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 10 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 16 March**.

Main conclusions

- **During the current week, the epidemic dynamics exhibits an increasing trend for the last days.** Thus, the 7-day average of daily cases for the current week has increased to 956 cases/day today compared to 757 cases/day for the week before, which corresponds to a 26% increase compared to a 18% increase last week.
- **R_{eff} of today has remained rather constant with 1.17** compared to 1.2 on Thursday of last week (Figure 1). The **7-day average value of R_{eff} has again slightly increased** to 1.13 for this week compared to 1.08 for the previous week.
- The current epidemic dynamics **exhibits a trend towards an exponential regime** with a slope of the cumulative cases of 774 cases/day since 20 February obtained by linear fitting (Figure 2 and 3) with an increasing trend for the last days.
- The 7-day average for the **normal care hospitalization demands has rapidly increased** compared to last week (32.4 cases on average for this week compared to 26 cases for last week). The average **ICU occupancy has further decreased** to 3.4 cases on average for this week compared to 5.1 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 between 1,200 and 1,500 cases** on average in beginning of April (Figure 4 and 5). The projections come with some uncertainties based on the approximately 30%-40% increased transmissibility of the BA.2 subtype of the Omicron variant and the recent relaxation in measures.
- The corresponding projections for the hospitalization demands reflect the apparently milder disease progression for the Omicron variant. With the assumption of a 60% reduction for normal care hospitalization, an 80% reduction of ICU hospitalization for the Omicron variant in comparison to the Delta variant and the current trend of an epidemic rebound, the **projections indicate an peak in normal care cases** between 60 and 80 beds in April (Figure 6). With the adapted assumption for disease severity and the recent increase in the epidemic dynamics, the current **projection for ICU demands indicates a potential peak between 10 and 17 beds** on average in April (Figure 7). Note that hospitalization and specifically ICU demands strongly depend on the age structure of the cases and the vaccination status of the population. 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 again increased to around 32%** compared to 28% for last week (Figure 8).
- The total number of estimated **active cases has also increased to 12,973** cases compared to 10,746 cases for the previous week which corresponds to a 20% increase (Figure 9).

The epidemic dynamics of the current week exhibits continuing increase in epidemic dynamics with a trend towards an exponential regime driven by the apparently 30%-40% increased transmissibility of the BA.2 subtype of the Omicron variant compared to the BA.1 subtype. The standard projections do not consider this increase explicitly and we have therefore applied also a two strain model similar to the situation for the Alpha and Delta variant. This model indicates a slightly larger rebound similar to the pessimistic scenario of the standard projections. Note that the spring vacation period may facilitate an intermediate relaxation in April, but the effect can only roughly be estimated. So far, there is no indication that the BA.2 subtype may lead to more severe cases and therefore the reduced hospitalization risk for the Omicron variants in comparison to the Delta variant might prevent a severe situation in the hospitals, but the relaxation of measures may further contribute to the epidemic rebound. **Hence, 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.

