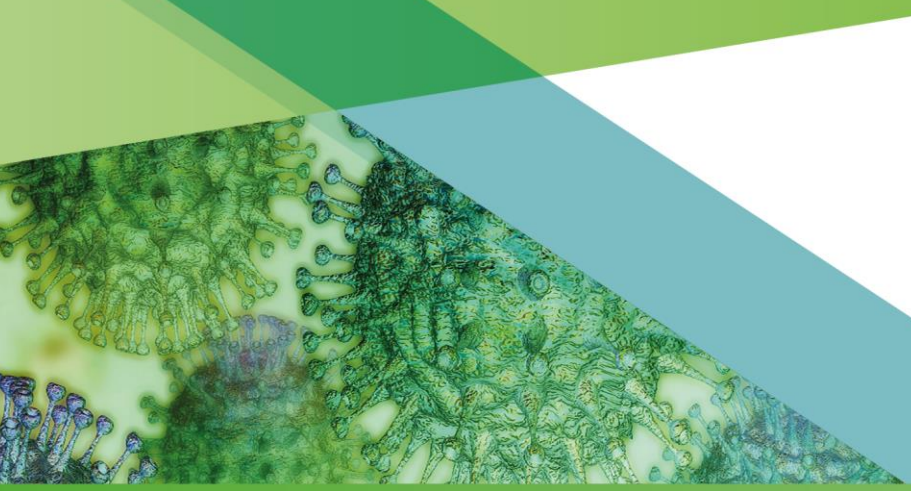

ECDC TECHNICAL REPORT

Introducing a coherent European framework for tuning COVID-19 response measures

17 March 2021

Executive Summary

- This document describes the development of a coherent, yet non-prescriptive framework for tuning COVID-19 response measures in the European Union and European Economic Area (EU/EEA). Its aim is to ensure efficiency and encourage public trust and compliance while continuing to protect the health of European citizens.
- The framework is based on the concept of a 'contact budget', allowing Member States to estimate the extent to which the effective contact rate needs to change, or can be allowed to change, to achieve certain epidemiological tiers.
- Estimates will be given for the effectiveness of different classes of response measures, enabling Member States to choose the most suitable policies for their context.
- On the basis of ongoing consultations, an interactive tool will be developed, supporting policy-makers and allowing Member States to make use of their own epidemiological parameters.

Background

COVID-19 has posed an unprecedented public health challenge to the EU/EEA. The SARS-CoV-2 virus spread rapidly through Member States, as it did globally, resulting in more than 22.5 million confirmed cases and half a million deaths to date in the EU/EEA. In early 2020, given the heavy burden on hospitals and intensive care units and the high number of deaths, the decision was made to implement stringent response measures to decrease viral transmission. The premise for these response measures, or non-pharmaceutical interventions (NPIs), was to reduce the level of contact between susceptible and infectious individuals, either by increasing physical distance (stay-at-home measures, school closures, cancellation of mass gatherings) or by preventing infection (face masks). These NPIs have proven to be effective at reducing the number of COVID-19 cases, but have come at a high social and economic cost, which has been exacerbated by cycles of lifting and re-implementing.

In 2021, all EU/EEA Member States have begun the important work of vaccinating citizens against COVID-19. Clinical trials for these vaccines have focused on the efficacy of the vaccines against severe disease, the probability of which is strongly associated with age, similar to the probability of dying from the virus, . The most rapid reduction in mortality and pressure on healthcare systems will therefore be achieved by prioritised vaccination of older people. However, in time, reduced disease incidence and viral transmission as a consequence of the vaccination programme will allow for the lifting of response measures.

This document presents a coherent, yet non-prescriptive framework for tuning COVID-19 response measures in the European Union and European Economic Area (EU/EEA). Its aim is to ensure efficiency and encourage public trust and compliance, while continuing to protect the health of European citizens.

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Outline of the framework

ECDC collects data on COVID-19 incidence, hospital and intensive care unit admissions, mortality, and vaccination coverage from across the EU/EEA and, in conjunction with the Joint Research Centre (JRC), maintains a comprehensive database of response measures implemented in Europe over time. As such, the Agency is well placed to develop a framework for tuning response measures that is strongly informed by the European experience.

The approach has three steps and it is recommended that it be conducted on at least a monthly basis.

