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Sunlit Uplands? Vaccine Rollout and the Return to Normality

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Contents

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Foreword by Tony Blair

Some months ago, the assumption of most policymakers around the world was that management of the pandemic would have three phases: first, heavy lockdown to bring the virus under control; second, easing of lockdown with measures to contain the virus including test and trace; then third and finally, rollout of vaccination over the course of 2021, with the most vulnerable at the front of the queue. What has happened is that the second phase has essentially collapsed as the new strain of the virus has sent cases rocketing again. So now the choice is: mass lockdown or mass vaccination.

The UK government is ramping up vaccination, and this is excellent news. There is acceptance that the only constraint should be the supply of vaccines. This paper shows what the path back to normality might look like and the difference that accelerating the vaccination programme would make.

It is this which is imposing huge urgency and a scramble for vaccines worldwide. The faster we vaccinate, the sooner we end lockdown and prevent further mutations.

Tony Blair
Executive Chairman

Summary

The new variant of Covid-19, first identified in south-east England, means that tough lockdown restrictions are required to keep the virus under control until vaccines are widely rolled out. We can already see that these measures are working to slow the spread of the virus. But the economic, social and other health impacts of these restrictions are severe.

The NHS is on track to vaccinate some 14 million of the most vulnerable people by mid-February, at a rate of around 300,000 per day. This is a hugely impressive achievement. The UK is already distributing vaccines faster than almost anywhere else in the world. The government aims to have offered the vaccine to all adults by September.

But indications from manufacturers and performance in some other countries suggest that it will soon be possible substantially to increase the pace of vaccination. TBI has proposed an accelerated rollout plan to average 500,000 vaccines per day in February, rising to a rate of 600,000 per day in March.

This paper maps out paths back to normality under both current and accelerated vaccine rollout plans. Our analysis is not intended as criticism of the programme to date, but an illustration of the prize if we succeed in speeding up that distribution. The study is based on an open source spreadsheet model – the TBI Total Covid Cost model – that links the spread of the virus to the performance of the economy.

The return to normality will happen in stages. We find that the pace of vaccine rollout makes only a limited difference to the decision about when the current lockdown could be lifted. On reasonable assumptions, the country could move back to Tier 3 restrictions in late February under accelerated rollout, compared to the start of March under the current schedule.

Subsequent steps in easing restrictions depend much more on the pace of vaccination. The move from Tier 3 to Tier 1 restrictions, similar to those in force in September, could be made at the start of June on the government's current plan, but as soon as early April on the accelerated one. Finally, we may see most remaining restrictions lifted only in late September on current plans, by which time around 70 per cent of the population would have been vaccinated. But this milestone could be brought forward to mid-May under accelerated rollout.

Over the course of 2021, the accelerated rollout scenario could save 3,000 more lives and around £50 billion in lost economic activity, as well as bringing forward a return to normal life by several months.

	Current plans	Accelerated scenario
End lockdown, move to Tier 3	1 March	27 February
Tier 1	1 June	7 April
Lift almost all restrictions	23 September	15 May
Deaths in 2021	40,000	37,000
Cases in 2021	5.4 million	4.6 million
GDP loss	£116 billion	£68 billion

Introduction

At the start of December, it was widely hoped that the second lockdown in November had been sufficient to break the second wave of the Covid-19 pandemic in the UK and see us through to the spring and the arrival of newly approved vaccines. But by Christmas those hopes had been dashed.

The new strain of the virus – labelled a "Variant of Concern" by Public Health England in December – appears to be substantially more infectious than conventional variants. As a result, the pre-existing restrictions quickly became inadequate to control the virus and the new strain came to dominate.

This is a blow for the country for several reasons. Most obviously, the reported daily death toll from Covid-19 has tragically exceeded levels seen during the first wave of the pandemic. To turn that around demanded the imposition of a trying third lockdown from the start of the new year – this time involving the closure of schools, with severe consequences for children's education, the wider population's mental health and millions of people's livelihoods.