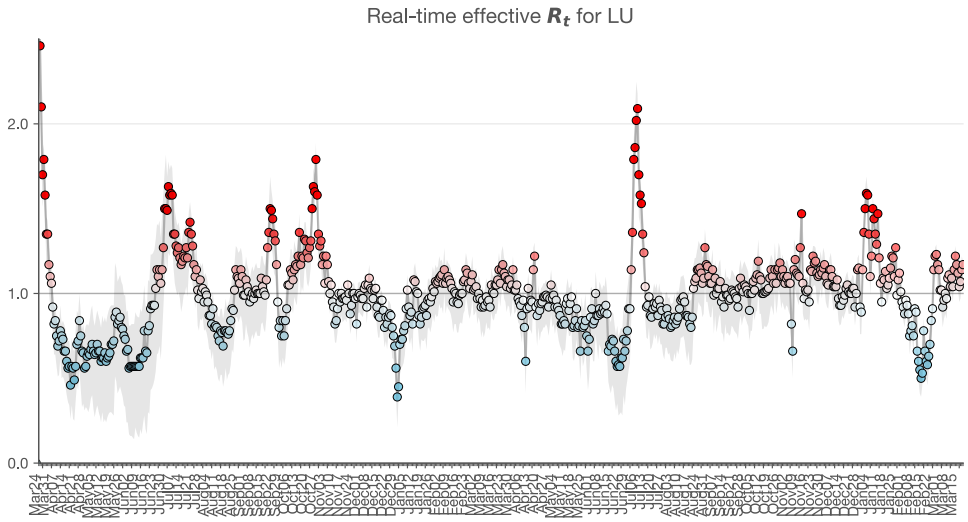

Figure 1. *For the current week, the effective reproduction R_{eff} has remained rather constant at 1.17 today compared to 1.2 on Thursday of last week. The 7-day average of the current week has increased to 1.13 compared to 1.08 of last week.*

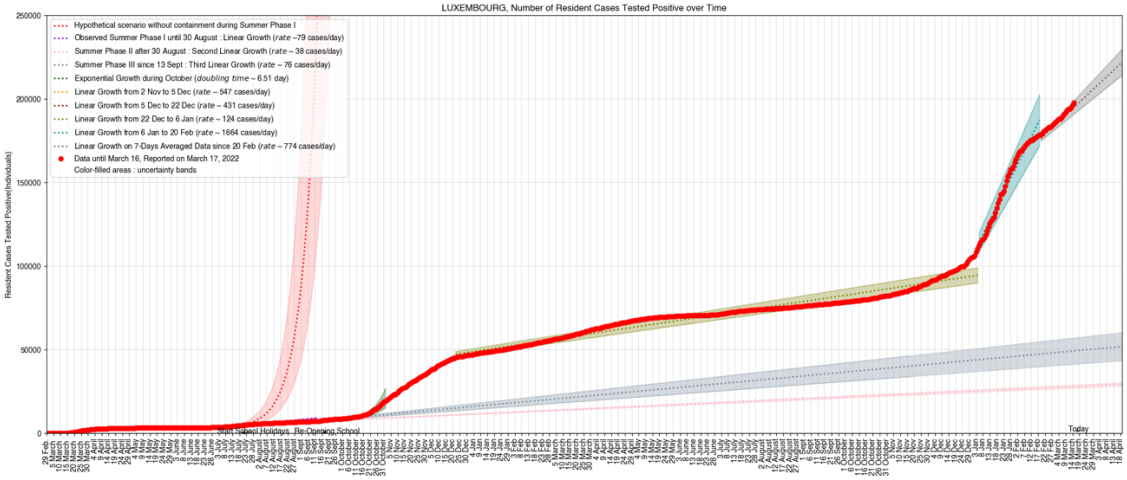

Figure 2. *Official COVID-19 case numbers up to 16 March (red dots) were approximated with an adapted model for short-term forecasts for the different phases of the epidemics (color coded).* ***The dynamics during the current week indicates a shift towards an exponential regime as indicated by a slightly increased slope of the linear fit of 774 cases/day*** *compared to 769 cases/day for the fit from last week.*

