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 February. 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 2 March**.

Main conclusions

- **After the strong relaxation over the vacation period, the last 2 weeks exhibit a stagnation in the relaxing dynamics** indicating a level of social interactions similar to the period before the vacation time. Thus, the 7-day average of daily cases for the current week has remained rather constant with 644 cases/day today compared to 637 cases/day for the week before, which corresponds to a 11% increase compared to a 5% increase last week.
- **R_{eff} of today has decreased to 1.0** compared to 1.23 on Thursday of last week (Figure 1). The 7-day average value of R_{eff} has slightly increased to 1.03 for this week compared to 0.95 for the previous week. The dynamics of R_{eff} might suggest a compensatory effect after the vacation period and corresponding projections indicate a relaxing epidemic dynamics for the next weeks.
- The stagnation in the overall relaxation during the last 2 weeks exhibits a linear regime with a slope of the cumulative cases of 903 cases/day since 20 February obtained by linear fitting compared to 1,664 cases/day for the period from 6 January to 20 February (Figure 2 and 3).
- The 7-day average for the **normal care hospitalization demands has further decreased** compared to last week (22 cases on average for this week compared to 29.3 cases for last week). Also, the average **ICU occupancies has further decreased** to 6.3 cases on average for this week compared to 8.3 cases for last week.
- Based on the continuing stagnation in the relaxation of the epidemic dynamics, the current **midterm projections of daily cases indicate an intermediate plateau for the next days and a subsequent slow decrease** in case numbers for the next weeks with approximately 200 cases/day on average in beginning of April (Figure 4).
- The corresponding **projections for the hospitalization demands** reflect the apparently milder disease progression for the Omicron variant by a reduction of 60% for normal care hospitalization and 80% reduction of ICU hospitalization for the Omicron variant in comparison to the Delta variant. Given these assumptions and the current stagnation, the projections indicate an intermediate plateau in the demands for normal care of around 24 beds for the next days and a subsequent slow decrease (Figure 5). With the adapted assumption for disease severity, the current projection for ICU demands indicates a plateau of around 6 beds on average for the next days and a subsequent decrease (Figure 6). 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 remained rather constant at** around 25% compared to 26% for last week (Figure 7).
- The total number of **estimated active cases has also remained constant with 9,661** cases compared to 9,980 cases for the previous week (Figure 8).

As for last week, the epidemic dynamics exhibits a stagnation in the relaxation probably due to the end of the vacation period and potential catch-up cases as indicated by the temporary rebound in the R_{eff} value. The overall dynamics is consistent with the projections from the time before the vacation period. Thus, it can be anticipated that the relaxing dynamics will continue within the next weeks. The evidence for a reduction in the hospitalization rate for the Omicron variant in comparison to the Delta variant has further manifested and will probably lead to further relaxations in the health care system despite the stagnation in the epidemic dynamics. Nevertheless, sustained efforts in social distancing, in following hygiene measures as well as in vaccination uptake, including booster shots, remain essential to support the epidemic relaxation. Monitoring immunity waning and virus variants will be key to mitigate potential future epidemic rebounds.

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.

