RESEARCH LUXEMBOURG
COVID-19 Task Force

Covid-19 report: Update on the current epidemic status in Luxembourg

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Background information

This report has been elaborated by the Research Luxembourg Covid-19 Task Force to inform the Luxembourg Government about the current epidemic status in Luxembourg as an update to the last report from 24 March. It gives a short overview on the most important epidemic indicators and contains projections for the current epidemic status **based on data available up to 30 March**. Note that, in agreement with the Cellule de Crise, the reports are now scheduled for every other week.

Main conclusions

- **During the current week, the epidemic dynamics exhibits a continuing exponential dynamics with a slightly decreasing trend for the last days.** Thus, the 7-day average of daily cases for the current week has increased to 1,393 cases/day today compared to 1,192 cases/day for the week before, which corresponds to a 17% increase compared to a 25% increase last week.
- **R_{eff} of today has reduced 0.9** compared to 1.28 on Thursday of last week (Figure 1). The **7-day average value of R_{eff} has remained rather constant** at 1.10 for this week compared to 1.12 for the previous week with a slightly decreasing trend for the last days.
- The current epidemic dynamics **exhibits a further manifestation of an exponential regime** with an increasing slope obtained by linear fitting since 20 February of the cumulative cases of 908 cases/day compared to 826 cases/day for last week's estimate (Figure 2 and 3).
- The 7-day average for the **normal care hospitalization demands has rapidly decreased** compared to last week (25.4 cases on average for this week compared to 36.8 cases for last week). The average **ICU occupancy has remained rather constant at 3.9 cases** on average for this week compared to 3.4 cases for last week.
- The continuously increasing case numbers of the current epidemic rebound driven by the BA.2 subtype of the Omicron variant trigger an **anticipated peak in the corresponding midterm projections of daily cases of around 1,500 cases** for the next days (Figure 4 and 5).
- The corresponding projections for the hospitalization demands reflect the apparently milder disease progression for the Omicron variant that has recently strengthened due to more infections of vaccinated and boostered people which have a subsequently reduced risk for hospitalization. With this adaptation based on the current Luxembourg data, the **projections indicate a reduced peak in normal care cases** between 25 and 40 beds in April compared to 80 beds in last week's projection (Figure 6). The adapted assumptions for disease severity lead also to a reduction in the current **projection for ICU demands indicating a potential peak between 4 and 11 beds** on average in April compared to a potential peak of 20 beds in last week's projection (Figure 7). Note that hospitalization and specifically ICU demands strongly depend on the age structure of the cases and the vaccination status as well as antiviral treatments. Hence, it is important that vulnerable people are fully vaccinated and remain cautious in their social interactions to prevent severe cases and an increase in hospital demands.
- The average **positivity rate has remained rather constant at 36%** compared to 37% for last week (Figure 8).
- The total number of estimated **active cases has further increased to 19,707** cases compared to 16,348 cases for the previous week which corresponds to a 20% increase compared to a 26% increase last week (Figure 9).

The epidemic dynamics of the current week exhibits still an exponential regime driven by the increased transmissibility of the BA.2 subtype of the Omicron variant compared to the BA.1 subtype and reduced measures. Based on the current dynamics with the indication of a slight relaxation, the standard projections indicate a potential peak of around 1,500 cases/day for the next days and a subsequent decrease in agreement with the projections considering the increased transmissibility of the BA.2 subtype. Note that the spring vacation period may facilitate an intermediate relaxation in April, but the effect can only roughly be estimated. The current situation in the hospitals has substantialized the evidence for a reduced hospitalization risk which is probably caused by better treatment strategies by antiviral compounds and the higher incidences of fully vaccinated and boostered persons, which have subsequently a lower risk for severe symptoms. With the corresponding adaptation, the projections exhibit a reduced hospital demand compared to last week's estimate. Nevertheless, sustained efforts in social distancing, in following hygiene strategies as well as in vaccination uptake, including booster shots, remain in particular for elderly and vulnerable persons essential to prevent severe situations in the hospitals.

Graphical analysis of epidemic indicators

Below, the epidemic indicators are visualized and analyzed in more detail including the midterm projections for daily cases and hospitalization.