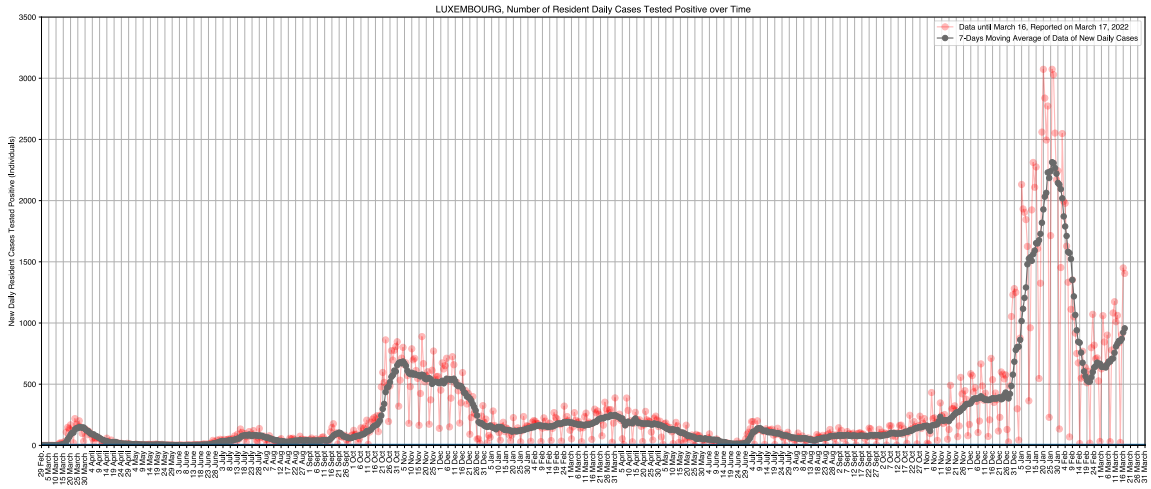

Figure 3. *The daily COVID-19 cases numbers up to 16 March (red dots) and the 7-day average (grey). Note that a linear regime is characterized by a flat curve and that an exponential behavior would correspond to a straight line.* ***For the current week, the 7-day average of daily cases (grey) has increased to 956 cases/day compared to 757 cases/day for the week before*** *where the linear increase for the last 2 weeks indicates the shift towards an exponential dynamics.*

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 vaccine efficacy against transmission for the Delta variant inferred from Luxembourg data as 44% and 68% for the first and the second dose, respectively, and the efficacy against severe outcome as 74% and 85%, respectively. For the Omicron variant, the transmissibility is increased by roughly 200%. However, the hospitalization risk is reduced by 60% for normal care and 80% for ICU compared to the Delta variant. 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 13% 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 and indicates that the anticipated rebound is likely to follow the pessimistic scenario of the standard projections (Figure 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 continuing increase with a peak of around 1200 cases/day on average in April (Figure 4 left) compared to the slow relaxation in last week's projections (Figure 4 right). The destabilized regime is further indicated by the pessimistic scenario corresponding to 13% change in social interaction, which exhibits a potential peak of around 1500 cases/day. Note that the increased transmissibility of the BA.2 subtype of the Omicron variant and relaxed measures are not explicitly considered in these projections. A comparison with the two-strain model (Fig. 5) indicates that the pessimistic scenario might represent a more realistic estimate for the next weeks. 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.