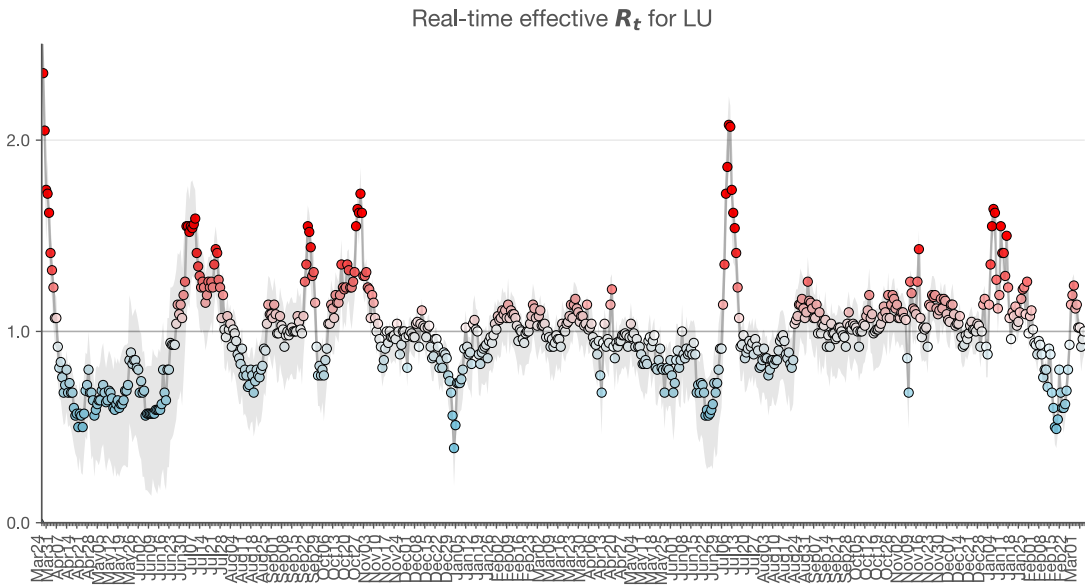

Figure 1. *For the current week, the effective reproduction R_{eff} has decreased to 1.0 today compared to 1.23 on Thursday of last week. The 7-day average of the current week has remained rather constant with 1.03 compared to 0.95 of last week.*

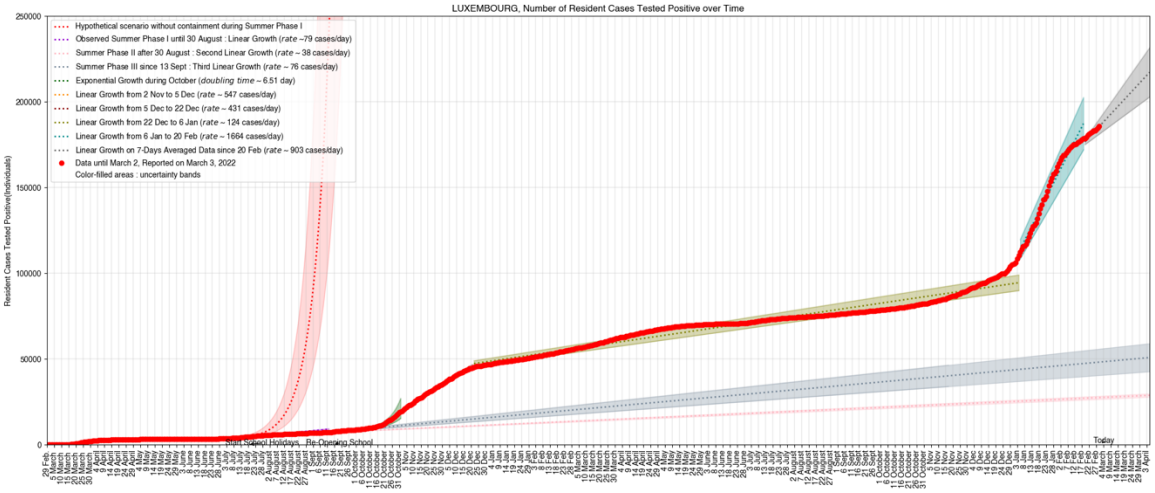

Figure 2. *Official COVID-19 case numbers up to 2 March (red dots) were approximated with an adapted model for short-term forecasts for the different phases of the epidemics (color coded).* ***The dynamics during the current week indicates a rather linear dynamics since 20 February (grey) with a slope of 903 cases/day*** *compared to 1664 cases/day for the fit from 6 January to 20 February.*