To add insult to injury, the greater transmissibility of the new strain means that vaccine coverage needs to be substantially higher than would have been the case with the original strain before the epidemic can be brought to an end. This, together with the explosion in cases, pushes back the date at which life can start to get back to normal.

In the depths of January lockdown, the question everyone wants an answer to is: When can we get back to something resembling normal life? Normalisation and easing of restrictions will happen in phases. But how quickly will those phases occur? How dependent is the timetable on vaccine rollout? And what are the likely health and economic costs in the meantime?

This report uses the TBI Total Covid Cost Model, bringing together the economic and health aspects of the pandemic, to simulate how the spread of the virus interacts with the economy, and to model how immunity – whether from past infections or vaccines – might slow the spread of the virus and allow restrictions to be eased.

This model is informed by the latest understanding of both the new UK strain of the virus and the effectiveness of vaccination and past infection on transmissibility. Here we use it to explore when we might see restrictions lifted, given the government's planned speed of vaccination of around 300,000 per day and all adults offered a jab by September.

This pace of rollout is an impressive operational achievement by the NHS. But the economic, social and health damage being done by the restrictions required to keep the new strain of the virus under control is severe. So we should, if rates of supply allow, do everything possible to speed up the programme.

TBI has outlined a plan for an accelerated vaccine rollout averaging some 500,000 per day in February and 600,000 in March. Our discussions with manufacturers suggest that production at these rates may be achievable within weeks. On distribution, Israel has shown what is possible, vaccinating 1 per cent of its population every day since the start of 2021 – equivalent to almost 700,000 per day for the UK. In this report we quantify how much more quickly society would be able to return to normal under this plan, and the associated economic and health benefits.

What Do We Know About the Disease?

In recent weeks we have learned a number of things about the virus and its interaction with the economy that inform the question of how long it will take, for any given pace of vaccine rollout, before social-distancing restrictions can be eased.

- **The new UK strain of Covid-19 is substantially more infectious than the original variants.** Research from Imperial College has suggested that it has an associated R number between 0.4 and 0.7 higher – approximately 50 per cent more infectious. This means that, as Professor Neil Ferguson has pointed out, we might expect measures as stringent as the spring lockdown, which pushed the R number down to around 0.6, to get the R number for the new strain of the virus down to 0.9. By extension, while September-style Tier 1 restriction achieved an R number of around 1.4, the same measures might achieve an R of around 2.1 with the new variant.
- **Vaccination or past infection reduces transmission substantially.** Early evidence from vaccine rollout in Israel suggests that at least half of vaccinated people not only avoid becoming symptomatic but also do not even contract the virus, suggesting that vaccines substantially reduce transmission. Meanwhile a Public Health England study has shown that the large majority of people who have been previously infected are not vulnerable to reinfection for at least a number of months, even if they are not 100 per cent immune.
- **Multiple new variants of the virus have been identified around the world.** It is currently unclear to what extent the above findings hold for some of the most concerning new strains, such as the one identified in Brazil.
- **The government plans to vaccinate around 14 million of the most vulnerable people by 15 February.** 1 million first-dose vaccinations had been administered as of 17 January, and the latest daily rate is around 300,000. This suggests the government is broadly on course to meet its February target.
- **November's lockdown was significantly less economically damaging than the spring lockdown.** The Office for National Statistics estimates that GDP ran at 91 per cent of its January 2020 rate during the month of November, compared to just 75 per cent in April. The impact of the latest lockdown is likely to be more severe than November's since the restrictions are tighter, particularly with most educational settings closed.
- **Government-imposed restrictions are not the only thing that reduce economic activity.** Numerous studies since the start of the pandemic suggest that as the prevalence of the virus increases, people voluntarily restrict their contact with others out of fear, hampering economic activity. This means that allowing the virus to spread unchecked causes economic damage, and early intervention to prevent the virus spreading is likely to minimise economic costs.