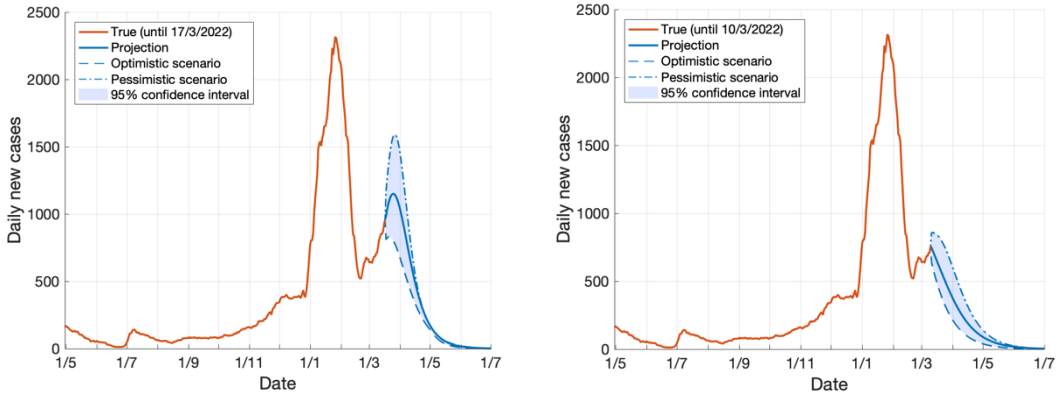

Figure 4. *Comparison of midterm projections for the 7-day average of daily cases from this week (left) and last week (right) based on an extended epidemiological SIR model parameterized to the situation in Luxembourg data by a Kalman filter. The blue solid line represents the most likely scenario whereas the optimistic (dashed line) and pessimistic scenarios (dashed-dotted line) correspond to a 13% decrease and increase in social interactions for this week's and for last week's projections.* ***The comparison indicates the effect of the current increase in infection numbers by a significant rebound with a peak of around 1,200 cases beginning of April compared to the slowly decreasing dynamics in the projection of last week (right).*** *Note that the increased transmissibility of the BA.2 subtype may push the dynamics towards the more pessimistic scenario as indicated by the comparison with the two-strain model shown in Figure 5.*

To estimate the effect of the increased transmissibility of the BA.2 subtype and relaxed measures, we applied a two-strain model (as done during the period of the Alpha and Delta variant appearance), which considers a 42% increased transmissibility (Fig. 5 left) and additional an effect due to relaxed measures by a 60% increase (Fig. 5 right). These projections indicate that the pessimistic scenario of the standard projections (Fig. 4 left) might be more realistic.

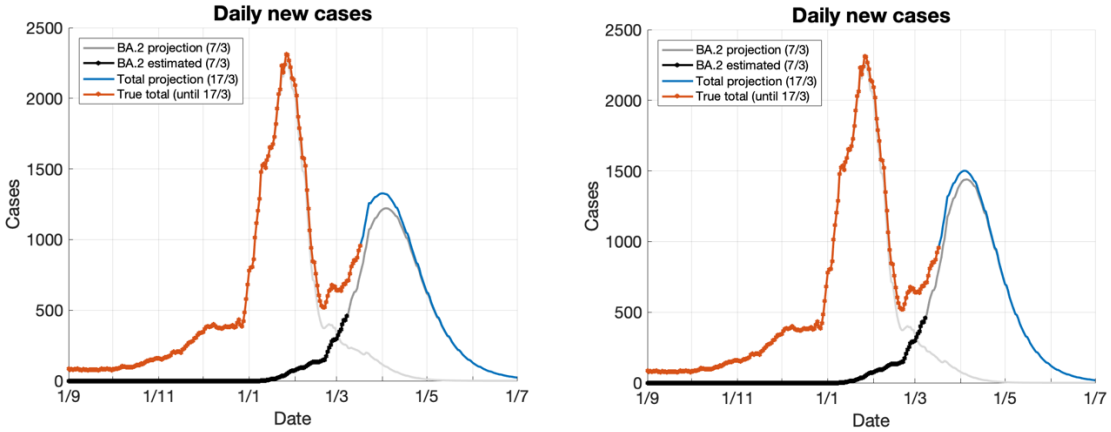

Figure 5. Estimates of the potential effect of the more contagious virus subtype BA.2. *Based on the epidemic dynamics of observed cases (red line for 7-day average), the projections show the overall dynamics (blue) and the potential contribution of the variants of concern (black).* ***Left:*** *Considering the reported prevalence of the subtype BA.2, a 42% increased contagiousness and current social interactions, the projection exhibits a potential rebound with a peak of 1,300 cases/day in April.* ***Right:*** *Projections considering an additional effect of reduced measures which may lead to an overall increase of 60% for the current BA.2 regime which would lead to a peak of around 1,500 cases/day on average in April, which is in the range of the pessimistic scenario of the standard projections shown in Figure 4. [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 Omicron variant compared to the Delta variant which seems to hold also for the Ba.2 subtype. Based on the current epidemic rebound in cases (Figures 4 and 5), the observed increase in normal care demands and age distribution of cases, the projections exhibit an anticipated peak of around 60 beds in April compared to 22 beds in last week's projection (Figure 6). Due to the increased transmissibility of the BA.2 subtype, the dynamics might tend towards the pessimistic scenario with around 80

normal care cases in the next weeks. 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.