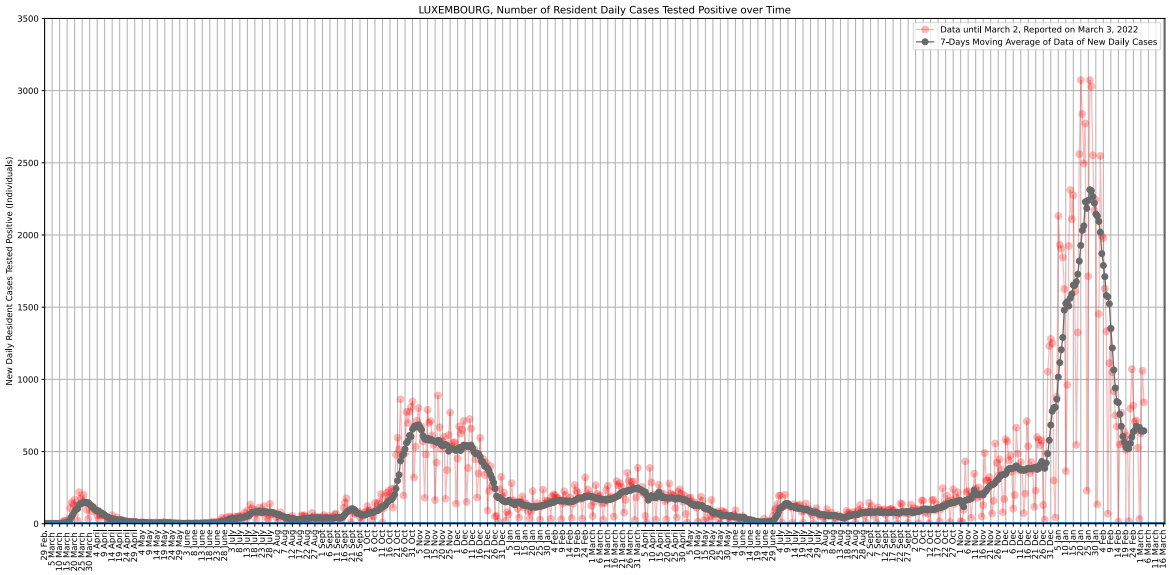

Figure 3. *The daily COVID-19 cases numbers up to 2 March (red dots) and the 7-day average (grey). Note that a linear regime is characterized by a flat curve and that an exponential behavior would correspond to a straight line.* ***For the current week, the 7-day average of daily cases (grey) has remained rather constant with 637 cases/day compared to 605 cases/day for the week before****, which indicates the current linear epidemic regime.*

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 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 to 6).

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 continuing stagnation and the corresponding projections for **the 7-day average of daily cases** indicates a continuing relaxation for the next weeks (Figure 4 left) with a slower trend than in last week's projections (Figure 4 right) as anticipated due to the end of the vacation period. The still stabilized regime is further indicated by the optimistic and pessimistic scenario corresponding to 12% change in social interaction which does not exhibit major differences but more expected cases than the projections from last week with on average 200 cases/day at the beginning of April in the current projection compared to around 150 cases/day in last week's projection. Note that the current projection is in line with projections from the period before the vacation time. In some countries the relaxing trend was followed by a stagnation or even moderate increase potentially due to increased social interactions. Hence, the epidemic dynamics will also depend on the future development of social life and potential import cases.

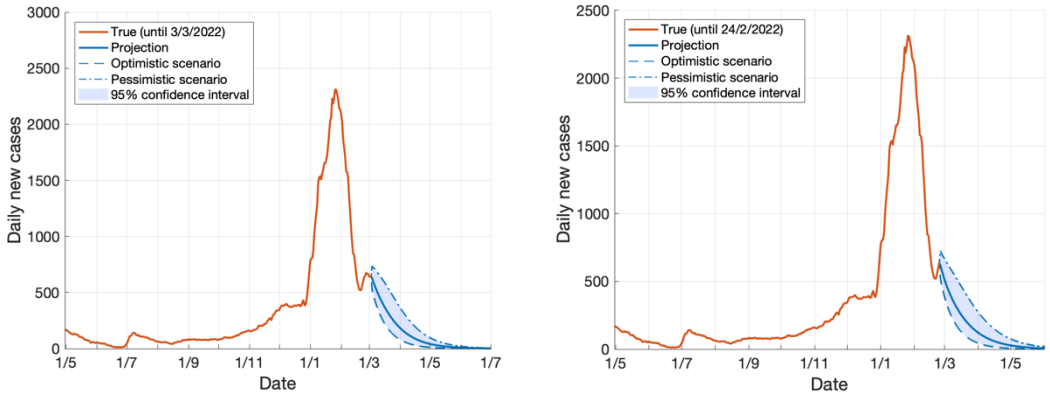

Figure 4. *Comparison of midterm projections for the 7-day average of daily cases from this week (left) and last week (right) based on an extended epidemiological SIR model parameterized to the situation in Luxembourg data by a Kalman filter. The blue solid line represents the most likely scenario whereas 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 last week's projections.* ***The comparison indicates the effect of the stagnation in the relaxation of the epidemics dynamics by the slower anticipated decrease with around 200 cases/day beginning of April compared to 150 cases/day from the projection of last week (right).***

The model **projection for normal care** assumes a 60% decrease in the hospitalization risk for the Omicron variant compared to the Delta variant. Despite the current stagnation in daily case numbers (Figure 4), the projections show a temporary plateau for the next days and a subsequent decrease in normal care demands with around 15 beds at the beginning of April (Figure 5). This dynamics is based on the case numbers shown in Figure 4 and the current age distribution of cases. For the normal care demands, the stagnation in the epidemic relaxation is also reflected in the hospitalizations which also exhibits an intermediate stagnation (Figure 5 left). 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.

