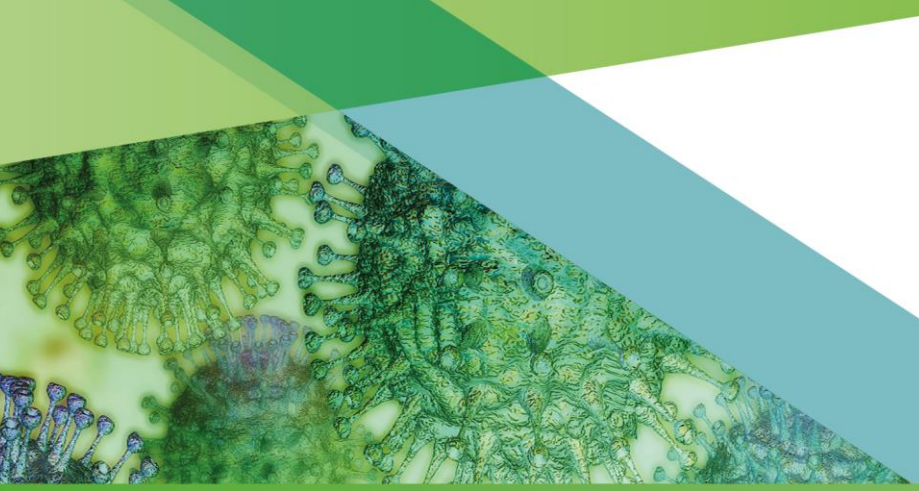

ECDC TECHNICAL REPORT

Integrated COVID-19 response in the vaccination era

1 February 2021

Executive summary

- Due to the emergence of more transmissible variants of SARS-CoV-2, it will be necessary to strengthen and maintain response measures in the coming months to avoid further rises in mortality, even in the context of a rapid, prioritised vaccination programme.
- Delays in vaccine procurement, distribution and administration would mean that non-pharmaceutical measures must be held in place for longer.
- In time, targeted and robust vaccination programmes will enable the lightening of non-pharmaceutical interventions.

Background

Roughly 19 million cases of COVID-19 and almost 450 000 associated deaths have been reported in the EU/EEA to date[1]. Until late 2020, the COVID-19 response focused on reducing transmission by minimising contact between infectious and susceptible individuals through measures such as stay-at-home recommendations and the use of face masks. However, a new response is now available: reducing susceptibility through vaccination. Previous analysis has shown that to minimise mortality and severe disease, it is essential to prioritise vaccination for those members of the community who are most likely to become seriously ill[2]. COVID-19 vaccines are being administered throughout the EU/EEA and supply and distribution will be ramped up in the coming weeks and months.

More than one novel, more transmissible variant of SARS-CoV-2 has recently been identified in the EU/EEA. These variants essentially reduce the effectiveness of response measures. However, they do not appear to alter clinical presentation, rate of disease progression or duration of infectiousness. As yet, it is unclear what proportion of incident COVID-19 cases are due to the novel variants but it is reasonable to expect that at least one of them will rapidly replace the previously predominant strain.

It had been hoped that the advent of the COVID-19 vaccination era would allow costly non-pharmaceutical interventions to be lifted. However, the emergence of the more transmissible variants means that the vaccination programme will be working against a stronger current.

[1] https://www.ecdc.europa.eu/en/covid-19-pandemic

[2] https://www.ecdc.europa.eu/en/publications-data/covid-19-vaccination-and-prioritisation-strategies-eueea

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Scope and objective

The purpose of this document is to provide an initial illustration of how the COVID-19 response could unfold in the vaccination era, given the emergence and replacement of the predominant strain with a novel, more transmissible variant.

Objectives

- To describe how SARS-CoV-2 transmission may increase as a result of the new variant(s).
- To predict the impact of easing non-pharmaceutical interventions (e.g. stay-at-home measures) as the COVID-19 vaccine is rolled out.
- To illustrate how delays in vaccine supply and administration could impact mortality and the lifting of non-pharmaceutical interventions.

Target audience

The target audience for this document includes public health institutes and professionals involved in COVID-19 vaccination planning, ministries of health and other decision-making bodies involved in the planning of COVID-19 vaccination campaigns at national and sub-national level.

Methods

This analysis was conducted using the ECDC COVID-19 dynamic transmission model, which has been adapted to include vaccination. In line with recent results from an observational study, we now assume that only 87% of individuals infected with SARS-CoV-2 naturally develop lasting immunity of an as yet undetermined duration[3].