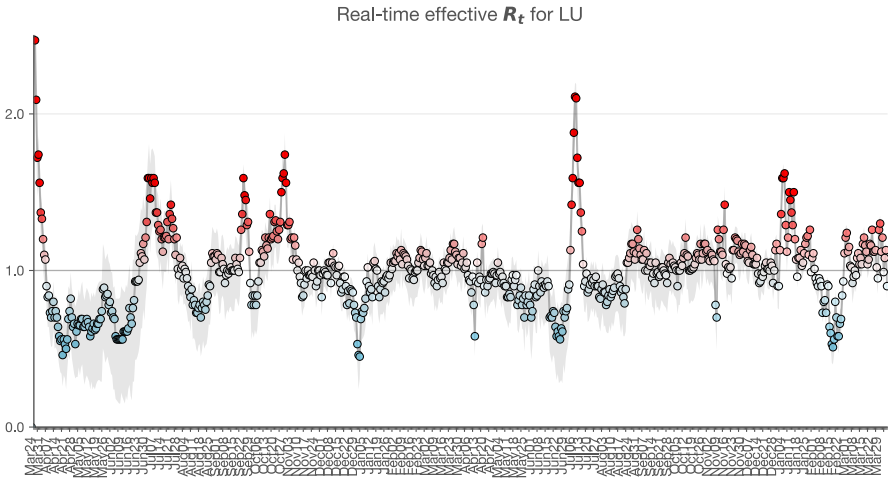

Figure 1. *For the current week, the effective reproduction R_{eff} has decreased to 0.9 today compared to 1.28 on Thursday of last week. The 7-day average of the current week has remained rather constant at 1.1 compared to 1.12 of last week.*

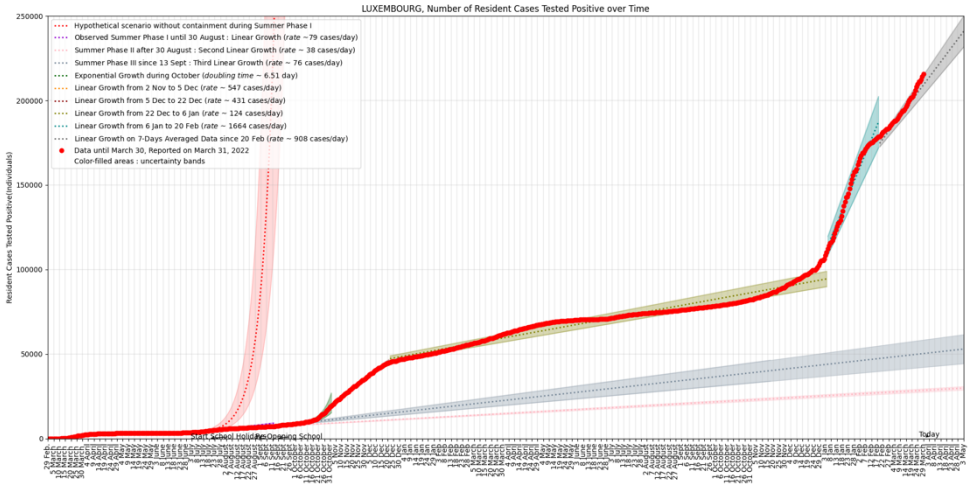

Figure 2. *Official COVID-19 case numbers up to 30 March (red dots) were approximated with an adapted model for short-term forecasts for the different phases of the epidemics (color coded).* ***The dynamics during the current week indicates a continuing exponential regime as indicated by the further increased slope of the linear fit of 908 cases/day*** *compared to 826 cases/day for the fit from last week.*