1. Assigning each Member State to an epidemiological tier, based on COVID-19 incidence and mortality rates.
2. Estimating a 'contact budget', to demonstrate how much latitude each Member State has to lighten response measures without shifting to a more negative tier, or how much needs to be done to achieve a more positive one.
3. Allocating the 'contact budget' by Member States, tuning the response measures that they prioritise.

In association with this approach, ECDC recommends that the 'safety system' of mobility data is continually monitored as this gives an early indicator of whether policy changes or external factors, such as fatigue, have had an unanticipated effect.

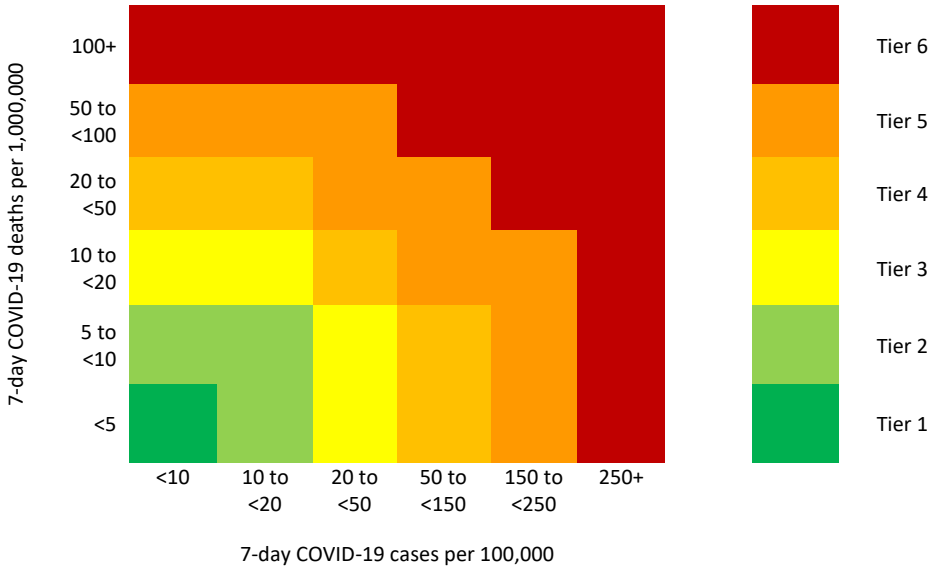
Step 1. Assessing epidemiological tiers

The tiers that define the potential for tuning response measures will be characterised in terms of seven-day COVID-19 incidence and seven-day COVID-19 mortality. While these are not the most dynamically responsive epidemiological indicators, they are appropriate for assessing the current status of a Member State. The mid-tiers are in line with the epidemiological thresholds specified by the World Health Organization (WHO) but these have been extended to include a more severe tier and a more positive one.

The tier of lowest COVID-19 impact is defined as equivalent to a country that has achieved, and is sustaining, a well-functioning vaccination programme. That is, rates of COVID-19 incidence and mortality that would be consistent with sustainable response measures; sensibly prioritised vaccination coverage and realistic assumptions about vaccine efficacy against both severe disease and death. For this most positive scenario, we assume that vaccine effectiveness has not been reduced as the result of viral mutation. It may be possible for Member States to reach the levels of incidence and mortality associated with this tier even before the vaccine is fully rolled out. However, in order to do so, more stringent response measures would be required.

Some Member States may reason that they would tolerate an increase in the number of confirmed COVID-19 cases if the vaccination programme were effective at reducing the occurrence of severe disease, the associated pressure on intensive care units and mortality. However, such a country could not be assigned to the most positive tier since, in the context of free movement, associated higher levels of community transmission would represent an ongoing risk to other Member States, which may lag behind in terms of vaccination coverage.

Figure 1. Tiers for determining the epidemiological status of an EU/EEA Member State



Tiers 2 to 5 match WHO's epidemiological thresholds but are extended to include a more severe tier and a more positive tier.

As of 15 March 2021, one EU/EEA Member State is designated as Tier 1, four are designated as Tier 4, 11 are designated as Tier 5 and 14 are designated as Tier 6. This highlights the need to create a more severe tier for the purposes of differentiation and to allow the epidemiological situation to be monitored.

Step 2. Setting the 'contact budget'

The continual reappraisal of response measure policy is costly and may have a negative impact on citizens' confidence in the approach taken. In the proposed framework, Member States will be able to assess the latitude for tuning response measures over the month ahead using an online tool developed by ECDC. The tool will illustrate the baseline scenario, where current trends in behaviour and incidence continue, and give the predicted tier for one, two, three and four weeks ahead.