With the prospect of vaccination bringing the epidemic to an end within a matter of months, this understanding suggests that the optimal strategy is to maintain restrictions sufficiently tough to keep the

virus under control. Measures can therefore be eased only as the rising degree of immunity allows. While the measures required to prevent the new strain from accelerating have substantial economic costs, it is likely that a more laissez-faire approach would also have very high economic costs alongside unacceptable consequences for public health.

Modelling the Costs and Benefits

Getting back to normality isn't just about lifting government-imposed restrictions on activity and social mixing. People also need to feel confident that they or their loved ones are not at risk of becoming seriously ill from the disease before they will be willing to return to normality. The rapid bounceback of activity in countries like Australia and New Zealand demonstrates the economic dividend from controlling the virus. Assessing the true economic costs of maintaining restrictions while the vaccine is rolled out must therefore take account of how people's fear of the virus would impinge on economic activity in the absence of any restrictions.

Several previous attempts to study the costs and benefits of Covid-19 restrictions have arrived at an incomplete economic assessment by omitting the impact of fear-driven voluntary social distancing from their assessment of scenarios where the government takes no or reduced action. A comprehensive comparison needs to take account not only of how restrictions reduce economic activity, but also how fear of the virus leads to voluntary social distancing that means economic costs mount if the virus is not contained.

The relationship between people's fear of the virus, its prevalence and the consequences for the economy are complex and probably changing all the time. Nevertheless, studies from the first lockdown allow us to make broad judgements, suggesting that during the early months of the pandemic, people's fear of the virus would have had a significant negative impact on economic activity even in the absence of any restrictions. The IMF, for example, has estimated that in advanced economies more than half of the reduction in mobility was voluntary rather than caused by government restrictions.

The TBI Total Covid Cost model seeks to simulate the spread of the virus under different levels of restrictions and relate that to the level of economic activity based on a mixture of data and research into these relationships from the first nine months of the pandemic. Quantifying the relationships between the prevalence of the virus and the impact of fear on the economy is obviously very difficult in a complex and fast-moving environment. The relationships between variables are highly uncertain because there are many moving parts, hence any forecast relies heavily on judgement. Our open-source model is available to download here for users to explore the impact of making different assumptions to those used here.

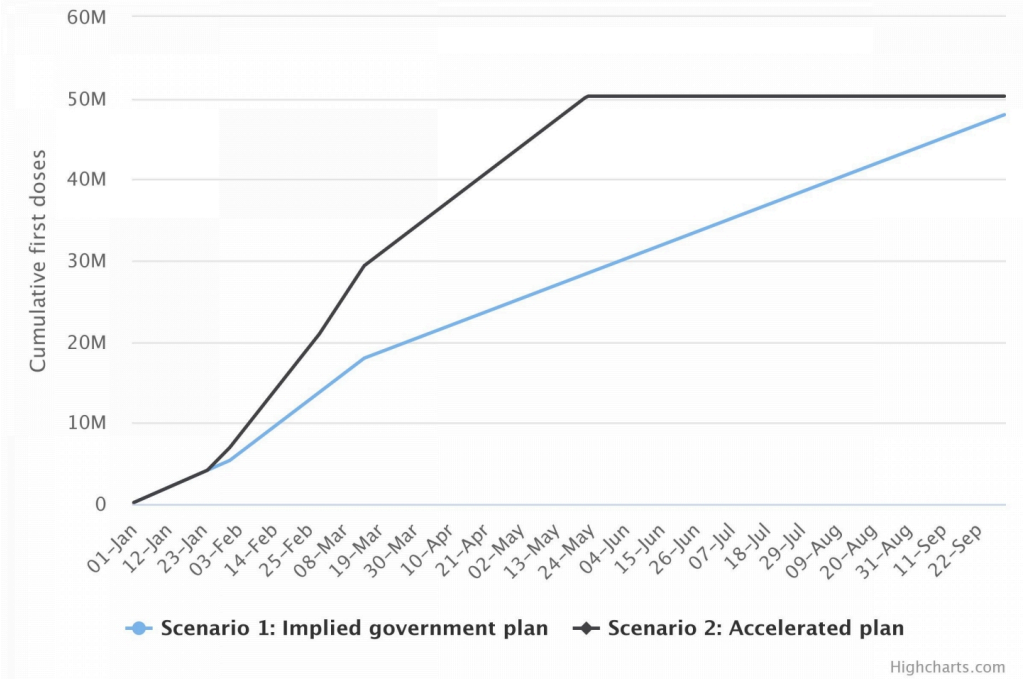
The spread of the virus is simulated using a simple SIR spreadsheet model. Vaccines and past infections therefore slow the rate of spread of the virus for any given level of policy restrictions. We assume that:

- Infection confers immunity and prevents transmission in full for six months.
- Vaccination prevents infection and transmission in 90 per cent of cases after three weeks.
- All vaccinations require two doses, but one dose is sufficient to confer immunity for at least three

months.

- Second doses begin to be delivered in mid-March, which reduces the capacity available to deliver first doses. Accordingly, under the planned rollout, with initial daily capacity of 300,000 doses daily, we assume that only 150,000 first doses are administered per day from mid-March, as earlier recipients start to require their boosters. This creates a rollout profile that is consistent with the timetable outlined by the Foreign Secretary for every adult to have been offered the vaccine by September. Under the accelerated rollout scenario, daily first doses slow to 300,000 per day from mid-March. The path of cumulative first doses administered under each scenario is illustrated in Figure 1.

Figure 1 – Assumed cumulative first doses



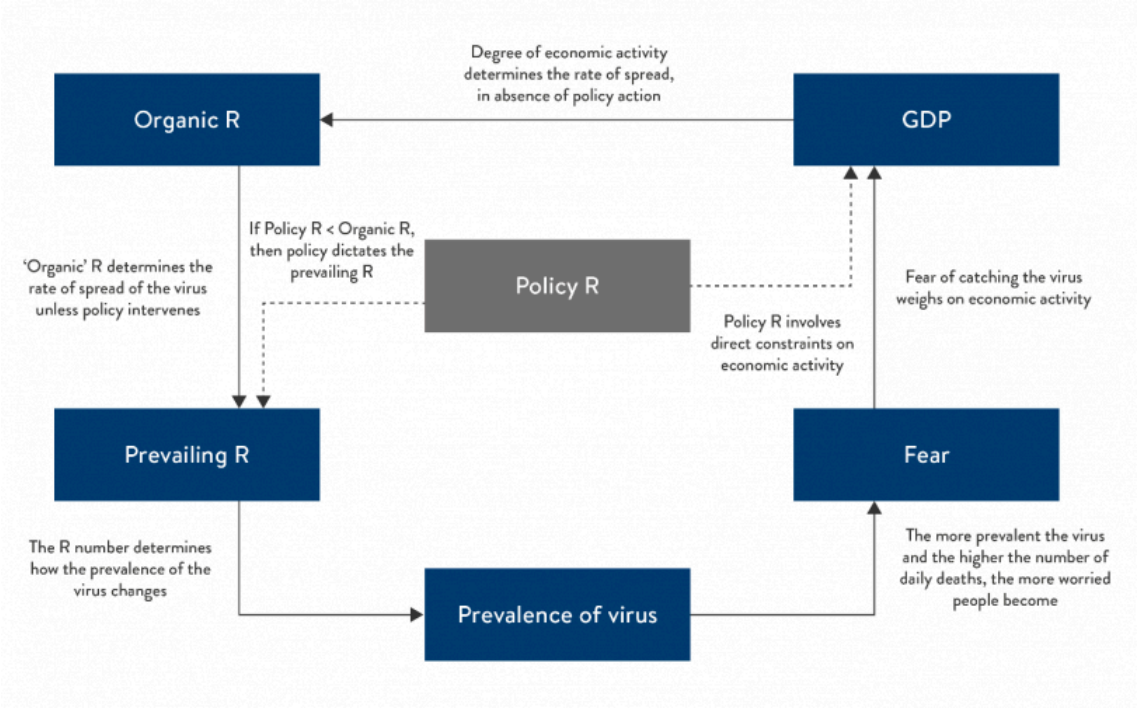
Note: Assumes maximum vaccine coverage is 75% of the population