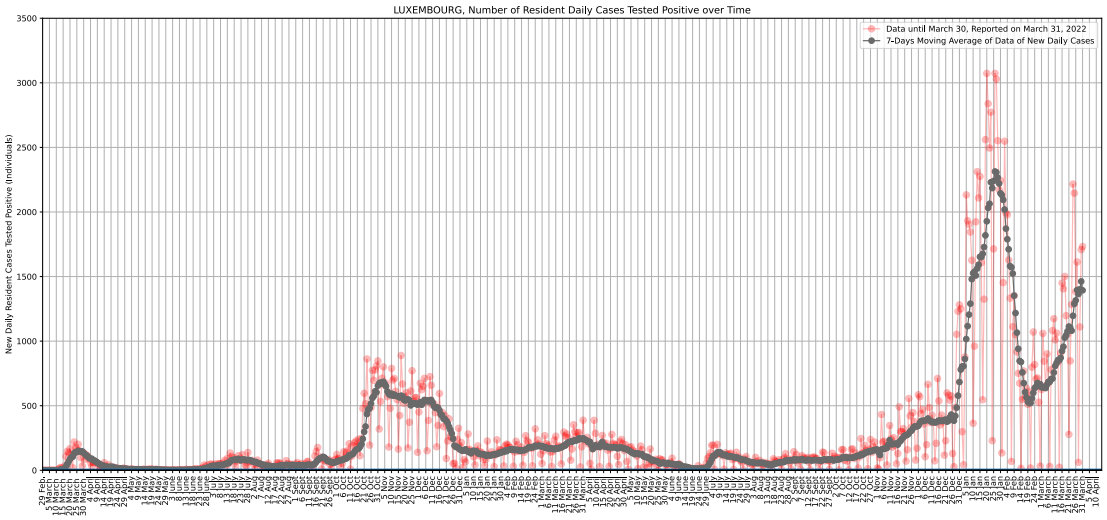

Figure 3. *The daily COVID-19 cases numbers up to 30 March (red dots) and the 7-day average (grey). Note that a linear regime is characterized by a flat curve and that an exponential behavior would correspond to a straight line.* ***For the current week, the 7-day average of daily cases (grey) has increased to 1,393 cases/day compared to 1,192 cases/day for the week before*** *with some evidence for a stabilization for the last days.*

To assess the future epidemiological development in Luxembourg, we parameterized an extended epidemiological SIR model with data from Luxembourg by a Kalman filter. The model considers the current state of vaccination in the population, the corresponding vaccine efficacy against transmission and hospitalization risk inferred from Luxembourg data. For the recent period, the data suggests a further reduction of the hospitalization risk since more vaccinated people get infected who have a reduced risk to develop severe symptoms. Based on these assumptions and the current age-distribution of infected persons of the last two weeks, the model integrates the dynamics of daily cases, hospitalizations and ICU occupancy and projects the future development of the epidemics. Note that the model does not consider future changes in social behavior or vaccine efficacies nor the increased transmissibility of the BA.2 subtype explicitly and that the projections are accompanied by uncertainties as shown by the confidence intervals, which currently correspond to a 12% decrease or increase in social interactions for the optimistic and pessimistic scenarios (Figures 4, 6 and 7). To respect the current rebound driven by the BA.2 subtype, we additionally applied a two-strain model which explicitly considers the increased transmissibility of BA.2. Due to the high prevalence of the BA.2 subtype of probably around 94% today, the projections indicate coherently an anticipated rebound with a peak of around 1,500 cases/day for the next days (Figures 4and 5). Note that none of the projections considers the potential relaxing effect of the spring vacation period since the effect cannot be estimated solidly.

The midterm **projections of the 7-day average of daily new cases** (Figure 4) estimate the current level of social interactions and consider the vaccination status. The projections reflect the recent epidemic rebound and the corresponding projections for **the 7-day average of daily cases** indicates a peak of around 1500 cases/day for the next days and a subsequent relaxation (Figure 4 left) similar to last week's projections (Figure 4 right). The potentially stabilizing regime is also indicated by the pessimistic scenario corresponding to 12% change in social interaction, which still indicates a relaxation for the next weeks. Note that the increased transmissibility of the BA.2 subtype of the Omicron variant and relaxed measures are not explicitly considered in these projections. Furthermore, the epidemic dynamics will also depend on the future development of social life where the spring vacation period might lead to an intermediate relaxation in the epidemic dynamics for the first weeks in April but also bears the danger of potential import cases.

