London Work, Travel, Convene Coalition

Preparedness: COVID-19 and Pandemic Modelling

January 2021

Aon
Empower Results®

"It is important to bear in mind that the virus is exceptionally difficult to suppress and will continue to spread unless the restrictions on social mixing and other countermeasures such as contact tracing are adequate. The virus is blind to what time a pub closes and whether patrons are served a substantial meal or not. The virus is indifferent to such considerations and does not bend to the will of the people. When we came out of lockdown in the summer, it was always going to come back, and the experience of the Southern Hemisphere demonstrated how challenging our autumn and winter would be."

James Robinson, PhD, COVID-19 Pandemic Modelling Analyst

Important metrics obscured

Important metrics, such as the proportion of infected people requiring hospitalisation, have been obscured by incomplete data, confusing our perception of the current and future threat of COVID-19

People requiring hospitalisation

The number of people requiring hospitalisation remains the principal risk posed by COVID-19

2–3%

The hospitalisation rate of the estimated infections has not changed dramatically through time, with around **2-3%** of infected individuals requiring hospital treatment

Warming climate will reduce the R value

The impact of a warming climate will reduce the R value for any given set of social mixing restrictions and other precautions in place

How does modelling help us better understand the consequences of COVID-19?

Public perception of COVID-19's unfolding events is primarily based upon what is reported by the media, which is founded upon an incomplete picture of transmission since the detection rates of infections have been both low and variable through time. Many important metrics, such as the proportion of infected people who require hospitalisation, or unfortunately die, have become obscured by the incomplete data, confusing the current and future threat of COVID-19. Modelling COVID-19 provides a forensic analysis of past events, improving our understanding of the present and our ability to predict the future.

How important is a worldview when constructing a model?

Although each country's experience of COVID-19 is unique, there are both many similarities and important differences, which can be used to help us build a robust model. Indeed, a near-complete model for the number of infections, hospitalisation and deaths arising from COVID-19 was constructed in February 2020, based upon the emerging outbreak in Asian countries.

A comparison across countries allowed us to identify key characteristics of COVID-19 as early as the end of February 2020:

- **In the absence of containment policies, the R value was similar across territories (in similar climatic settings)**
- **The principal impact of COVID-19, which would drive government policy, was the proportion of infected people who would require hospital treatment**
- **Major outbreaks were underway in Europe and would require lockdowns to bring them under control.**

By quantifying the progression in each country – for example, the R value that is achieved at any point in time – and matching it to containment policies, we were able to form an initial view of the threat of COVID-19 and the magnitude of effort required to suppress its spread.

Daily confirmed cases (rest of Mainland China)

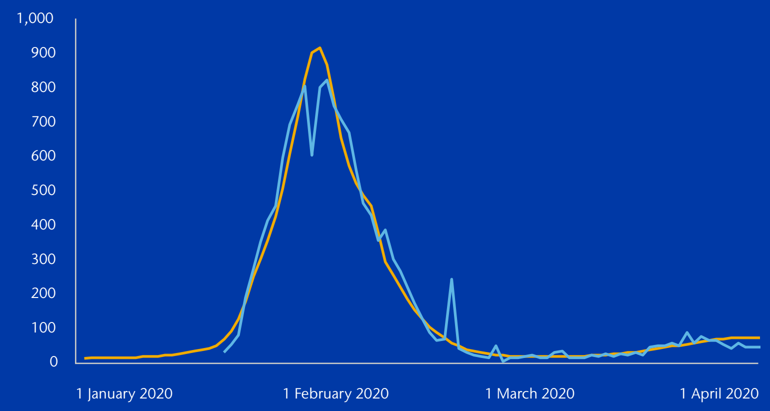

Figure 1: **Reported daily confirmed cases (blue)** versus **model (orange)** for mainland China excluding Hubei province. The fitting of the model to the reported cases in China was the basis of the model used in other countries as the virus spread worldwide.