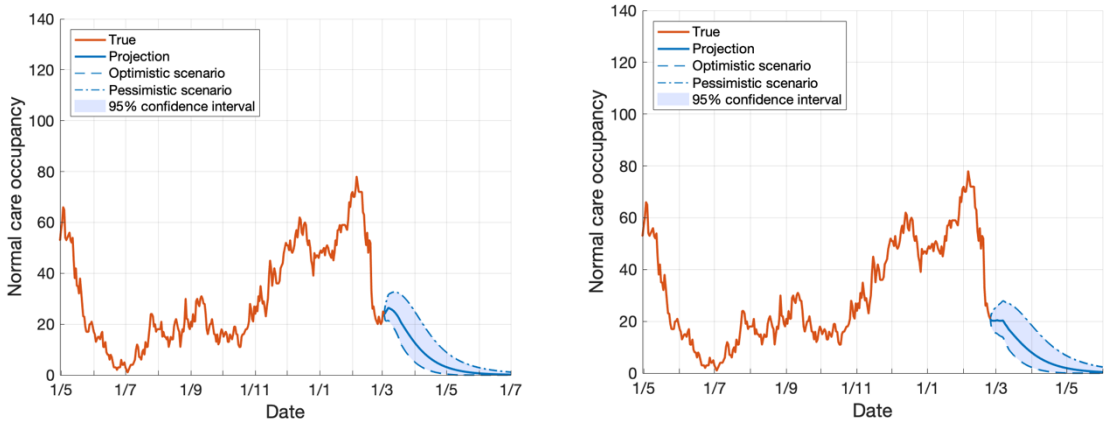

Figure 5. *Comparison of midterm projections for the 7-day average of normal care demands from this week (left) and last week (right) based on the extended epidemiological SIR model. The blue solid line represents the most likely scenario whereas the optimistic (dashed line) and pessimistic scenarios (dashed-dotted line) correspond to a 12% decrease and increase in social interactions.* ***The comparison indicates a temporary stagnation for the next days before the decrease will continue (left) similar to the projections of last week (right)****. The rather stable epidemic regime is indicated by the similar trend in normal care demands for the pessimistic and optimist scenario with a 12% change in social interactions.*

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The corresponding **projections for ICU demands** also reflect the reduced hospitalization risk for the Omicron variant and stagnation in the relaxation of the epidemic dynamics. Together with the current age distribution of cases, the projections with the adapted hospitalization risk indicate a temporary plateau with a subsequent slow decrease in the ICU bed demands for the next weeks from the current level (Fig. 6 left) with a similar trend as in the projection of last week (Fig. 6 right). The pessimistic scenario with a 12% increase in social interactions indicates a slightly slower decrease of cases but anyway on a low level. 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 (including booster shots) and remain cautious in their social interactions to prevent severe cases. Therefore, the projections are accompanied by uncertainties.