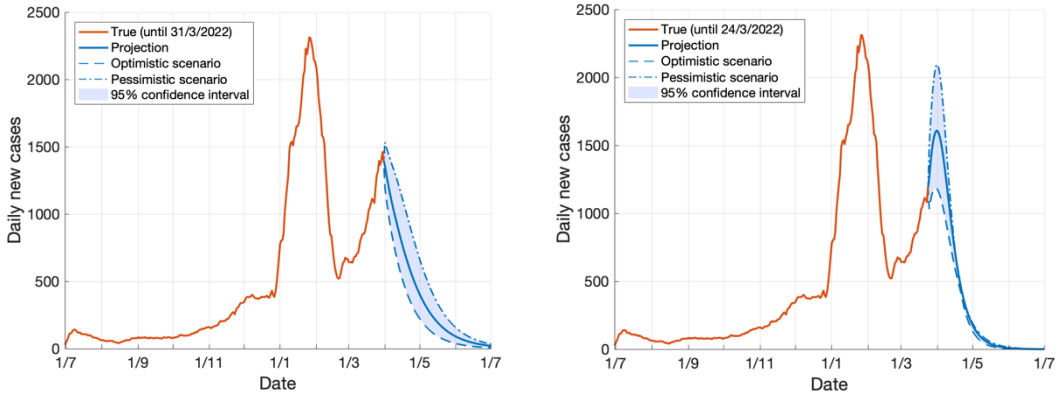

Figure 4. *Comparison of midterm projections for the 7-day average of daily cases from this week (left) and last week (right) based on an extended epidemiological SIR model parameterized to the situation in Luxembourg data by a Kalman filter. The blue solid line represents the most likely scenario whereas the optimistic (dashed line) and pessimistic scenarios (dashed-dotted line) correspond to a 12% decrease and increase in social interactions for this week's and for last week's projections.* ***The comparison indicates the current stabilizing trend in infection numbers by a slightly reduced peak of around 1,500 cases for the next days compared to the projection of last week (right).***

To estimate the effect of the increased transmissibility of the BA.2 subtype explicitly, we also applied a two-strain model (as done during the period of the Alpha and Delta variant appearance), which considers a 60% increased transmissibility (Fig. 5 left) in analogy to the projections form last week (Fig. 5 right). This comparison indicates the current trend towards a stabilized dynamics by a slightly reduced rebound of just below 1,500 cases/day on average for the next days compared to the slightly larger peak in the projections from last week. The consistency with the standard projection (Fig. 4) is based on the high prevalence of the BA.2 subtype of around 94% and therefore future reports will not consider the two-strain model anymore as long as there is now new variance appearing.