Concurrent serious cases (Hubei)

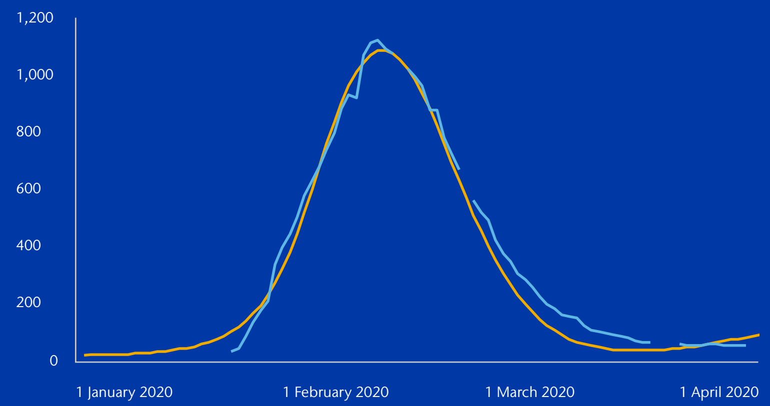

Figure 2: **Reported number of inpatients in a serious condition (blue)** versus **model (orange)** for mainland China excluding Hubei province. The large proportion of cases, which progressed to severe disease was an early demonstration of the threat the virus would pose to healthcare systems worldwide.

How can we better understand the impact of climate on COVID-19?

Quantifying the impact of climate on communicable diseases is known to be extremely complex. For example, we know that climate impacts seasonal influenza. Yet, it is still not clear how much each of the possible factors – such as temperature, humidity, UV, human behaviour – contribute to the effect. However, from early on in the COVID-19 pandemic, there were clear indications of the impact of climate such as:

- **A difference in the northern and southern US states**
- **Lower transmission rates in equatorial countries**
- **Outbreak clusters occurring in climate-controlled environments such as food processing plants**

Melbourne provided a clear warning for the UK

With the first wave of COVID-19 occurring in the Northern Hemisphere spring, it was the Southern Hemisphere where we anticipated first observing COVID-19 in a winter setting, which would serve as a precursor to understanding what challenges the UK would face in its winter. However, with only 10% of the world's population living in the Southern Hemisphere, and most of that population living in tropical or sub-tropical latitudes, there were limited opportunities to make credible observations in populations that experience a cold winter. The most important observation was Melbourne, which experienced a second wave in winter (Jun-Sep) 2020, which was far more challenging to contain than its first wave earlier in the year.

Melbourne's experience provided a clear warning of what was in store for the UK in late 2020, with the modelling predicting a significant second wave. Indeed the transmission of COVID-19 increased across Northern Hemisphere countries as soon as temperatures began to cool at the end of summer. Unfortunately, this adverse impact is highly likely to persist whilst temperatures continue to cool in early 2021, and we may not see a significant shift until the climate becomes milder later in the spring.

Daily deaths (Australia)

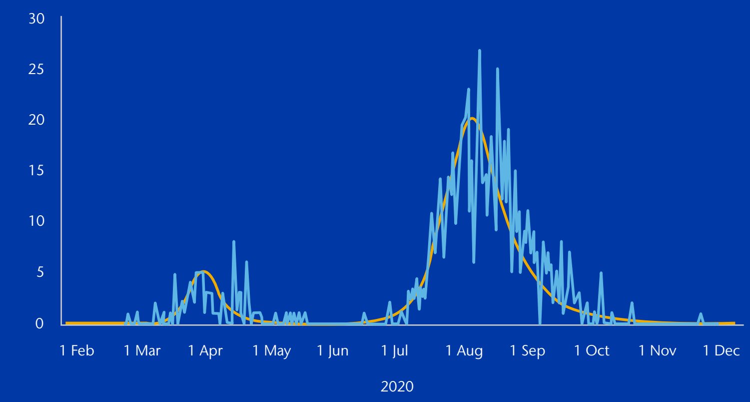

Figure 3: **Reported daily deaths (blue)** versus **model (orange)** for Australia showing the challenge of keeping the most vulnerable in society shielded, especially during winter.