Using estimates of the current effective reproductive number, R, at country level, the tool will also enable users to estimate the extent to which contact between citizens could be allowed to increase proportionally, without risking a shift into a worse epidemiological tier in four weeks' time. Conversely, it will also indicate how much it would be necessary to further restrict contact between individuals in order to move into a more positive tier in four weeks' time.

For a given increase in R, the associated allowance in terms of contact rates depends on the proportion of the population that is susceptible. As countries roll out the vaccination programme, population-level susceptibility may fall rapidly, even over a four-week period. The underlying calculations therefore account for changes in vaccination coverage. Many countries have followed advice to prioritise the vaccination of those at highest risk of developing severe disease, or dying. This means that countries may improve more rapidly in terms of mortality than incidence. In predicting the tiers, the tool will therefore also account for the divergence between the number of confirmed COVID-19 cases and the number of associated deaths.

The online tool will be configured in such a way that decision-makers and public health professionals in Member States will be able to choose whether they wish to use their own estimates or ECDC estimates for the effective reproduction number, R, and for vaccination coverage. In the longer term, the 'ensemble forecast' of the European COVID-19 Forecast Hub[1] may be used to inform the estimated epidemiological parameters.

Step 3. Allocating the 'contact budget'

Member States differ in their social and economic priorities and this will influence their choice of which response measures to tune first. While there may be a common view across the EU/EEA on those measures that are considered to be of central importance, there may be a greater degree of flexibility in relation to others.

Alongside the tool for calculating the 'contact budget', ECDC will provide estimates of the effectiveness of different types of response measures in reducing contact between individuals and the delay before a change policy can be observed. These estimates will draw on the comprehensive response measures database, curated jointly by the JRC and ECDC, and on the epidemiological data collected by ECDC.

Analysis of the effectiveness of response measures involves two steps. The first step estimates the time involved to vary the transmission potential of the virus. This is measured as the reproductive number, while accounting for epidemiological characteristics of the virus, population immunity and incomplete or delayed reporting of cases and deaths. The second step estimates the impact of response measures, implemented by various Member States at different times, on the local effective number of contacts, and thus transmission. The analysis accounts for contextual differences between Member States, delays for measures to become effective, and behavioural fatigue. Hierarchical effect estimates account for between-country differences while leveraging the extensive European data set. It is important to note that single-country estimates will not be provided.

This framework ensures a coherent approach across the EU/EEA, while allowing Member States the latitude to define their own priorities for the tuning and, in time, lifting of COVID-19 response measures.

Step 4. Monitor mobility data

While it is envisaged that the framework for tuning response measures will alleviate the need for continual reappraisal of policy, it is important to maintain a safety alert system to highlight whether there has been a rapid unforeseen change in the epidemiological situation. The 'contact budget' is set by looking four weeks into the future and, for each type of response measure, an indication is given of the time lag before the consequences of a change in policy will be observed.

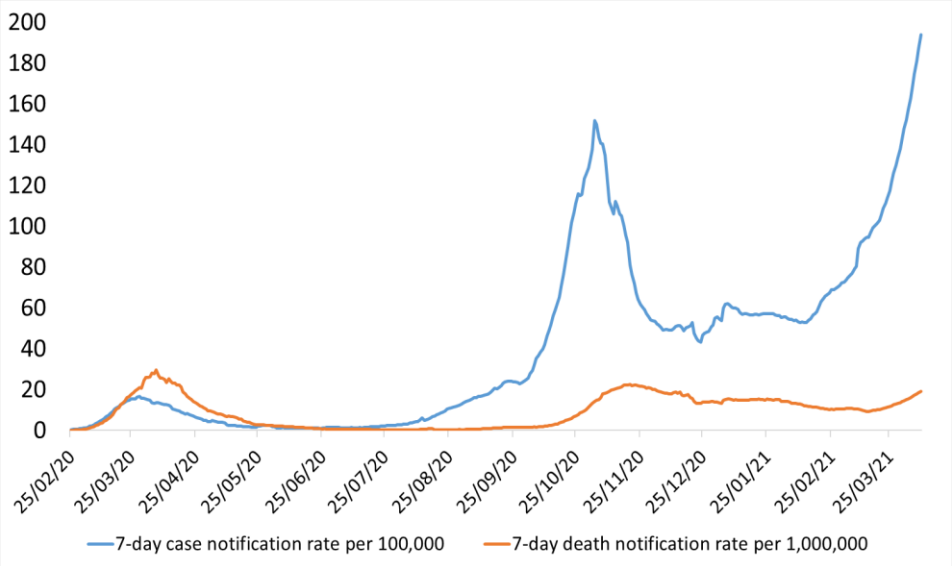
However, a prudent approach would be to monitor mobility data, such as the mobile phone operator data made available to the JRC, or that which is made publicly available by telecommunications providers. Telecommunications data is arguably the earliest indicator of behavioural change. In the absence of external factors, such as viral mutation or fatigue, this data can be used as a proxy for how incidence rates and hospital and intensive care unit admissions may alter in the days and weeks ahead. Member States are encouraged to use this data to assess whether the mobility of citizens is increasing more rapidly than the 'contact budget' would allow.