- Vaccination reduces the infection fatality rate (IFR) linearly from an average of 0.75 per cent as the most vulnerable 15 million people are vaccinated. Thereafter, partly due to less-than-complete coverage of the most vulnerable people, we assume the IFR remains at 0.1 per cent. This is broadly in line with the findings from a recent report by the Covid-19 Actuaries Response Group.
- Every infected person is assumed to be equally likely to transmit the virus. To the extent that older people – the first to be vaccinated – have less social contact, this may overstate the effectiveness of the early stage of vaccine rollout in reducing transmission.

In the model, economic activity is affected both by policy restrictions (a relationship drawn from monthly ONS GDP estimates and government estimates of the prevailing R number) and by the fear factor described above (see Figure 2, below). We assume that, in line with the GDP reduction in the first lockdown and the IMF analysis, that voluntary social distancing is sufficient to reduce economic activity

compared to January 2020 by around 8 per cent when daily deaths hit 100, and 12 per cent at 1,000 per day. Further details of the assumptions and sources are available within the spreadsheet.

Figure 2 – How the fear factor affects GDP and the R number in the absence of policy restrictions



Model Inputs

For the purpose of this report, results are given for the full 2021 calendar year. To simulate the progress of the virus over the course of the year, we assume that the government plans gradually to ease restrictions in three steps:

- Step 1: Lifting the lockdown and reverting to Tier 3, with schools open but non-essential retail closed. [1]
- Step 2: Moving from Tier 3 to Tier 1, similar to September-style restrictions, with non-essential retail open and hospitality open but subject to restrictions. [2]
- Step 3: Near-full normalisation, perhaps excluding large events. [3]

In determining the timing of these steps we assume the government plans to maintain the current lockdown until the vaccine is sufficiently widely rolled out, and the virus prevalence low enough, that lifting it will not result in any significant increase in deaths, and daily case numbers no higher than seen in the autumn. Specifically, Step 1 is triggered after daily new cases fall below 20,000 and Step 2 when daily new cases are no more than 5,000 (note this is all cases, including asymptomatic ones and those that go undiagnosed, not just daily positive test numbers, which tend to be around half of the true total). Step 3 occurs only once around 70 per cent of the population has been vaccinated. Assumed effective R numbers associated with different levels of restrictions, and the associated economic activity, are shown in Figure 3.

We then use the model to construct two easing scenarios that are broadly similar in terms of case numbers and deaths across the year, one based on the government's planned pace of rollout (initially around 300,000 vaccines per day) and a second based on the faster rollout plan that TBI has proposed (500,000 vaccines per day in February, rising to around 600,000 per day in March). This allows us to see how soon it may be possible to lift restrictions.

Figure 3 – Model inputs and assumptions on impact of restrictions on the spread of the virus and economic activity

Period	Measures	R for original variant	R in January for new variant	GDP reduction[4]
April 2020	Lockdown 1	0.7[1]		-25%
September 2020	Tier 1	1.4[1]		-7%
November 2020	Lockdown 2	0.9[1]		-9%
December 2020	Tier 3	0.9[2]	1.4[3]	-7%
January 2021	Lockdown 3	0.7[2]	0.9	-15%
March 2021?	Tier 3		1.4	-7%
Spring/Summer 2021?	Tier 1		2.1	-5%

Notes:

1. Assumption based on gov.uk and Cambridge MRC Biostatistics Unit

2. Assumption based on Imperial finding of 50% more transmissibility of new vs old strain

3. ONS Covid-19 Infection Survey, in December approximately 44% of cases were new VOC, while overall R was around 1.2

4. ONS monthly GDP estimates or assumptions based on past ONS estimates and prevailing restrictions

Findings

The evolution of daily new cases and Covid-19 deaths under each scenario, and the timing of the steps, are shown in Figures 4 and 5 below.

