

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 27 January. 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 February**.

Main conclusions

- **The development during the current week exhibits a faster relaxation in the epidemic dynamics than anticipated from the projections of last week.** Thus, the 7-day average of daily cases for the current week has decreased to 1871 cases/day compared to 2,307 cases/day for the week before, which corresponds to a 19% decrease compared to a 20% increase last week.
- **R_{eff} of today has decreased to 0.75** compared to 1.01 on Thursday of last week (Figure 1). The 7-day average value of R_{eff} has also decreased significantly to 0.89 for this week compared to 1.11 for the previous week.
- The last week exhibits a relaxing dynamics with a shift from exponential increase towards a decreasing linear regime. A linear fitting to the cumulative cases for the last month still indicates an increased slope of 2,037 cases/day compared to 1,708 cases/day for last week's estimate due to long fitting period which does not reflect yet the recent relaxation (Figure 2 and 3).
- The 7-day average for the **normal care hospitalization demands has strongly increased** compared to last week (68.3 cases on average for this week compared to 58.1 cases for last week). The average **ICU occupancies has further decreased** with 9.7 cases on average for this week compared to 12.3 cases for last week.
- Based on the relaxing trend of the epidemic dynamics, the current **midterm projections of daily cases indicate a continuing decrease** in case numbers for the next weeks with approximately 500 cases/day on average in beginning of March (Figure 4).
- The corresponding **projections for the hospitalization demands** reflect the apparently milder disease progression for the Omicron variant with a 50% reduction of normal care hospitalization and 70% reduction of ICU hospitalization, respectively for the Omicron variant in comparison to the Delta variant. Given these adapted assumptions reflecting the current epidemiological dynamics in Luxembourg and the faster decrease in case numbers than expected, the projections indicate a small decrease in the anticipated peak of normal care demands of around 75 beds in the next weeks compared to 85 beds from last week's projection (Figure 5). With the adapted assumption for disease severity, the current projection for ICU demands is indicating a slightly reduced demands of around 15 beds for the next weeks compared to 20 beds in last week's projection (Figure 6). Note that hospitalization and specifically ICU demands depend strongly on the age structure of the cases and the vaccination status of the population. Hence, it is particularly 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 decreased** to around 33% compared to 36% for last week (Figure 7).
- The total number of **estimated active cases has remained rather constant** with 32,354 cases compared to 31,807 cases for the previous week (Figure 8).

As anticipated from the projection of last week, the epidemic dynamics exhibits a relaxation with a slightly faster decay than expected. Furthermore, the evidence from Luxembourg data indicating a reduction in the hospitalization rate for the Omicron variant in comparison to the Delta variant has further manifested and the current data suggests a reduction of 50%-60% for normal care and a 70%-80% reduction of ICU demands. Despite the current relaxation, the Omicron variant will still lead to high case numbers during the next weeks, which might lead a significant short cut in different sectors, and sustained efforts in social distancing, in following hygiene measures as well as in vaccination uptake, including booster shots, remain essential to mitigate the epidemic rebound.

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.