[1] European COVID-19 Forecast hub. Available at: https://covid19forecasthub.eu/

Worked example

Figure 2 provides a hypothetical example to illustrate how the framework could be used. As a consequence of the recent replacement of the circulating SARS-CoV-2 strain by a new variant with an increased transmissibility of 0.6, 'Country A' is currently experiencing a resurgence in COVID-19 incidence. The most stringent response measures were lifted at the end of January 2021 and the current policy is to recommend teleworking and the use of facemasks in indoor public spaces. It is estimated that an additional 5% of the population will be vaccinated against COVID-19 over the coming four weeks, all of whom belong to a group with an elevated risk of mortality.

Figure 2. Seven-day case notification rate and seven-day mortality rate of an example country



NB. Both measures are projected four weeks into the future, on the basis of the effective reproduction number.

STEP 1. Assessing epidemiological tiers

The first step in applying the framework is to assess the current epidemiological tier and the potential shift in designation over the coming four weeks. Table 1 shows the tier designations for the example Country A. The current tier is Tier 4 but a shift to Tier 5 is anticipated during the coming week as a consequence of the increase in the seven-day death notification rate above the threshold level of 10 deaths per 1 000 000 citizens over a seven-day period.

Table 1. Current and predicted seven-day case and death notification rates of an example country

	Seven-day case notification rate per 100 000	Seven-day death notification rate per 1 000 000	Tier
Current	92.8	9.87	4
1 week	101.0	10.0	5
2 weeks	114.4	11.3	5
3 weeks	131.9	12.8	5
4 weeks	147.8	15.8	5

The table illustrates how the epidemiological tier, currently Tier 4, is anticipated to rise to Tier 5 within the next week, and remain there, if response measures are not altered.

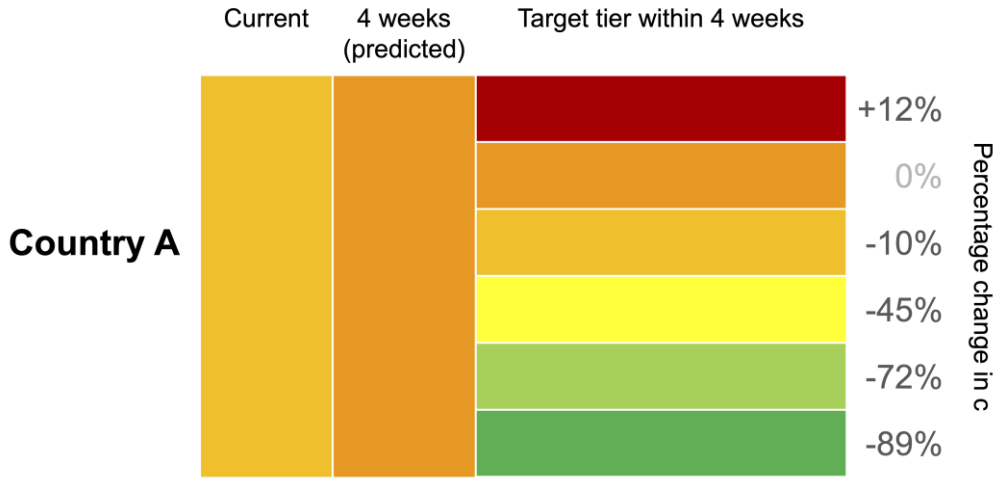
STEP 2. Setting the 'contact budget'

The second step is to assess the degree to which the effective contact rate between individuals, c, could be changed, or needs to be changed, to shift to a tier other than the baseline projection. In this example, if the measures are not altered, in four weeks' time we estimate that Country A will be in Tier 5.