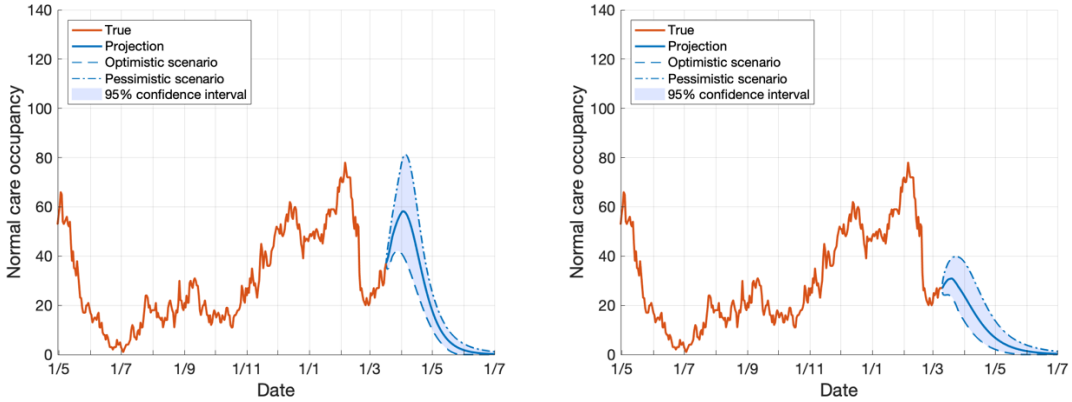

Figure 6. *Comparison of midterm projections for the 7-day average of normal care demands from this week (left) and last week (right) based on the extended epidemiological SIR model. The blue solid line represents the most likely scenario whereas the optimistic (dashed line) and pessimistic scenarios (dashed-dotted line) correspond to a 13% decrease and increase in social interactions.* ***The comparison indicates a significant peak of around 60 beds in April before a relaxation (left) compared to the more relaxing dynamics in the projections of last week (right)****. The increased transmissibility of the BA.2 subtype and the relaxed measures may lead to an epidemic regime more similar to the pessimistic with a 13% change in social interactions which might lead to a peak of up to 80 beds. [Note again that the model does not consider an 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 the current epidemic rebound. Together with the current age distribution of cases, the projections with the adapted hospitalization risk indicate a temporary increase in the ICU bed demands with a peak of around 10 beds in April (Fig. 6 left) compared to a slow decrease in the projection of last week (Fig. 6 right). The more pessimistic scenario with a 13% increase in social interactions indicates a peak of 17 beds in April. 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. Furthermore, the projections consider the same reduction of the hospitalization risk for the subtype BA.2 as for the original Omicron variant.