In the baseline analysis, we assume that two doses of COVID-19 vaccine have a 90% efficacy in preventing clinical disease in adults of any age, 20% efficacy against infection in adults aged under 60 years and 10% in adults aged over 60 years. In an alternative scenario, we assume that the efficacy against clinical disease is lower, offering 80% protection for the under 60s and 70% for the over 60s. The efficacy against infection in this scenario remains unchanged. We assume that the efficacy of the vaccines against new emergent variants is the same as for the vaccine type. Lower efficacy against these variants would reduce both the direct and indirect protection offered by the vaccines and increase the need for non-pharmaceutical interventions.

We also model two scenarios for vaccine supply, distribution and administration. Our assumptions on vaccination coverage by age and over time are detailed in Annex 1. In the baseline analysis, we simulate a scenario where the coverage targets set by the European Commission in its Communication dated 19 January 2021 are achieved. That is, that by March 2021, Member States have vaccinated 80% of health and social care professionals and people over 80 years old and by August 2021, Member States have vaccinated 70% of the adult population of the EU/EEA. In the alternative scenario, we assume that 25% of vaccine doses are delayed by one month and 25% by two months. This delay may be caused by supply chain issues, logistics or recruitment; it is a composite delay in the administration of the vaccine to individuals. We simulate monthly rounds of vaccination, beginning on 15 January 2021.

In line with our previous findings that a prioritised vaccination programme will lead to the most rapid reduction in COVID-19 hospitalisations and mortality[4], we simulate the progressive prioritisation of adults aged 80 years and over, followed by healthcare workers, adults aged 70–79 years, 60–69 years and then all other adults. Since it may not be possible to vaccinate many adults for medical reasons, as a result of preference, or due to lack of access to healthcare, we assume that the maximum uptake achieved in healthcare workers and adults aged 80 years and over is 90%, in adults aged 60–79 years, 80%, and in younger adults, 70%.

We account for viral replacement with the novel, more transmissible SARS-CoV-2 strains in the calibration of the model to epidemiological data. The estimation of the effectiveness of a given response measure is decoupled on 7 December 2020 from its effectiveness before that date. We assume that a variant of SARS-CoV-2 with an increased transmissibility of 70% rapidly replaces the previous predominant strain, accounting for 25% of infections in the EU/EEA by the end of January 2021, and 100% of infections by the end of February 2021. A 70% increase in transmissibility of the virus is equivalent to a 40% reduction in the effectiveness of a given response measure.

[3] https://www.nature.com/articles/d41586-021-00071-6

[4] https://www.ecdc.europa.eu/en/publications-data/covid-19-vaccination-and-prioritisation-strategies-eueea

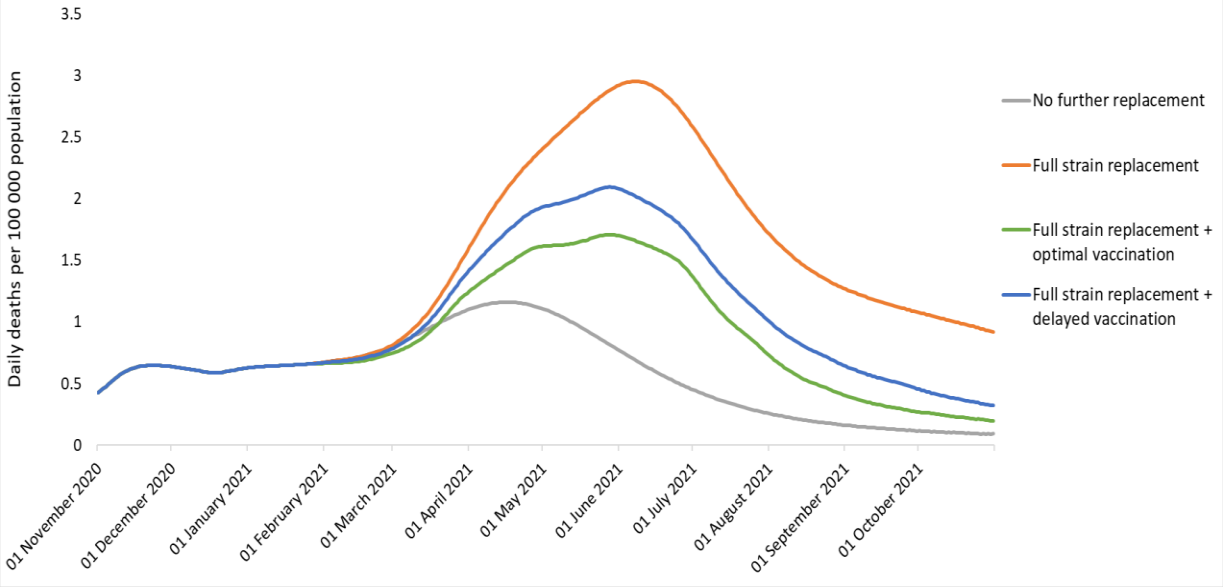
We simulate a strengthening of response measures on 1 February 2021, assuming that people resume behaviour observed during the strictest approach of 2020: 1 April 2020. We then simulate the lightening of these measures, to their current levels (28 January 2021), on 1 March 2021, 1 April 2021 and 1 May 2021.