Figure 3. Current and predicted tiers for Country A in the next four weeks, if no change is made to response measures

By reducing the level of effective contact between its citizens, it may be possible to move to a more favourable tier. Using the forecast value of the effective reproduction number, R, and the predicted increase in vaccination coverage over the four-week period (by age), we can estimate the change in c that would be needed for a 95% chance of reaching each tier within that time. In this example, a shift to the more negative Tier 6 would occur if the current levels of contact increased by 12% or more. To maintain the current Tier 4 would require a 10% decrease in contact rates, compared with current values. It is predicted that an 89% decrease in today's contact rates is required to achieve Tier 1 with 95% probability. As is illustrated, in Step 3, this would not be feasible.

Figure 4. Proportional change in the contact rate needed to achieve, with 95% probability, each of the epidemiological tiers



NB. A shift to the more negative Tier 6 would occur if the current levels of contact increased by more than 12%. To maintain the current Tier 4 would require a 10% decrease in contact rates, compared with current values.

STEP 3. Allocating the 'contact budget'

Depending on the target tier and the response measures currently in place, a country may choose to increase or lift measures in accordance with a menu of options. Suitable options are based on the expected effectiveness of response measures (estimated as described above) and practical considerations for combining different response measures.

In this example, Country A's goal might be not to proceed to the predicted Tier 5, but to improve the epidemiological situation to Tier 3. This would require a 45% reduction in effective contacts (see Figure 4). As part of the framework, a list of response measures and their effectiveness in reducing the effective contact rate will be provided. An illustrative example is provided in Table 2.

Country A is currently recommending teleworking and face mask use in indoor public places and, according to these estimates, would need to implement a stay-at-home order to achieve this goal within the next four weeks. In order to stay in the current Tier 4, and halt the ongoing upward trend in cases, it is estimated that a 10% reduction in the contact rate would be sufficient. This would not require such a strong intervention and, in this example, it could be achieved by recommending that face masks are used in all public places or, alternatively, by restricting people's social interactions to limited social groups or keeping restaurants and bars closed. Here the choice of policy is somewhat broader since the required reduction is not as large.

Table 2. Marginal proportional increase in contact rate in a country similar to Country A, given that recommendations for teleworking and face mask use in indoor public spaces are currently in place

	Marginal proportional decrease in contact rate
Stay-at-home order	0.47
Stay-at-home recommendation	0.26
Social bubbles	0.12
Closure of all public places	0.31
Closure of all schools	0.21
Closure of secondary schools	0.18
Closure of bars and restaurants	0.15
Closure of gyms	0.04
Use of face masks in all public places	0.11

STEP 4. Monitoring mobility data

Near real-time data on human mobility by telecommunications companies can be an early indicator of the increase in contact rates between people. However, these data do not correlate directly with changes in the rate of effective contacts between infectious and susceptible individuals (a 10% reduction in contacts will not necessarily be linked to half the change in mobility when compared to the mobility trend during a 20% reduction in contact rate). Trends also differ depending on the contexts in which mobility is measured. However, if rates do not appear to be falling in line with the values estimated in Table 2 (i.e. to achieve a 47% reduction over four weeks in the case of a stay-at-home order) then progress towards the targets may not be on course.

Final considerations

The primary objective of public health policy is to reduce COVID-19 mortality and the burden on the healthcare system. This will be achieved most sustainably by prioritised vaccination of those most at risk of severe disease and death (i.e. older adults). However, in time, it will be possible to lighten, and eventually lift, COVID-19 response measures.

ECDC has developed a coherent, yet non-prescriptive framework for estimating how response measures can be tuned, in light of the observed data on incidence and mortality. The aim of the framework is to enhance public trust and compliance and to make the process of assessing response measure policy more efficient. By providing a tool for the calculation of a so-called 'contact budget' alongside an estimate of the effectiveness of different response measures in various Member States, it is hoped that public health professionals and policy makers will be able to choose the most appropriate approach for their context.

The framework, and its implementation in the form of an interactive tool, will be further developed, with extensive consultation of technical and public health experts in the EU/EEA Member States.