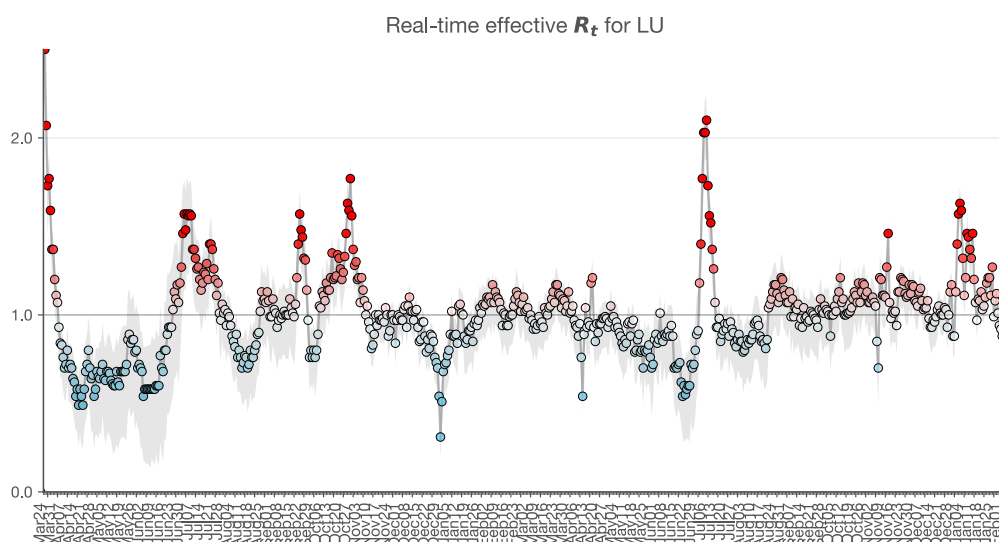


Figure 1. For the current week, the effective reproduction R_{eff} has decreased to 0.75 today compared to 1.01 on Thursday of last week. The 7-day average of the current week has also significantly decreased to 0.89 compared to 1.11 of last week.

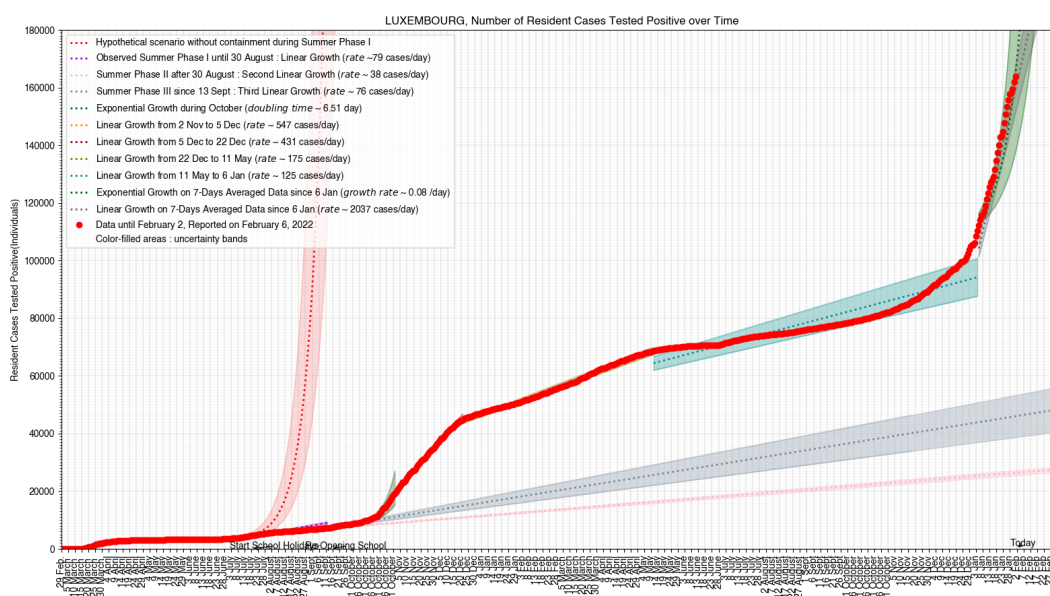


Figure 2. Official COVID-19 case numbers up to 2 February (red dots) were approximated with an adapted model for short-term forecasts for the different phases of the epidemics (color coded). **The dynamics during the current week indicates an exponential (green) regime and a linear fit (grey) exhibits an increased slope of 2,037 cases/day compared to 1,708 cases/day for the fit of last week.**