Daily confirmed cases (Australia)

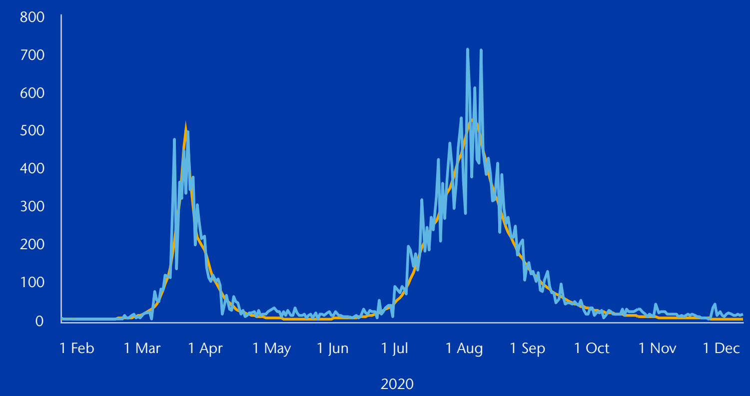

Figure 4: **Reported daily confirmed cases (blue)** versus **model (orange)** for Australia showing the second wave, in the Australian winter, was harder to contain than the first wave.

How should we interpret changing hospitalisation and mortality rates?

One of the biggest challenges in understanding the risk that COVID-19 poses to individuals is correctly assessing the proportion of infected people who are hospitalised, and the number who unfortunately die. These proportions in many countries, including the UK, were initially very high, but only by virtue of very low detection rates. Through the summer, as detection improved, these rates decreased rapidly. When combined with a change in the demographics of the infected towards younger ages, this produced decreasing hospitalisation and mortality rates, suggesting that COVID-19 was becoming less of an 'issue'. However, such optimism was misplaced since a deeper analysis of the demographic data showed that the rapid increase in the infection rates of younger demographics was predominantly a result of their detection rates at the start of the outbreak being particularly low.

Once the hospitalisation rate of confirmed cases is adjusted for the detection rate, the hospitalisation rate of *infections* has remained stable at around 2-3% cases since the first wave in March.

14-Day rolling CFR (England)

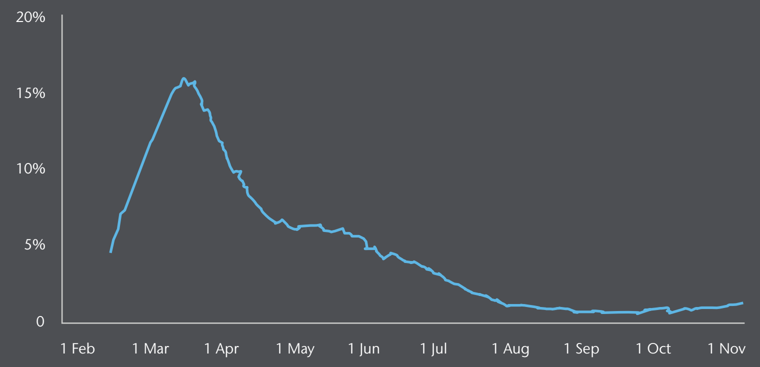

Figure 5: 14-day rolling average case fatality ratio (CFR) showing the significant reduction in the CFR in England through the summer.

Hospitalisation rates by age (England)

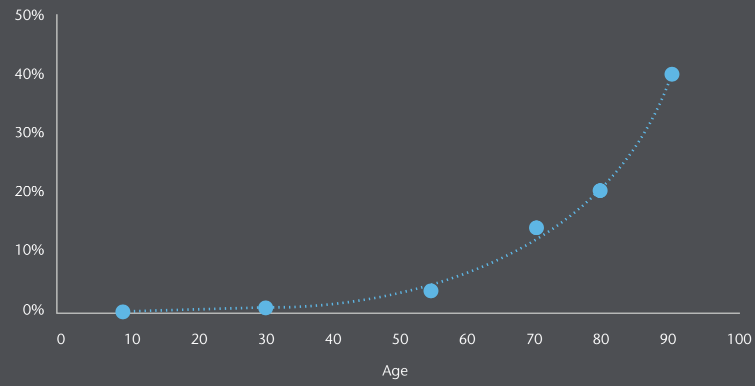

Figure 7: The estimated proportion of infections in England, which leads to hospitalisation by age. Older age groups are far more likely to be hospitalised.