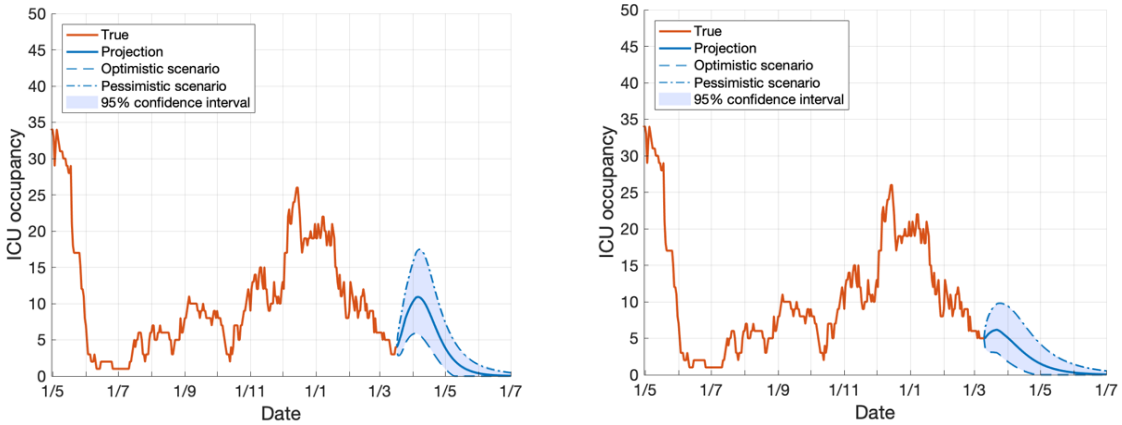

Figure 7. *Comparison of midterm projections for the 7-day average of ICU demands from this week (left) and last week (right). The blue solid line represents the most likely scenario and the optimistic (dashed line) and pessimistic scenarios (dotted-dashed line) correspond to a 13% decrease and increase in social interactions.* ***The comparison exhibits an intermediate increase in ICU demands for the next weeks (left) compared to a continuous decrease in the projection of last week's projections (right)****. The current pessimistic scenario with a 13% increase in social interactions exhibits a potential ICU demand of around 17 beds beginning of April and may represent a more likely scenario due to the increased BA.2 transmissibility.*

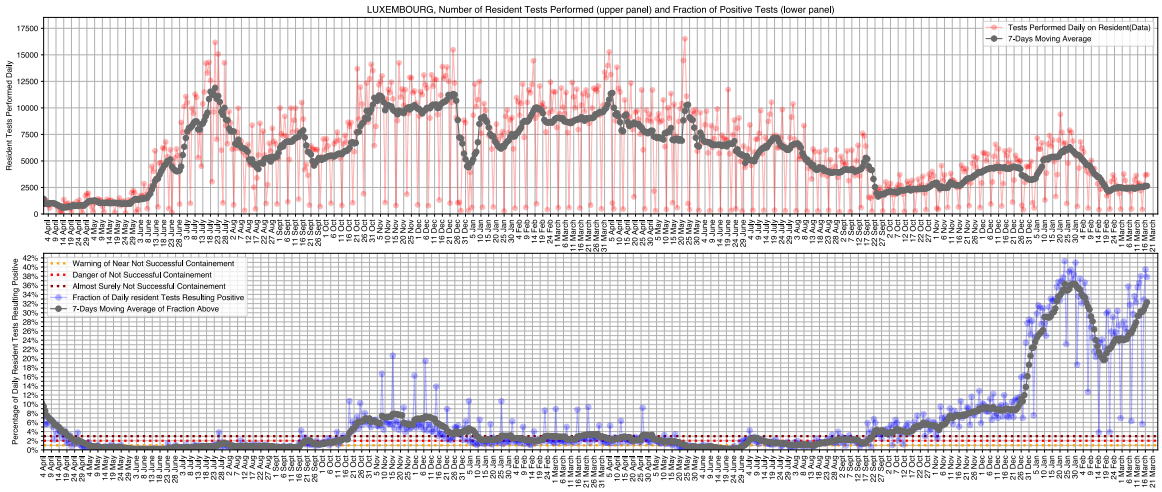

Figure 8. *Number of daily tests performed (top) and overall normalized positive tests (bottom).* ***During the current week, the 7-day average of positivity rate (grey) increased to around 32%*** *compared to 28% last week.*