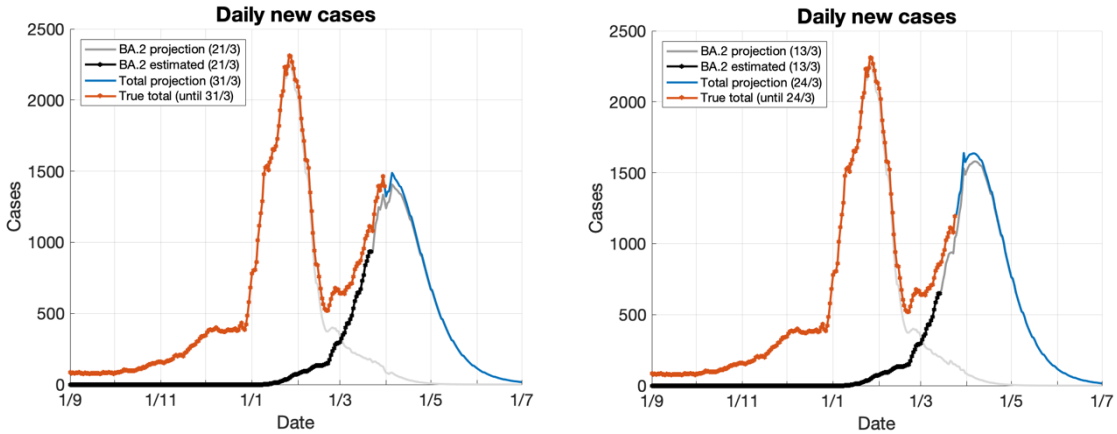

Figure 5. Estimates of the potential effect of the more contagious virus subtype BA.2. *Based on the epidemic dynamics of observed cases (red line for 7-day average), the projections show the overall dynamics (blue) and the potential contribution of the variants of concern (black).* ***Left:*** *Considering the reported prevalence of the subtype BA.2, a 60% increased transmissibility and current social interactions, the projection exhibits a potential rebound with a peak of around 1,500 cases/day in the next days.* ***Right:*** *Corresponding projections from last week with an overall increase of 60% for the current BA.2 regime which indicated a slightly higher peak in April. This consistency supports the hypothesis that the current rebound is driven by the BA.2 subtype. [Note that the model does not consider a potential effect of the spring break which may lead to an intermediate relaxation due to reduced social interactions.]*

The model **projection for normal care** assumes a 60% decrease in the hospitalization risk for the BA.1 subtype of the Omicron variant compared to the Delta variant and a further reduction for the current period dominated by the BA.2 subtype. Based on the current epidemic rebound in cases (Figures 4 and 5), age distribution of cases and the observed dynamics in normal care demands with the corresponding adaptation in the hospitalization risks, the projections exhibit reduction in the anticipated peak between 25 and 40 beds in April compared to 80 beds in last week's projection

(Figure 6). The further reduction in the hospitalization risk for the current situation is probably based on more infections of vaccinated and boostered people who have a reduced risk to develop severe symptoms. In addition, the improved treatment strategies by antiviral compounds may further decrease the anticipated hospital demands. Note that hospitalizations strongly depend on the age distribution of cases since older people are more likely to develop severe symptoms and that booster shots are essential to push down the curve. Hence, changes in the age distribution and the administration of booster shots can significantly modify the projections.

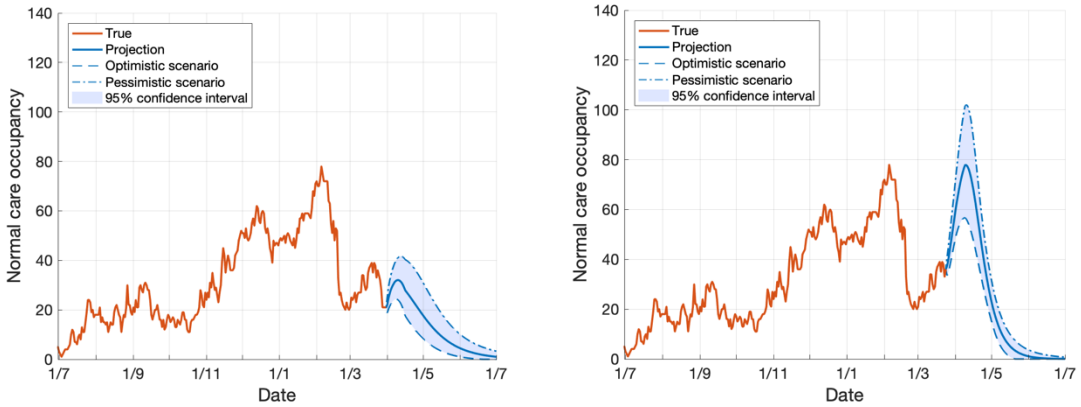

Figure 6. *Comparison of midterm projections for the 7-day average of normal care demands from this week (left) and last week (right) based on the extended epidemiological SIR model. The blue solid line represents the most likely scenario whereas the optimistic (dashed line) and pessimistic scenarios (dashed-dotted line) correspond to a 12% decrease and increase in social interactions.* ***The adaptation in the hospitalization risk leads to a significantly reduced peak between 25 and 40 beds in April (left) compared to a peak of 80 beds in the projections of last week (right)*** *based on improved treatments by antiviral compounds and the current high incidences of vaccinated and boostered people [Note again that the model does not consider a potential effect of the spring break which may lead to an intermediate relaxation due to reduced social interactions.]*

The corresponding **projections for ICU demands** also reflect the 80% reduced hospitalization risk for the Omicron variant and an additional reduction for vaccinated people. Together with the current age distribution of cases, the projections with the adapted hospitalization risk indicate a reduced peak in ICU between 4 and 11 beds in April (Fig. 6 left) for the optimistic and pessimistic scenarios, respectively, compared to a peak between 8 and 20 beds in the projection of last week (Fig. 6 right). Note that hospitalization and specifically ICU demands strongly depend on the age structure and vaccination status of cases. Hence, it is particularly important that vulnerable people are vaccinated and remain cautious in their social interactions to prevent severe cases.