Detection rate by age

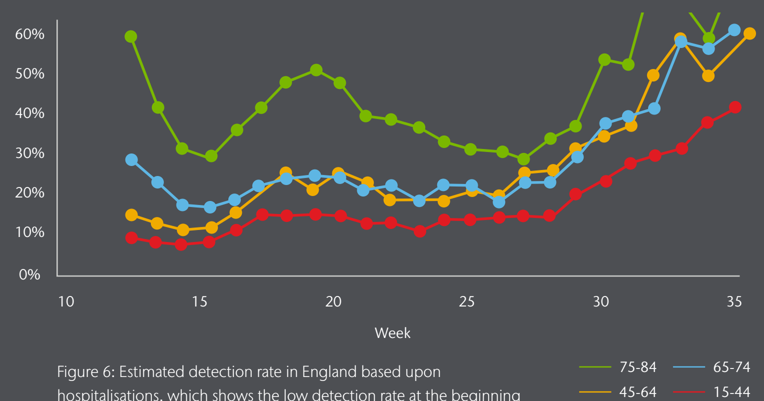

Figure 6: Estimated detection rate in England based upon hospitalisations, which shows the low detection rate at the beginning of the epidemic in England, especially for the younger age groups.

Hospitalisation rates (England)

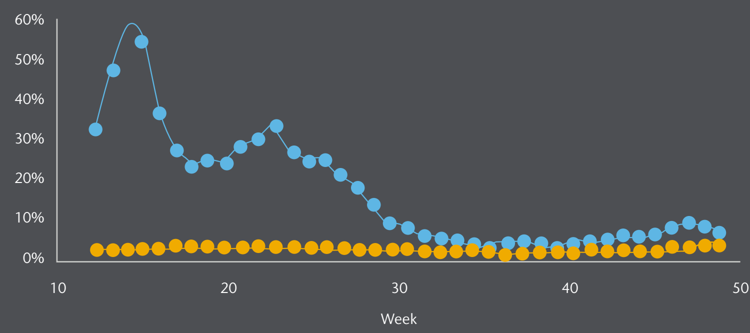

Figure 8: Comparison of the hospitalisation rates in England as measured by the percentage of **confirmed cases (blue)** and **estimated infections (orange)**. The latter has remained fairly consistent through the year, with only slight fluctuations reflecting modest changes in the average age of the infected.

How does the risk posed by COVID-19 compare to the first wave and why are the restrictions necessary?

The number of people requiring hospitalisation remains the principal risk posed by COVID-19. As shown in figure 8 overleaf, the hospitalisation rate of estimated infections has not changed dramatically over time. The level of infections in the UK remains very high, and in early January is at similar levels to the peak of the first wave (over 100,000 infections per day).

Generally, in both the UK and other countries experiencing major outbreaks, the restrictions on social mixing are necessarily increased as hospitals reach capacity. Without the current restrictions (as of January 2021) in the UK, hospitals would rapidly become overwhelmed, with the most severe restrictions (such as recent tiering systems and national lockdown) taking time to impact the number of admissions. As a result of the lag time between infection and the severe form of COVID-19 disease, the numbers of admissions continue to increase even after a lockdown is initiated.

How does the risk posed by COVID-19 compare to the first wave, and are the current restrictions necessary?

New variants, such as VUI 202012/01, serve to remind us that the virus continually mutates and that the new variants may possess different characteristics in terms of their threat, such as an increased transmissibility.

It is important to bear in mind that the virus is exceptionally difficult to suppress and will continue to spread unless the restrictions on social mixing and other countermeasures such as contact tracing are adequate. The virus is blind to what time a pub closes and whether patrons are served a substantial meal or not. The virus is indifferent to such considerations and does not bend to the will of the people. When we came out of lockdown in the summer, it was always going to come back, and the experience of the Southern Hemisphere demonstrated how challenging our autumn and winter would be.