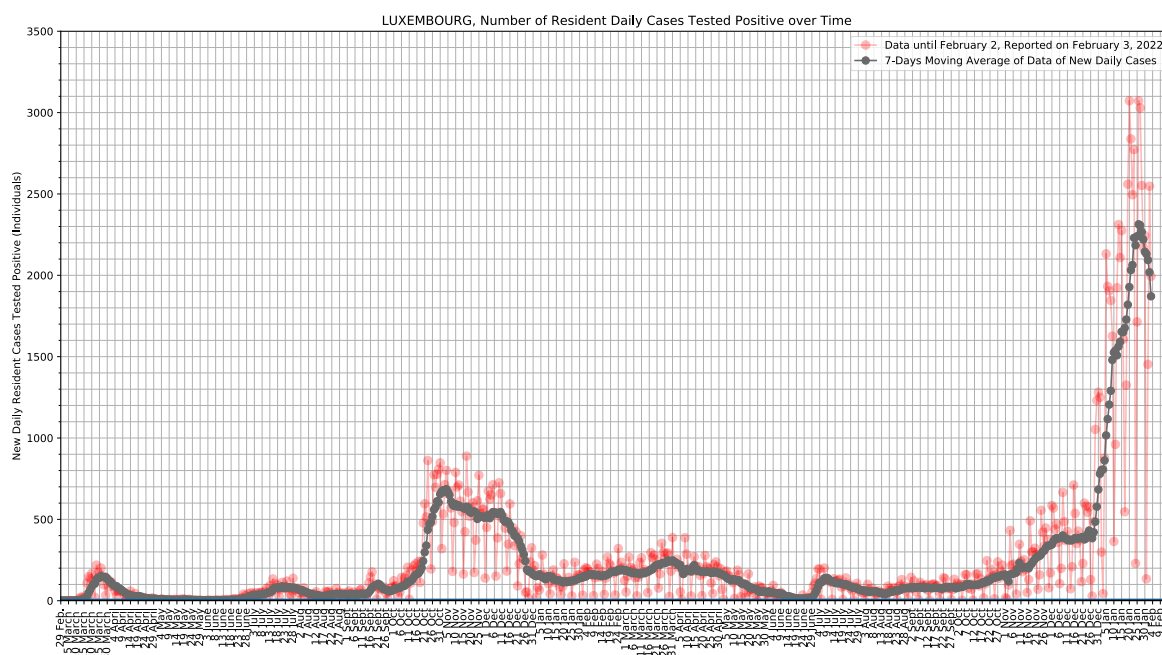


Figure 3. The daily COVID-19 case numbers up to 2 February (red dots) and the 7-day average (grey). Note that a linear regime is characterized by a flat curve and that an exponential behavior would correspond to a straight line. **For the current week, the 7-day average of daily cases (grey) has decreased to 1,871 cases/day compared to 2,307 cases/day for the week before, which corresponds to a decrease of 19% compared to a 20% increase last week.**

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 high and low risk groups, the current state of vaccination, and 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 50% for normal care and 70% for ICU compared to the Delta variant (and might be further adapted in the future since current data indicate a further reduction). 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 an 8% 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 current trend and the corresponding projections for **the 7-day average of daily cases** indicates a continuing relaxation for the next weeks (Figure 4 left) as indicated in last week's projections (Figure 4 right). The stabilized regime is further indicated by the optimistic and pessimistic scenario corresponding to 8% change in social interaction which do not lead to a major difference in expected case numbers of around 500 cases/day on average at the beginning of March. Note that in some countries the relaxing trend was followed by 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 associated to the ski vacation period, including different virus variants.

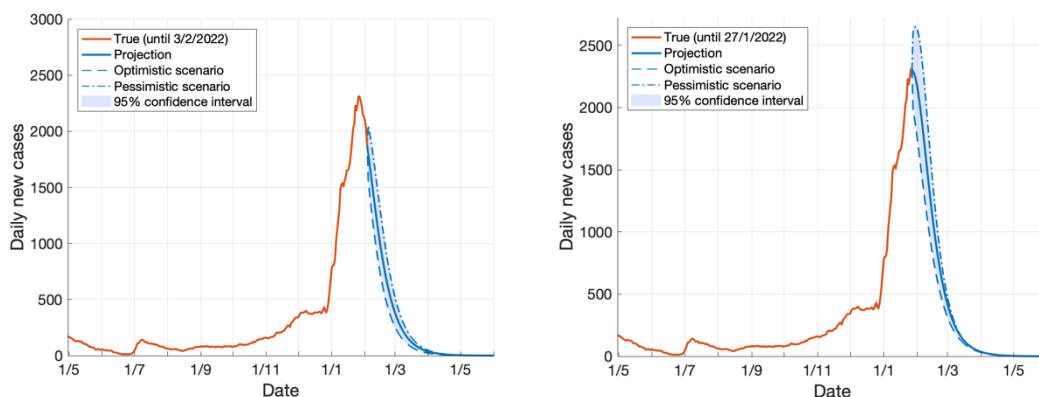


Figure 4. Comparison of midterm projections for the 7-day average of daily cases from this week (left) and the week of 16 December (right) based on an extended epidemiological SIR model parameterized to the situation in Luxembourg data by a Kalman filter. The blue solid line represents the most likely scenario whereas the optimistic (dashed line) and pessimistic scenarios (dashed-dotted line) correspond to an 8% decrease and increase in social. **The comparison indicates a continuing decrease in the 7-day average for the next weeks with around 500 cases/day beginning of March similar to the projection from last week (right).**