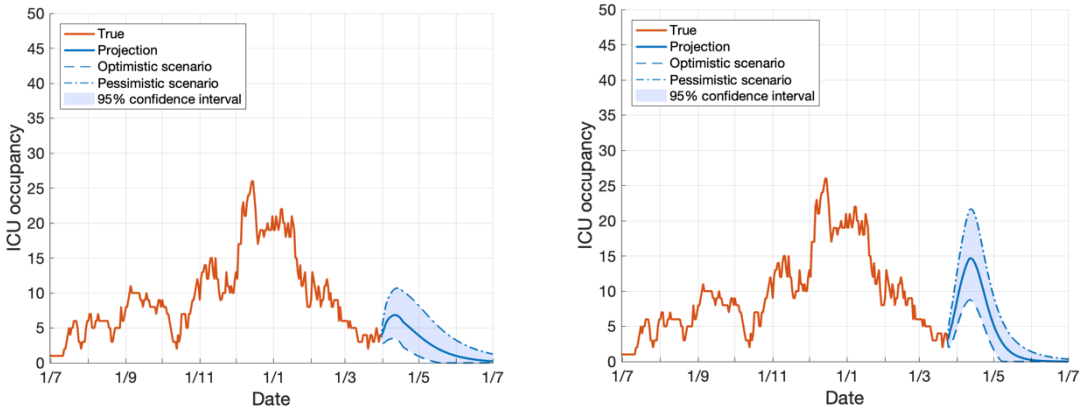

Figure 7. *Comparison of midterm projections for the 7-day average of ICU demands from this week (left) and last week (right). The blue solid line represents the most likely scenario and the optimistic (dashed line) and pessimistic scenarios (dotted-dashed line) correspond to a 13% decrease and increase in social interactions.* ***Based on the adaptation of the current hospitalization risk, the projections exhibit a reduced peak in ICU demands between 4 and 11 beds in April (left) compared to 15 beds in the projection of last week's projections (right).***

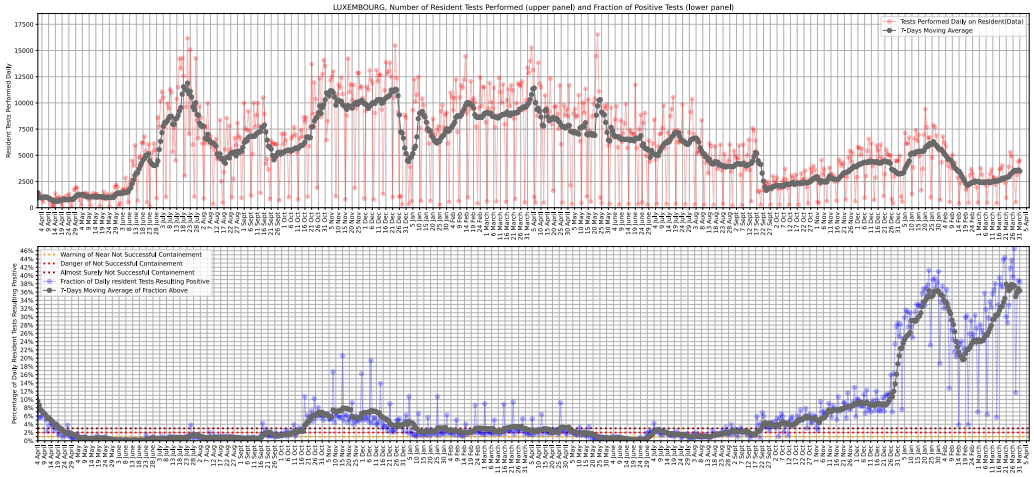

Figure 8. *Number of daily tests performed (top) and overall normalized positive tests (bottom).* ***During the current week, the 7-day average of positivity rate (grey) remained rather constant at 36%*** *compared to 37% last week.*