Daily infections (England)

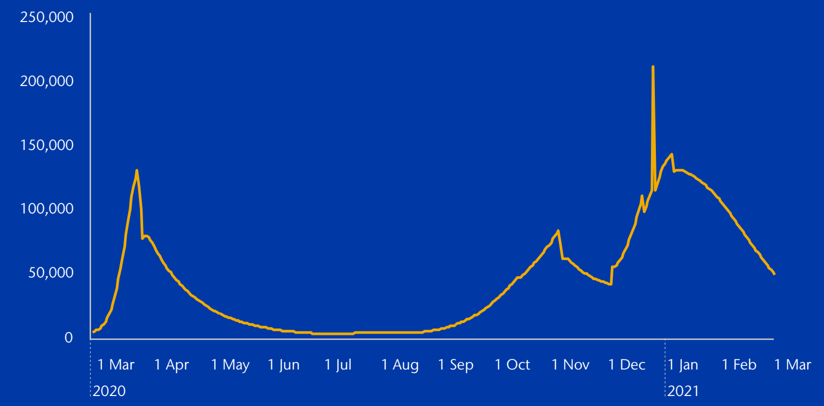

Figure 9: Model number of daily infections in England, which shows the numbers in the current wave are comparable to the peak of the first wave at the end of March 2020.

Daily hospital admissions (England)

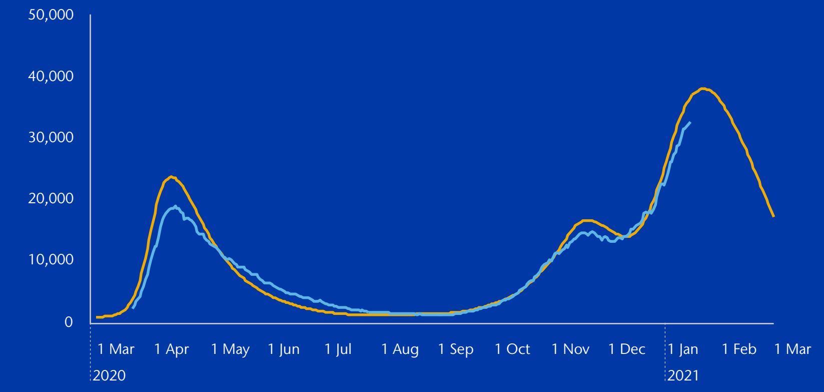

Figure 10: **Reported number of hospital inpatients (blue)** versus **model (orange)** in England showing the demand on the health system is greater in the current wave and that demand will likely stay high into March 2021.

% of confirmed cases VOC 202012/01 (England)

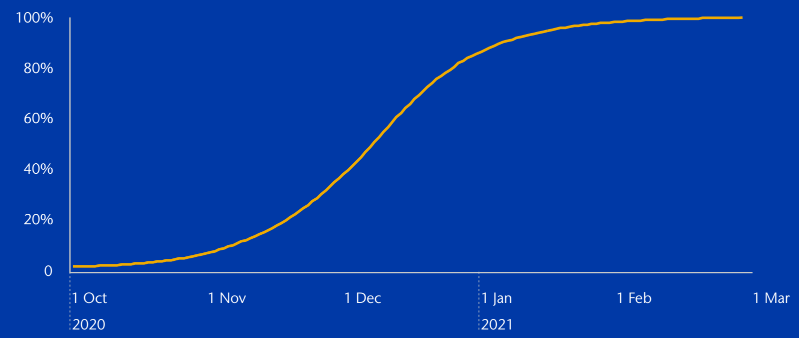

Figure 11: Modelled emergence of the UK variant VOC 202012/01, which went from being rare in mid-October to being dominant only 2 months later.

Number of infections by variant (England)

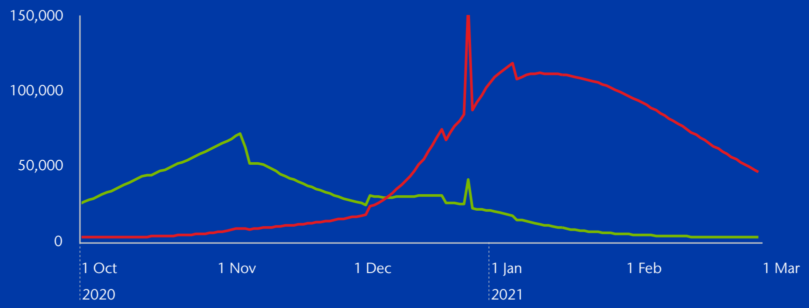

Figure 12: Modelled progression of the new (VOC 202012/01) and **old variants** in England, which shows how the tier system following the second national lockdown was sufficient to contain the old variants but could not contain the new variant.