To illustrate the impact of a combined vaccination and non-pharmaceutical intervention approach, we plot the number of deaths per 100 000 population in the EU/EEA over time. We do not include the United Kingdom.

Results

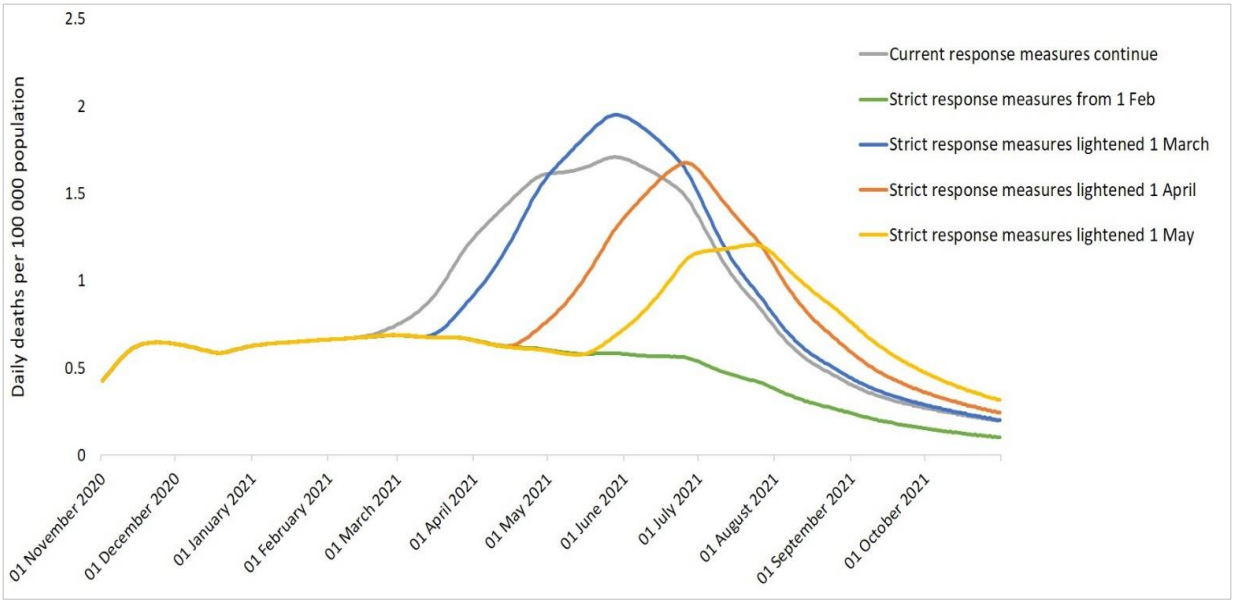
Our findings suggest that if a novel strain of SARS-CoV-2 with an increased transmissibility of 70% replaces the previously circulating strains in the EU/EEA by the end of February 2021, current non-pharmaceutical measures will not be sufficient to prevent a substantial increase in COVID-19 mortality, even as vaccines are being rolled out (Figure 1). If Member States achieve the vaccination targets set by the European Commission in its Communication dated 19 January 2021, the peak excess mortality rate due to the new strain will be approximately halved and the majority of excess deaths will be prevented. However, if 25% of doses are delayed by one month and 25% by two months, the impact of the vaccination programme will be substantially reduced.

Figure 1. Projected daily mortality rate in the EU/EEA, assuming no further replacement by more transmissible strains (grey) and no vaccination, complete replacement with a strain that is 70% more transmissible (orange) and the potential impact of an optimal (green) and delayed (blue) vaccination programme in mitigating the effect in the scenario of complete replacement. Current non-pharmaceutical interventions are maintained throughout the period.