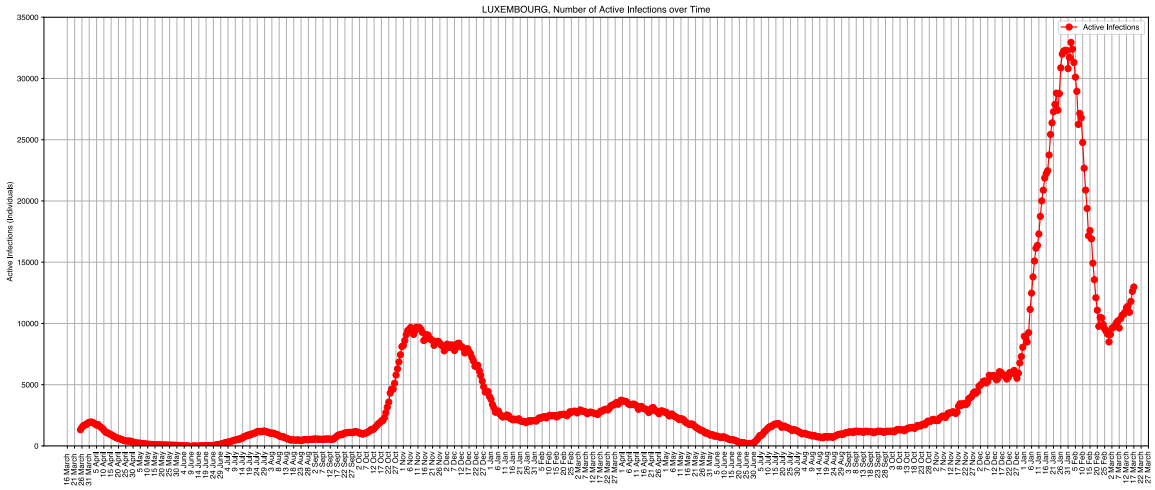

Figure 9. *During the current week,* ***the number of estimated active cases has increased by 20% to 12,973 cases*** *compared to 10,746 cases last week.*

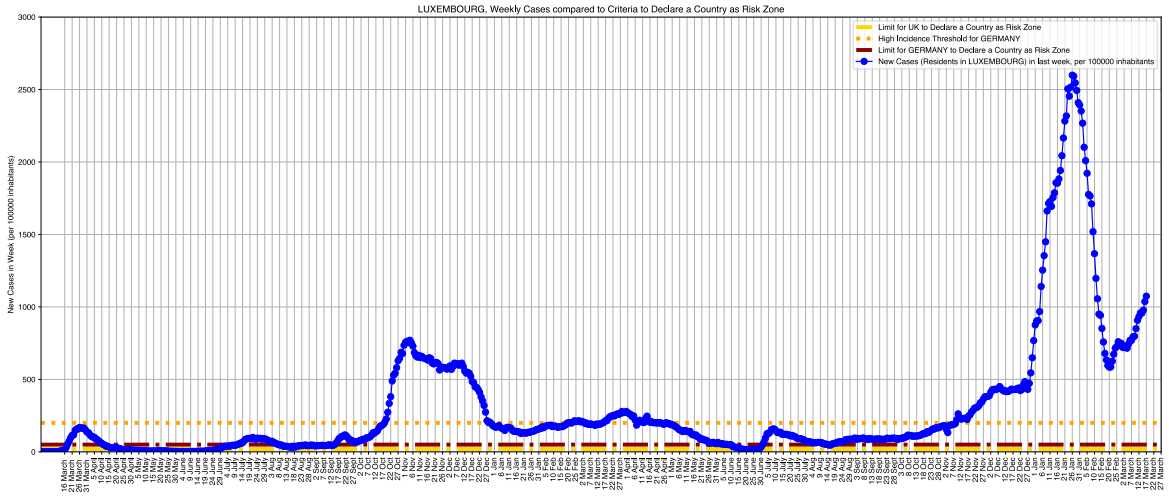

Figure 10. *Number of weekly cases per 100,000 inhabitants that is used by different countries to set thresholds for risk zone definitions such as Germany with 50 cases per week and per 100,000 inhabitants (dark red line)****. During the current week, the number of weekly cases per 100,000 inhabitants increased to around 1,100 cases for this week compared to 800 cases for last week.***