Step 1: Lifting lockdown

Under the implied government plans, the simulation suggests that the current lockdown would need to continue until the start of March, by which time new case numbers might be less than a quarter of their level at the start of the year. Daily deaths are projected to fall below 100 in the second half of March as the most vulnerable groups are protected and cases fall.

The accelerated rollout scenario – with daily vaccinations increasing to around 600,000 per day in March – makes only a limited difference to when lockdown could be lifted. The simulation suggests it could happen at the end of February, with cases and deaths brought down slightly more rapidly.

Step 2: Easing to Tier 1

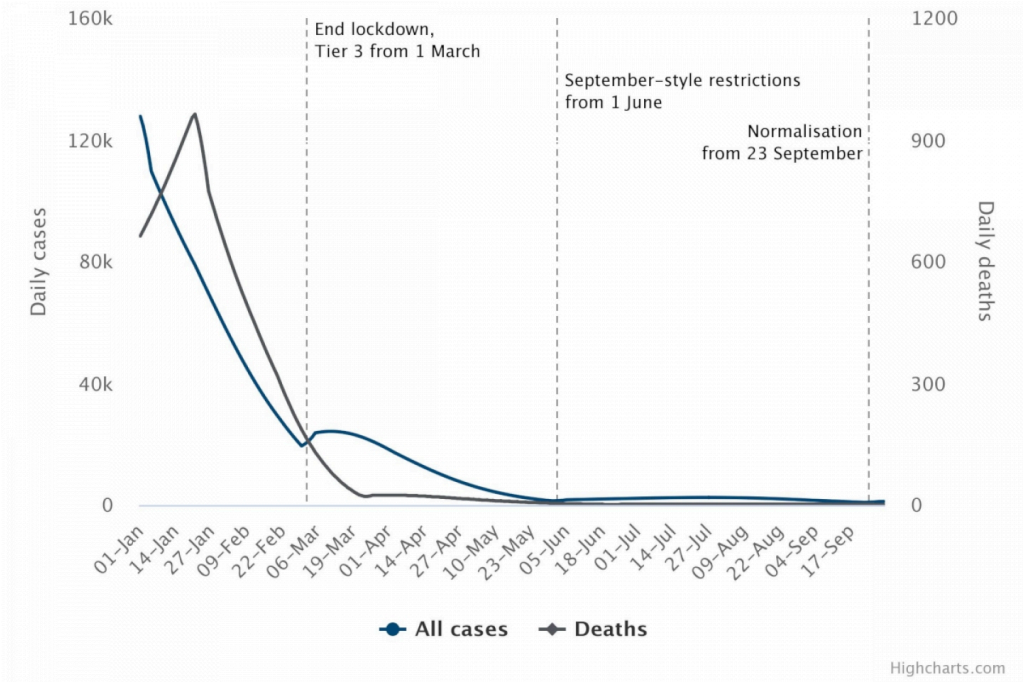
Once lockdown measures are lifted, the country would remain under tough Tier 3 restrictions. Step 2 would entail returning to the relatively light-touch restrictions that the country saw back in September. Under the 300,000 daily vaccines scenario, we estimate this move from Tier 3 to Tier 1 could happen at the start of June, with daily positive test numbers by that point running below the level they were in September and a low rate of daily deaths. Under the accelerated rollout scenario, however, the move to Tier 1 could be brought forward by several weeks, to early April.