The model **projection for normal care** assumes a 50% decrease in the hospitalization risk for the Omicron variant compared to the Delta variant. The current relaxation in daily case numbers (Figure 4) suggests a rather constant level of normal care demands of around 75 beds in the next weeks compared to 85 beds in the projection from last week with a subsequent decrease (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 more stable epidemic regime is also reflected by a only minor increase in hospitalizations for the pessimistic scenarios with an 8% increase in social interactions (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, particularly for the Omicron variant. Furthermore, current data from Luxembourg indicates a stronger reduction in the hospitalization risk for the Omicron variant compared to the Delta variant which would lead to less demands. Hence, changes in the age distribution and the administration of booster shots can significantly modify the projections.

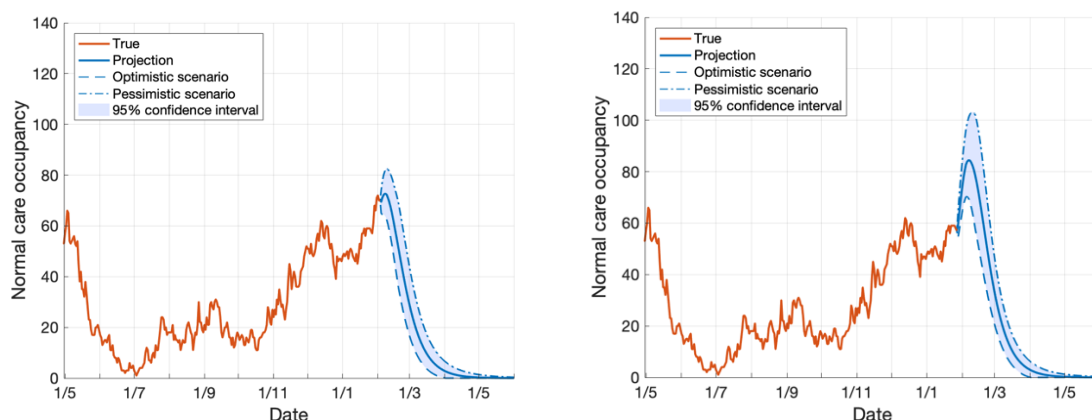


Figure 5. Comparison of midterm projections for the 7-day average of normal care demands from this week (left) and last week (right) based on the extended epidemiological SIR model. The blue solid line represents the most likely scenario whereas the optimistic (dashed line) and pessimistic scenarios (dashed-dotted line) correspond to an 8% decrease and increase in social interactions, respectively for this week, and 6% for the projections from last week. **The comparison indicates a rather constant level in normal care demands of around 75 beds for the next weeks (left) compared to 85 beds in the projections of last week (right).** The more stable epidemic regime is further indicated by the rather similar normal care demands for the pessimistic scenario with an 8% increase in social interactions.

The corresponding **projections for ICU demands** also reflect the reduced hospitalization risk for the Omicron variant and relaxed epidemic dynamics. Together with the current age distribution of cases, the projections with the adapted hospitalization risk only indicate a reduced demand of around 15 ICU beds for the next weeks (Fig. 6 left) compared to 20 beds in the projection of last week (Fig. 6 right). The pessimistic scenario with an 8% increase in social interactions indicates around 20 ICU cases in February but for the current estimate of the ICU hospitalization risk this represent a rather conservative estimate. 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.