What are the risks posed by new variants?

New variants, such as the 'UK variant' (VOC 202012/01), which are transmitted more easily, pose a particular danger in that we can no longer rely on previous containment regimes to suppress the virus adequately. Our modelling of the emergence of the new variant, which has quickly become the dominant variant in the UK in a matter of weeks, demonstrates that while the tier system in place after the end of the second lockdown in England was sufficient to keep the old variants contained, it was not sufficient to contain VOC 202012/01.

Thus, ultimately, a more restricted third lockdown, which included the closure of schools, was required. However, even this more restrictive lockdown, in the absence of vaccinations, would only be able to stabilise the infection rates and the number of hospital admissions, but not necessarily reduce them, at least not initially. Although the UK was unfortunate to see the emergence of such an easily transmitted variant, it is very fortunate that the emergence occurred at the same time as the mass availability of vaccines. Without this, the period we would have to remain in lockdown would likely be significantly longer.

New variants may also pose an additional risk in that the existing vaccines may offer less protection. However, quantification of that risk will take considerably more time and research than the more straightforward quantification of the impact on transmissibility.

How quickly may the situation improve in 2021?

Two major drivers will contribute to a rapidly improving situation in the UK in 2021:

- **Impact of a warming climate, which will reduce the R value for any given set of social mixing restrictions and other precautions in place**
- **Impact of the vaccination roll out programme, which will first reduce the impact of COVID-19 disease, such as the number of hospitalisations, and later a material impact on the level of transmission (i.e. a reducing R value). However, the potential for asymptomatic transmission is an important consideration and this will impact the return to 'normality'.**

The climatic effect may not be observable in countries with colder winters until temperatures start to rise from March onwards, with the full effect being observed later in the summer. The vaccine impact will be dependent on how quickly vaccines are rolled-out across a significant proportion of the population, the timing of which remains uncertain. However, as all current COVID-19 vaccines are non-sterilising, when a vaccinated person encounters COVID-19, they could still contract and transmit the virus, but will be asymptomatic. This has important and perhaps under-discussed consequences: mask wearing and social distancing will still be needed.

The vaccine is just one of our lines of defence against the virus, and no vaccine is expected to provide enough protection to stop COVID-19 from spreading between people altogether. Whilst the vaccine's rapid development and distribution is good news - we must recognise that no single intervention will stop the spread. A gradual return to normality therefore may not begin until well into 2021, and some restrictions are likely to remain in place for most of the year.

What is the London Work, Travel, Convene Coalition?

The London Work, Travel, Convene Coalition launched in September 2020. It brings together large employers in the City and Canary Wharf to share key learnings and insights related to planning and operations, to assess impact and measurement of efforts and to evaluate the latest technologies. The coalition's aim is to develop a set of guidelines to help navigate the challenges businesses face as society re-opens throughout the recovery phase of the COVID-19 pandemic.

Founding members of the coalition include, Accenture, Ashurst, Aviva, Clyde & Co, JLL, Legal & General and others. Member roles range from Chief Operating Officer, Director of People Services, Director of Employee Experience, and Future Workplace Director.

Other coalitions worldwide include Chicago and New York, Dublin, and Singapore.

If you would like to find out more about the coalition, please contact The London Work, Travel & Convene Coalition Team [LondonWTC@aon.co.uk]

About Aon

Aon plc (NYSE:AON) is a leading global professional services firm providing a broad range of risk, retirement and health solutions. Our 50,000 colleagues in 120 countries empower results for clients by using proprietary data and analytics to deliver insights that reduce volatility and improve performance.

Aon UK Limited, The Aon Centre, The Leadenhall Building, 122 Leadenhall Street, London, EC3V 4AN

AON

Empower Results®