Step 3: Near-full normalisation

The model suggests that we could expect largely to return to normal only by late September, on the current rollout schedule. However, the accelerated schedule may allow normalisation to be brought forward to the middle of May.

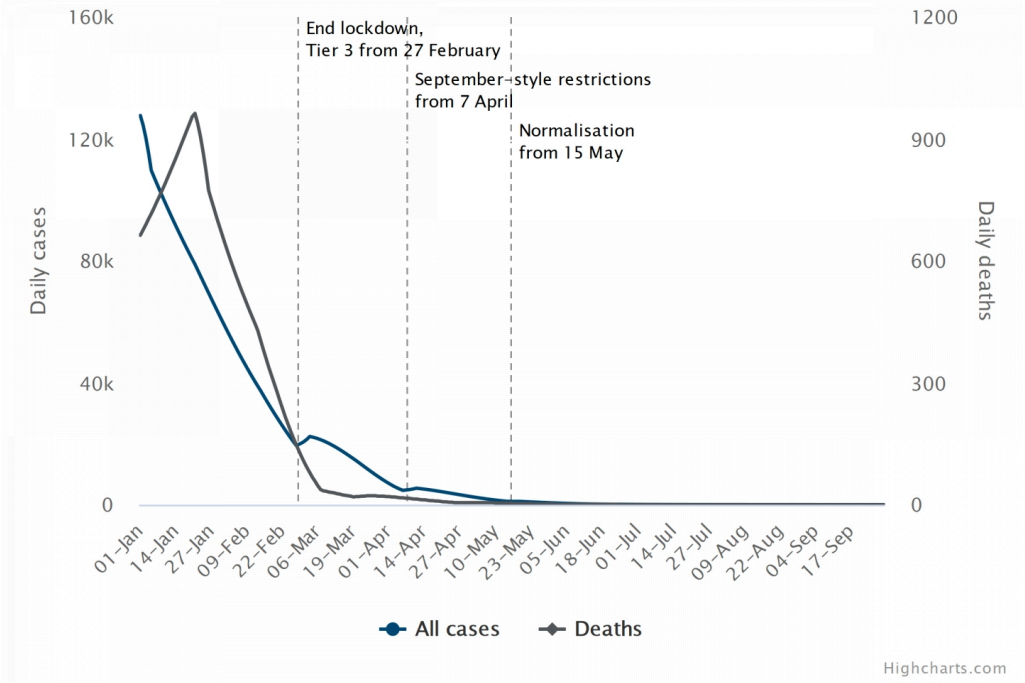
One reason why somewhat faster rollout accelerates normalisation so much is that from the spring onwards vaccination capacity gets increasingly used up for delivering second doses. Continuing to expand capacity quickly can therefore have a disproportionate impact on the rate at which the population receives first doses.

Figure 4 – UK cases and deaths based on implied government plan



Note: Cases include asymptomatic and undiagnosed. For reference: ONS community infections in England averaged 25,700 in week to 28 November while diagnosed cases were 14,520.

Figure 5 – UK cases and deaths based on accelerated rollout



Note: Cases include asymptomatic and undiagnosed. For reference: ONS community infections in England averaged 25,700 in week to 28 November while diagnosed cases were 14,520.