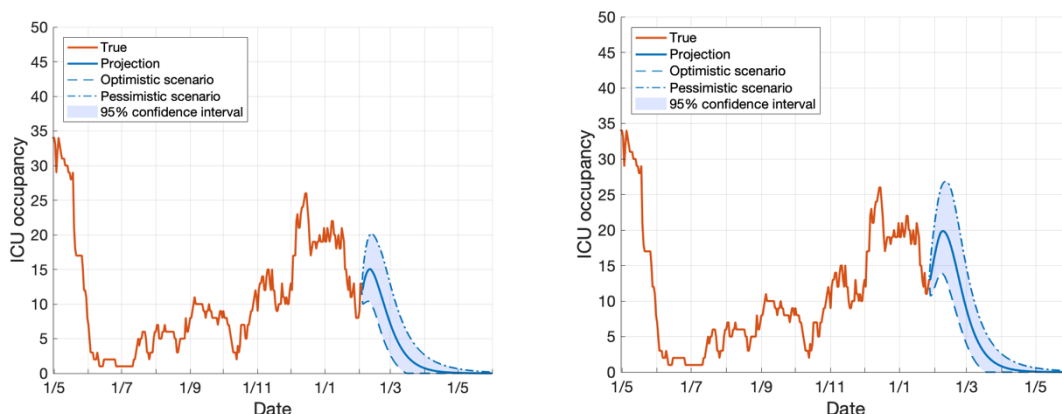


Figure 6. Comparison of midterm projections for the 7-day average of ICU demands from this week (left) and last week (right) based on the extended epidemiological SIR model. The blue solid line represents the most likely scenario and the optimistic (dashed line) and pessimistic scenarios (dotted-dashed line) correspond to an 8% decrease and increase in social interactions, respectively for this week and a 6% change for the projection of last week. **The comparison exhibits a rather constant ICU demands of around 15 ICU beds for the next weeks (left) compared to around 20 beds in last week's projections (right).** The current pessimistic scenario with an 8% increase in social interactions also shows a potential increase to around 20 ICU beds in February.

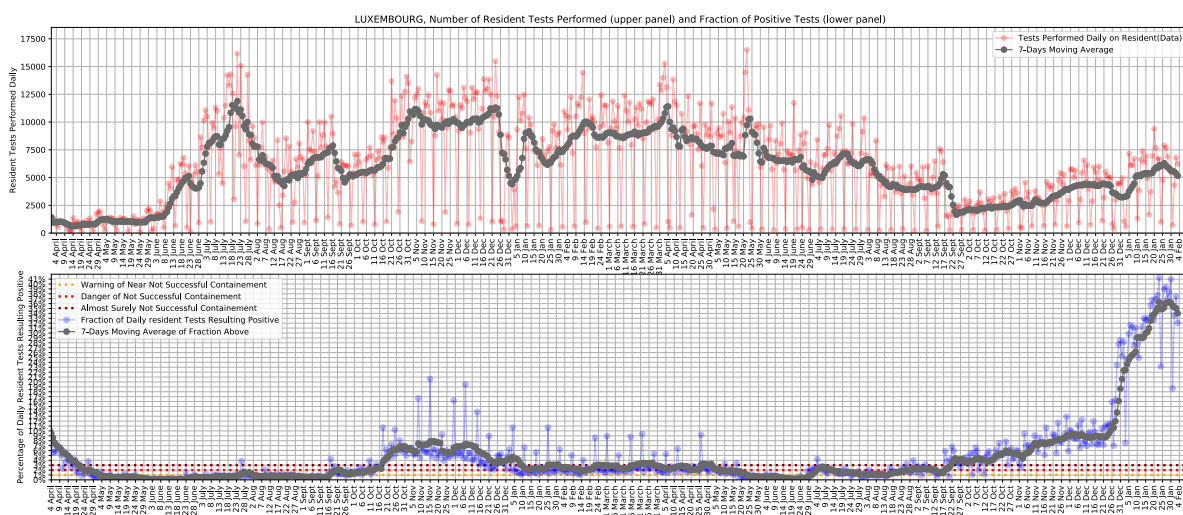


Figure 7. Number of daily tests performed (top) and overall normalized positive tests (bottom). **During the current week, the 7-day average of positivity rate (grey) has decreased to 33% compared to around 36% last week.**