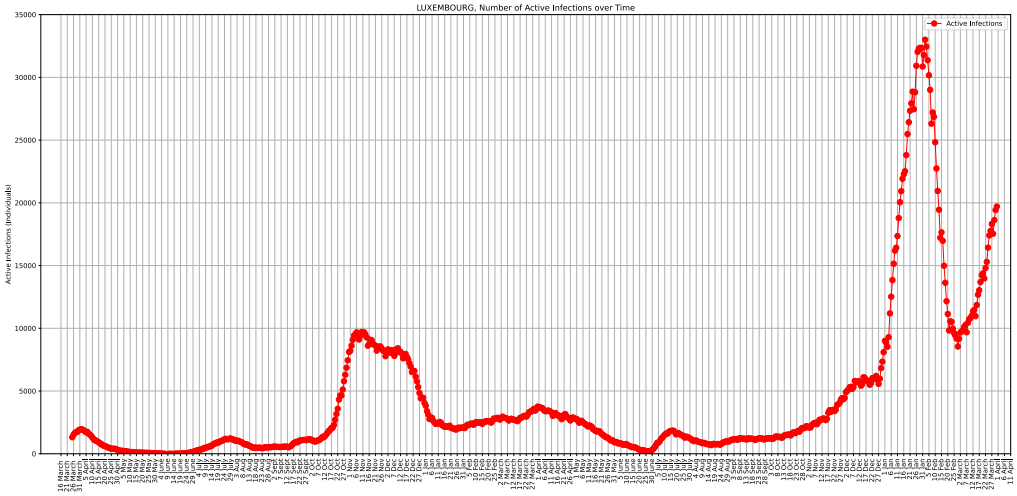

Figure 9. *During the current week,* ***the number of estimated active cases has increased by 20% to 19,707 cases*** *compared to 16,348 cases last week.*

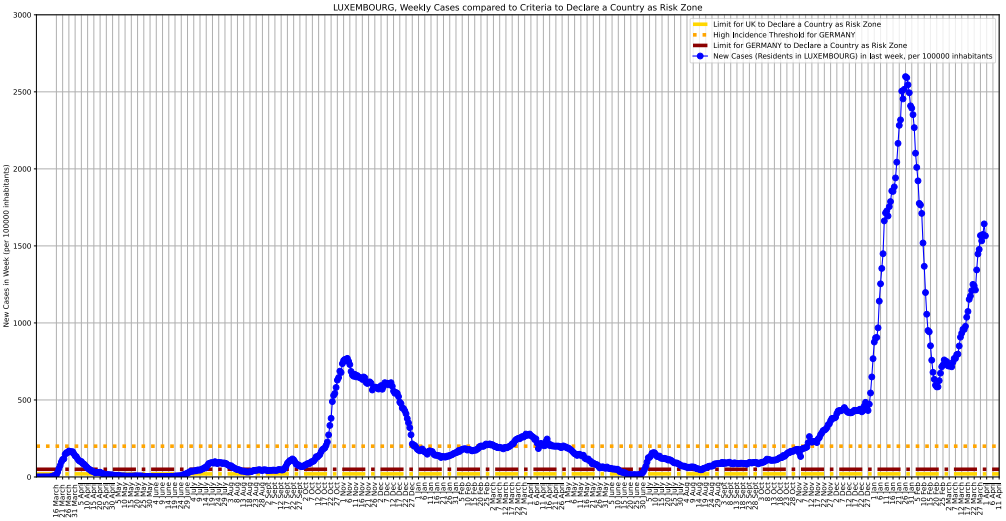

Figure 10. *Number of weekly cases per 100,000 inhabitants that is used by different countries to set thresholds for risk zone definitions such as Germany with 50 cases per week and per 100,000 inhabitants (dark red line).* ***During the current week, the number of weekly cases per 100,000 inhabitants increased to around 1,650 cases for this week compared to 1,400 cases for last week.***