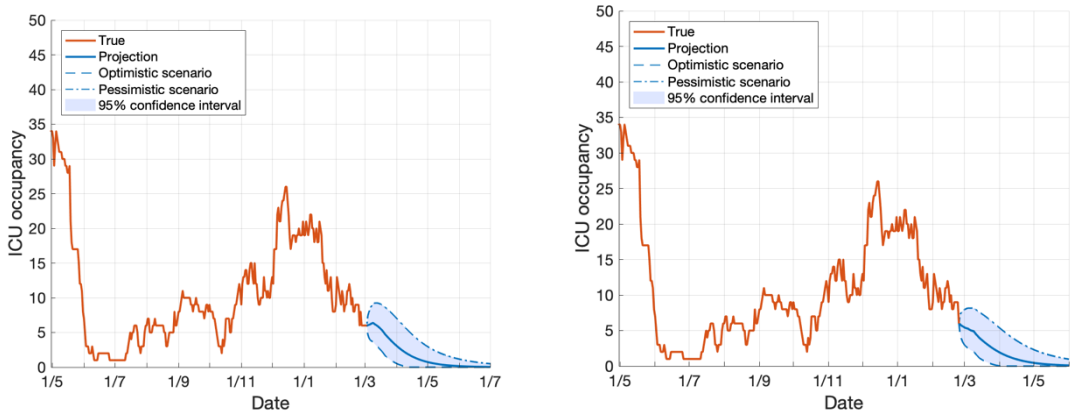

Figure 6. *Comparison of midterm projections for the 7-day average of ICU demands from this week (left) and last week (right) based on the extended epidemiological SIR model. The blue solid line represents the most likely scenario and the optimistic (dashed line) and pessimistic scenarios (dotted-dashed line) correspond to a 12% decrease and increase in social interactions, respectively for this week and a 13% change for the projection of last week.* ***The comparison exhibits a slowly decreasing ICU demands for the next weeks (left) with a similar trend as in the projection of last week's projections (right)****. The current pessimistic scenario with a 12% increase in social interactions exhibits slower but persistent decrease in ICU demand.*

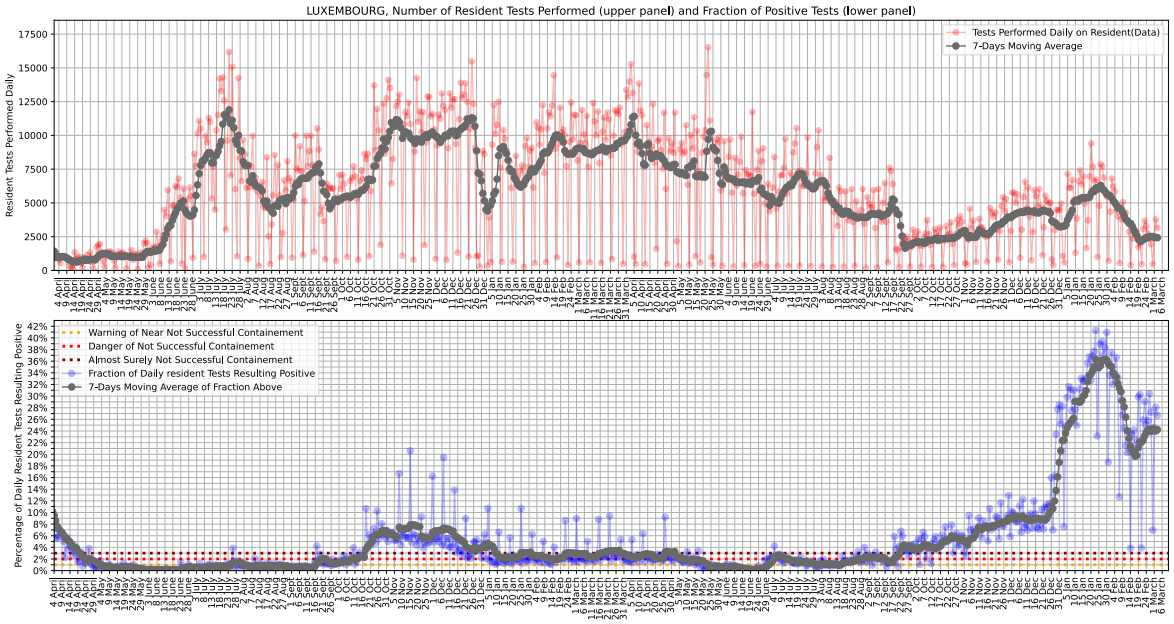

Figure 7. *Number of daily tests performed (top) and overall normalized positive tests (bottom).* ***During the current week, the 7-day average of positivity rate (grey) has remained rather constant with 24%*** *compared to 24% last week.*