Health and Economic Consequences Compared

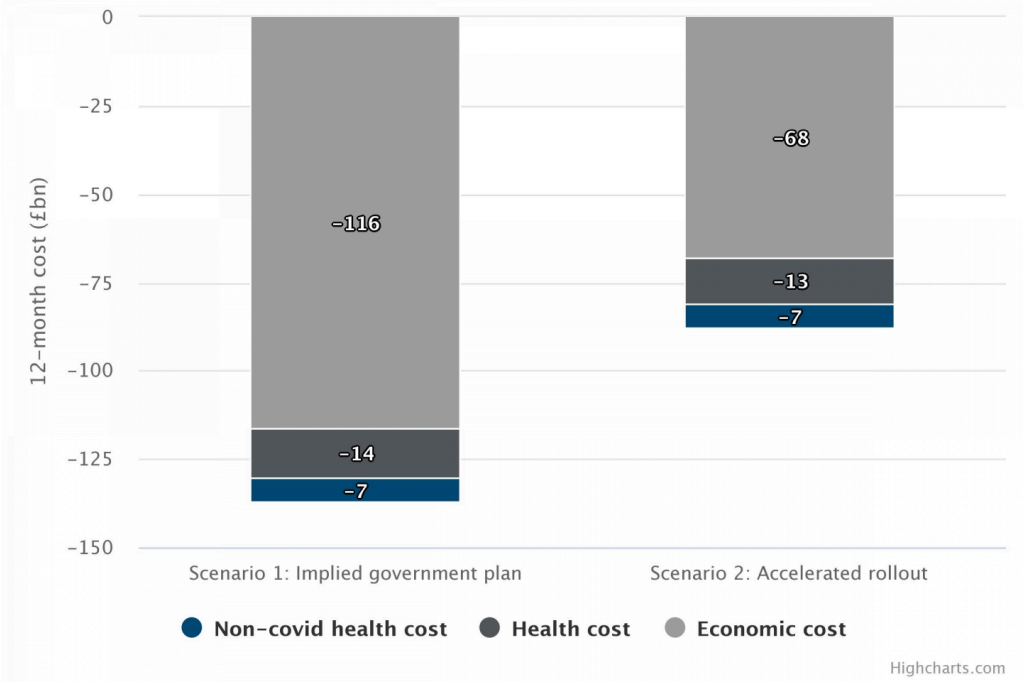
Both scenarios entail substantial costs in terms of lives lost to Covid-19 and lost economic activity, but the accelerated rollout scenario is substantially less costly. In both scenarios the large majority of Covid-19 deaths in 2021 take place in January and February. Under the government's implied rollout plan, the total number of Covid-19 deaths for the year reaches around 40,000 on the easing timetable given here, and we can expect to see a total of around 5.4 million cases. This is reduced to 37,000 deaths under accelerated rollout, with around 4.6 million cases. Monetised values of the health outcomes in each scenario are shown in Figure 6, based on assumptions detailed in the spreadsheet.

	Current plans	**Accelerated scenario**
End lockdown, move to Tier 3	1 March	27 February
Tier 1	1 June	7 April
Lift almost all restrictions	23 September	15 May
Deaths in 2021	40,000	37,000
Cases in 2021	5.4 million	4.6 million
GDP loss	£116 billion	£68 billion

The earlier lifting of restrictions afforded by accelerated rollout substantially reduces the economic consequences of the virus across the year. Under the easing timetable associated with the implied

government plan, total lost GDP for the year is estimated at around £120 billion, while under rapid rollout the total GDP cost is reduced by £50 billion.

Figure 6 – Total Covid-19 cost breakdown for 2021, under current and accelerated rollout plans



Conclusion

The scenarios developed here suggest that, barring new strains of the virus, life could be largely back to normal by September under the government's current plans for vaccine distribution. But normality could return in May under TBI's accelerated vaccine rollout plan. The economic benefits of accelerating rollout are significant since it would mean being able to lift heavy restrictions sooner.

The modelling exercise reported here is inevitably speculative and contingent on many assumptions. While the absolute numbers should be treated as only indicative, comparisons between the scenarios and the pace of normalisation are informative.

The speed of vaccine rollout to date has been unprecedented. But with rates of manufacture set to grow rapidly in coming weeks, this analysis shows just how much there is to gain if we can be ready for accelerated rollout.

Footnotes

1. ^ Tier 3 is assumed to be consistent with an R number at the start of January of 1.4. Once immunity levels are higher the effective R will of course fall.
2. ^ Tier 1 is assumed to be consistent with an R number in early January of 2.1.
3. ^ Normalisation is assumed to be consistent with an R number in early January of 3.

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