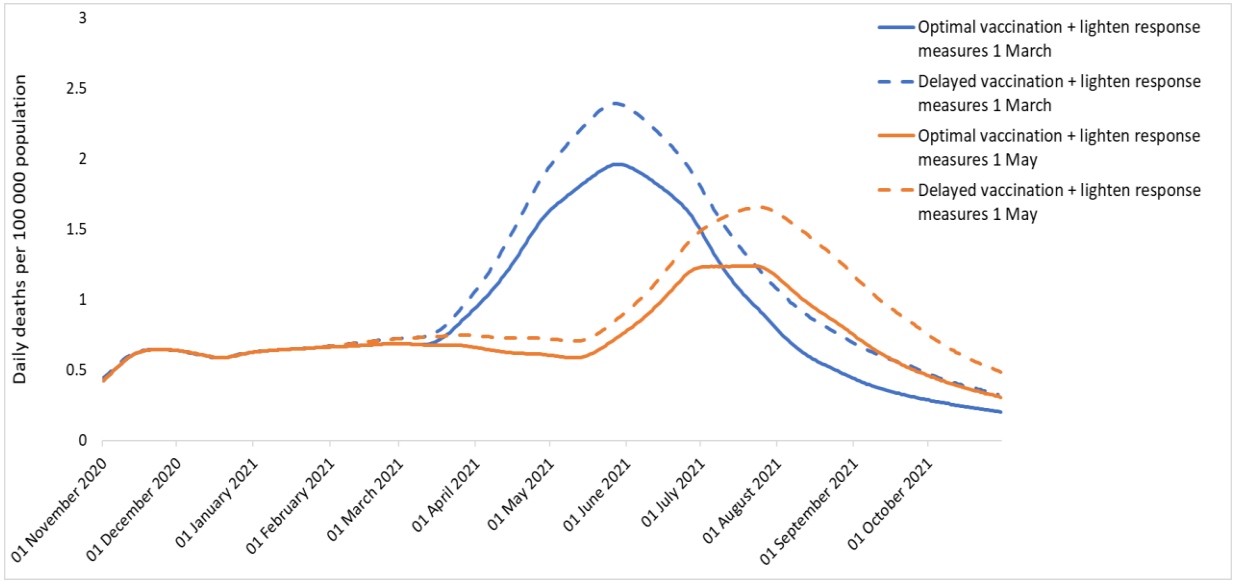
Given that an increase in mortality is predicted as a result of replacement with a more transmissible strain, we then simulated a heightened stringency of non-pharmaceutical interventions from 1 February 2021 (Figure 2). We assumed that people returned to their behaviour of 1 April 2020, which was the time when measures were strictest for the pandemic across Europe. We then simulate the lightening of these measures to 29 January 2021 levels on 1 March 2021, 1 April 2021 and 1 May 2021. Our findings suggest that strengthening non-pharmaceutical measures in February will prevent an increase in mortality associated with the more transmissible strain. As the vaccine is being distributed and administered, each additional month that the measures are kept in place will reduce both the peak mortality rate and the total number of deaths. Our findings suggest that there would be 10% fewer deaths in 2021 if measures were lifted on 1 April instead of 1 March, and 20% fewer deaths in 2021 if measures were lifted on 1 May instead of 1 March. When measures are lifted, the longer they have been maintained, the smaller the impact of resurgence will be.

Figure 2. The impact of lifting non-pharmaceutical interventions on COVID-19 mortality in light of the vaccination programme and replacement with a 70% more transmissible strain of SARS-CoV-2. Every month that stricter measures are kept in place reduces the peak mortality rate and the total number of deaths



If vaccine doses are delayed due to supply, procurement, distribution or administrative challenges, non-pharmaceutical interventions will need to be maintained for longer to mitigate the impact of replacement with more transmissible strains. Figure 3 illustrates the effect of vaccine delays with 25% of doses being delayed by one month and 25% by two months, in the context of different strategies to ease non-pharmaceutical measures. If non-pharmaceutical measures were lightened on 1 May 2021, approximately 30% more deaths would occur if vaccination had been delayed than if there had been an optimal vaccination programme.

Figure 3. The impact of delays to the COVID-19 vaccination programme on mortality, in light of the lifting of non-pharmaceutical interventions on 1 March 2021 (blue) or 1 May 2021 (orange)



Discussion

The emergence of new, more transmissible strains of SARS-CoV-2 will delay and limit the easing of non-pharmaceutical interventions that many had hoped would accompany the advent of the COVID-19 vaccination programme. To avoid an increase in COVID-19 mortality in the first half of 2021, it will be necessary to use both modes of response: reduction of social contacts and reduction of susceptibility through vaccination.

