development of symptoms and death in those who succumb, there is either a gross under-estimate of the case-fatality rate or the number of cases. It seems most likely that it is the number of cases that is under-estimated, and this is consistent with the work of other authors (Read *et al.*, 2020; Wu, Leung and Leung, 2020).

If we examine the rate of change of the growth in cases and deaths we can get some idea of how the accuracy of reporting is evolving. If we make an assumption that the number of deaths is more accurate, this can be a guide to the accuracy of the cases. Prior to the 2nd February, there was a clear discrepancy, with higher growth in the number of cases. This would be consistent with catching up with a back-log of cases.

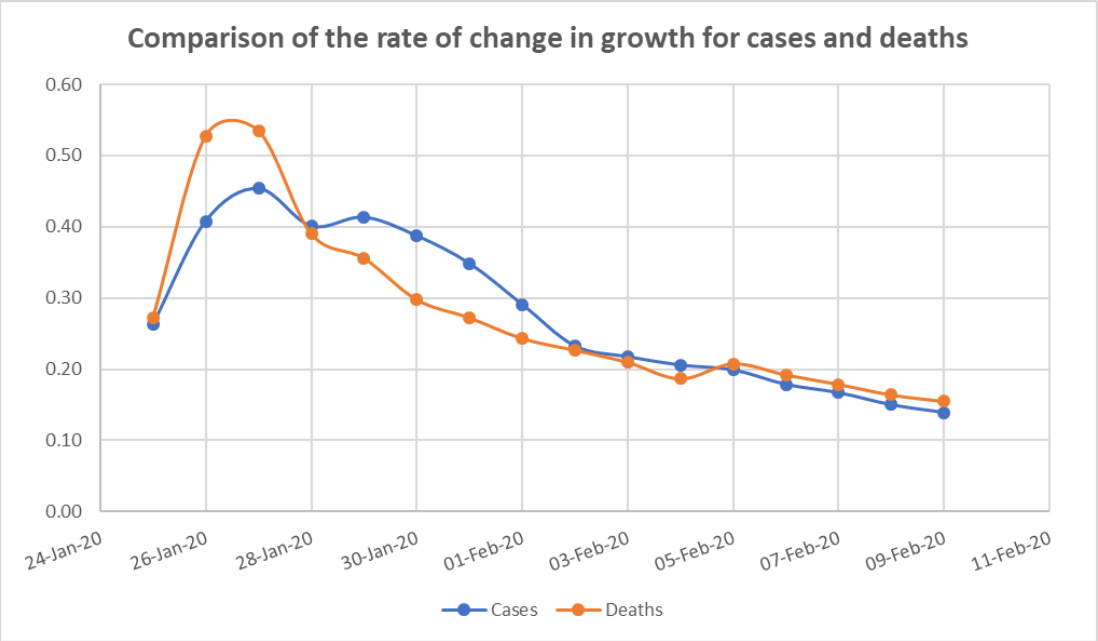

Figure 3 The growth in cases and deaths of 2019-nCoV per day as a proportion with a projection forward to the 24th February taking account of the slow-down in growth.

Using the simple projections of cases using a log-linear approach, or the rate of change in growth taking into account the slow-down in growth, we still have a very wide range of estimates from 245 thousand to 50 million cases by the 1st of April (Figure 4). Assuming a case-fatality rate of 2.5% this would make the estimate of the number of deaths by May being between 5 thousand and 250 thousand.

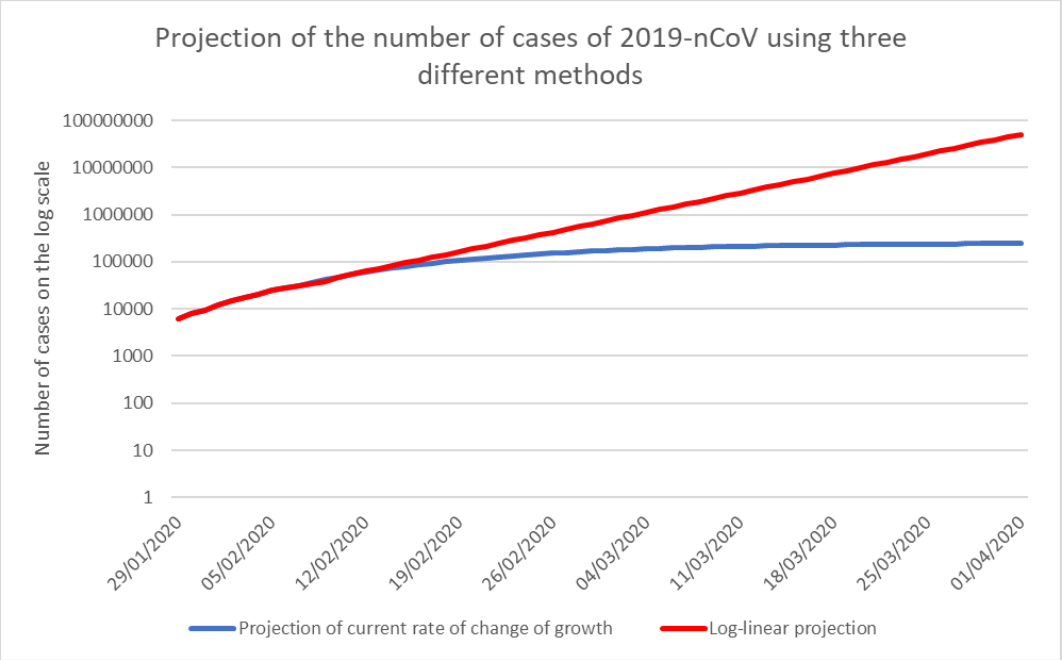

Figure 4 Projection of the number of cases of 2019-nCoV from the 7th February using two different methods: a simple log-linear projection of the number of cases, and a projection using the rate of change of growth of cases.

Conclusion

The rate of growth of cases and deaths from 2019-nCoV has slowed down over the past week.

The true number of cases up to the 2nd February was greatly under-estimated, but reporting may be more reliable since then. This has made the estimation of parameters for an SIR model difficult. We could not find a parameterisation that was consistent with the data available without assuming a very high degree of under-estimation of cases or a large under-estimation of the case-fatality rate.

Using simple projections of the log-linear trend or the rate of change in growth of cases, the number of cases would be expected to be between 245 thousand to 50 million cases by May, and the number of deaths being between 5 thousand and 250 thousand globally.

References

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