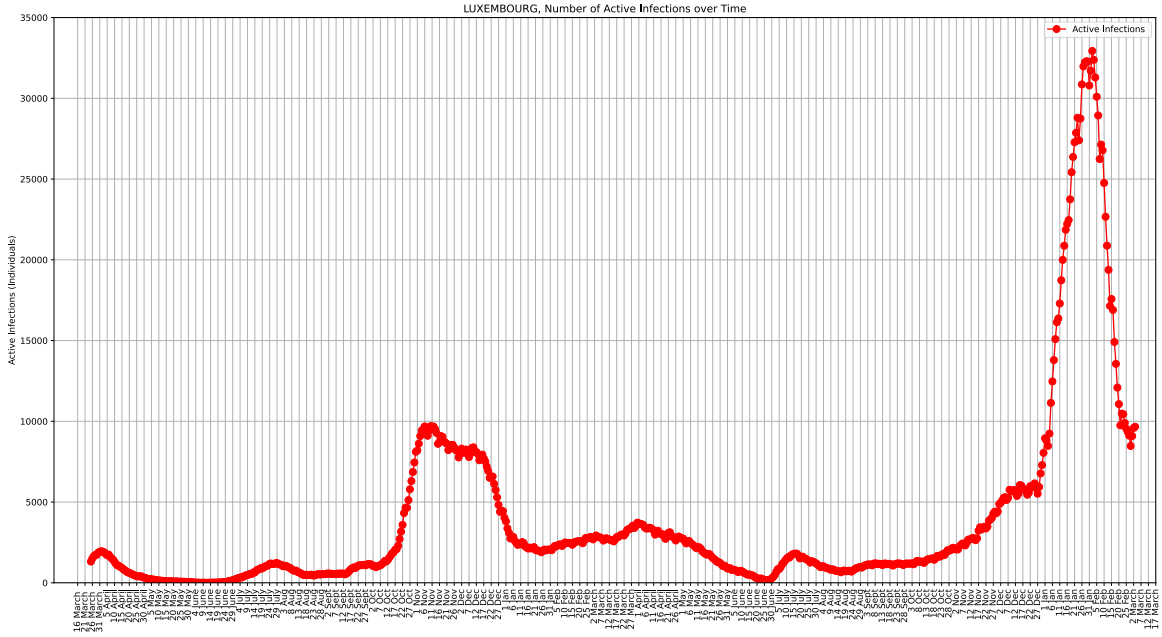

Figure 8. *During the current week,* ***the number of estimated active cases has remained rather constant with 9,661 cases*** *compared to 9,980 cases last week.*

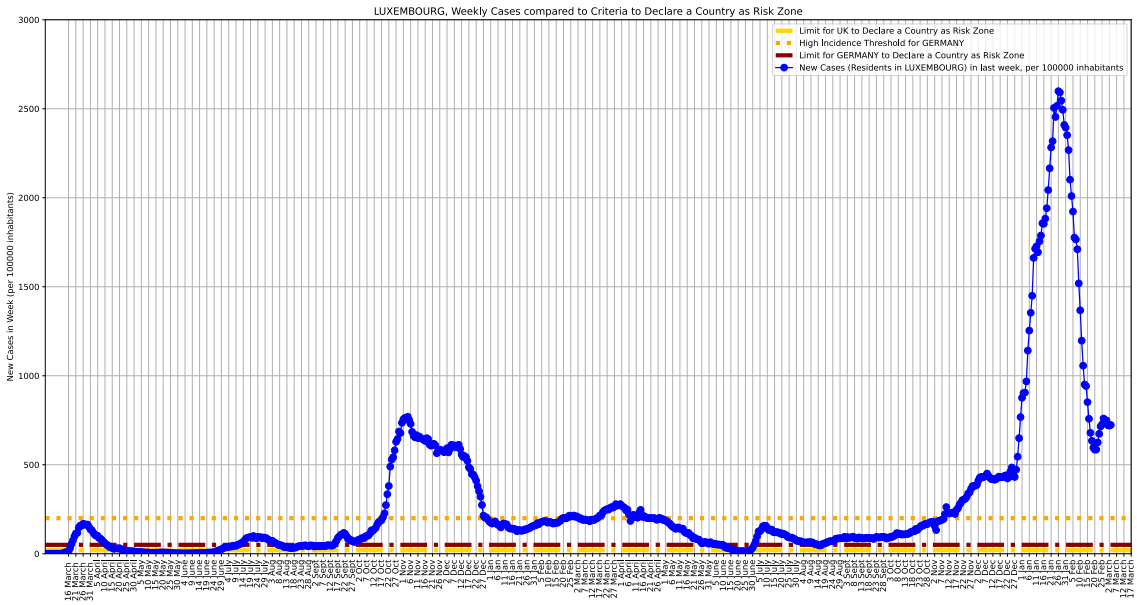

Figure 9. *Number of weekly cases per 100,000 inhabitants that is used by different countries to set thresholds for risk zone definitions such as Germany with 50 cases per week and per 100,000 inhabitants (dark red line)****. During the current week, the number of weekly cases per 100,000 inhabitants remained rather constant at around 700 cases for this week similar to the level of last week.***