A targeted approach to vaccination, prioritising the groups at greatest risk of severe disease and death, will be the most effective way to prevent mortality and, in time, vaccination will minimise the impact of the virus so that non-pharmaceutical interventions can be eased. However, it is important to communicate that for at least several more months, it will be necessary to maintain stringent non-pharmaceutical interventions to prevent increased transmission, hospitalisation and death. Delays in vaccine procurement, distribution and administration will mean that non-pharmaceutical measures must be kept in place for longer.

In this analysis, we have made assumptions concerning the effectiveness of the vaccines in preventing infection and clinical disease in different population groups. In practice, estimating the impact of the vaccination programme (i.e. the overall reduction in infection and disease in the population) is challenging. The European COVID-19 vaccination programme uses multiple vaccines, which will have different levels of efficacy against different clinical endpoints (infection, mild disease, severe disease) in different age groups. Furthermore, since physical distancing measures vary among European Member States and regions, the exposure of the population to SARS-CoV-2 infections also differs. It is not uncommon for the vaccine effectiveness resulting from the implementation of vaccination programmes to not be as high as the vaccine efficacy measured in clinical trials under ideal experimental conditions.

We have also made assumptions about future vaccination coverage. In the scenario of limited vaccine supply, some Member States are considering vaccinating a higher number of individuals with one vaccine dose and delaying the second dose. This may have a negative impact on vaccination coverage if longer intervals lead to a loss of follow-up, where individuals do not return for a second dose. Coverage will also be affected by vaccine acceptance. Media reports suggesting that the effectiveness of the programme is not as high as hoped may lead individuals to feel that it is not worth being vaccinated. This may be a particular risk for younger, healthier adults who consider their individual risk of developing severe disease to be low.

In this report, we illustrate the dynamic trade-off between action aimed at reducing contact between infectious and susceptible individuals and action to reduce susceptibility - i.e. vaccination. However, we have not taken into account how behaviour may change as a result of the vaccination programme. It is possible that individuals may feel less at risk, either as a consequence of their own vaccination or the wider programme. This may lead to an increase in social mixing and a reduction in adherence to other infection control measures, such as hand-washing or the use of facemasks.

In summary, COVID-19 vaccination will, over time, enable the easing of non-pharmaceutical interventions. However, measures should be held in place for the months to come due to heightened transmission from new variants and uncertainty regarding the impact of the vaccination programme.

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Annex 1. Simulated vaccination programme

Baseline scenario (90% efficacy against clinical disease in all adults; 20% efficacy against infection in adults aged under 60 years, 10% efficacy in adults aged 60 years and over). Coverage by target group and by month. Proportions of age groups vaccinated refer to adults not in the healthcare worker group.

	January	February	March	April	May	June	July	August	September	October
80+	20%	50%	80%	90%	90%	90%	90%	90%	90%	90%
Healthcare workers	20%	50%	80%	90%	90%	90%	90%	90%	90%	90%
70-79	0%	0%	0%	20%	40%	70%	80%	80%	80%	80%
60-69	0%	0%	0%	0%	20%	40%	70%	80%	80%	80%
50-59	0%	0%	0%	0%	0%	20%	40%	70%	70%	70%
40-49	0%	0%	0%	0%	0%	20%	40%	70%	70%	70%
30-39	0%	0%	0%	0%	0%	20%	40%	70%	70%	70%
20-29	0%	0%	0%	0%	0%	20%	40%	70%	70%	70%
18-19	0%	0%	0%	0%	0%	20%	40%	70%	70%	70%

Alternative scenario (80% efficacy against clinical disease, 20% efficacy against infection in adults aged under 60 years; 70% efficacy against clinical disease, 10% efficacy against infection in adults aged 60 years and over). Coverage by target group and by month, assuming 25% of vaccine doses are delayed by one month and 25% by two months. Proportions of age groups vaccinated refer to adults not in the healthcare worker group.

	January	February	March	April	May	June	July	August	September	October
80+	10%	30%	58%	78%	88%	90%	90%	90%	90%	90%
Healthcare workers	10%	30%	58%	78%	88%	90%	90%	90%	90%	90%
70-79	0%	0%	0%	10%	30%	50%	68%	78%	80%	80%
60-69	0%	0%	0%	0%	10%	28%	35%	58%	78%	80%
50-59	0%	0%	0%	0%	0%	10%	28%	35%	58%	70%
40-49	0%	0%	0%	0%	0%	10%	28%	35%	58%	70%
30-39	0%	0%	0%	0%	0%	10%	28%	35%	58%	70%
20-29	0%	0%	0%	0%	0%	10%	28%	35%	58%	70%
18-19	0%	0%	0%	0%	0%	10%	28%	35%	58%	70%