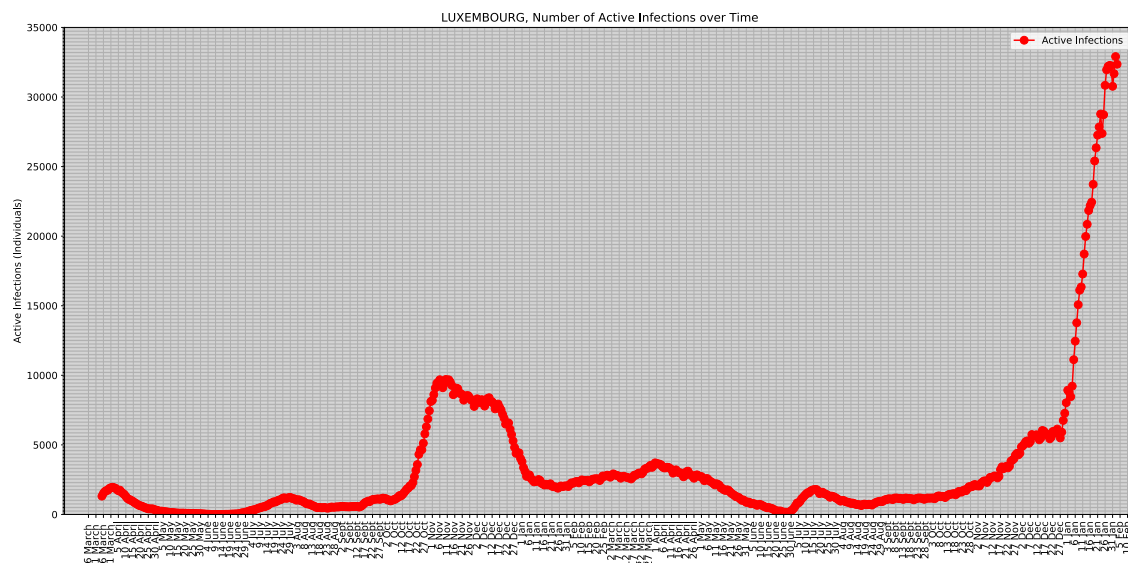


Figure 8. During the current week, the number of estimated active cases has remained rather constant at 32,354 cases compared to 31,807 cases last week.

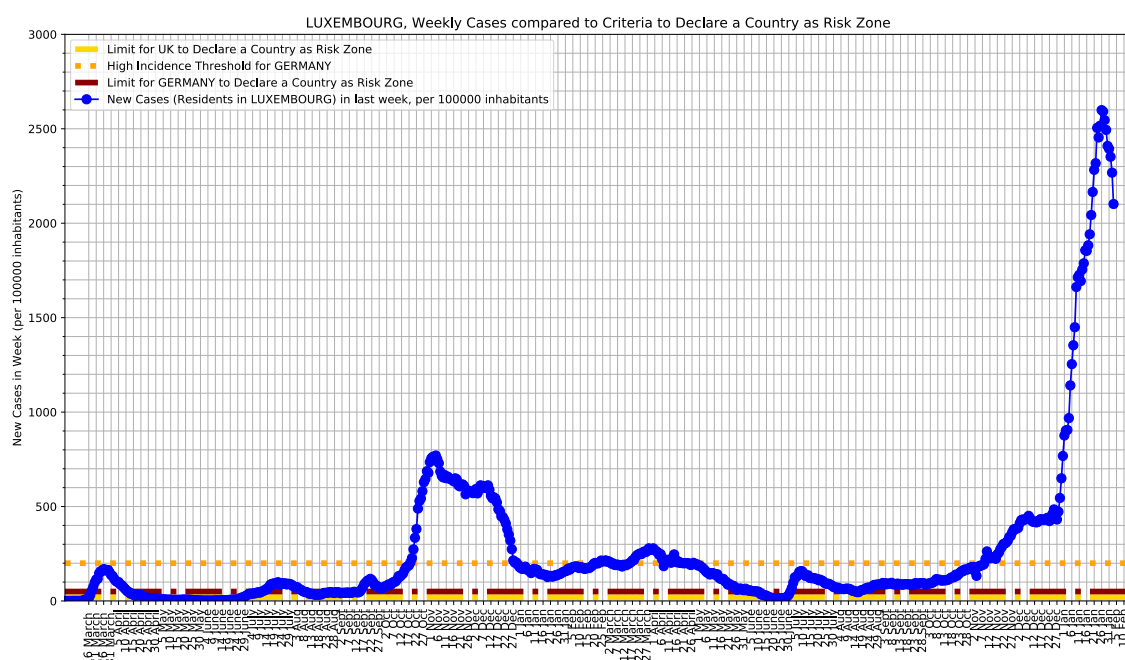


Figure 9. Number of weekly cases per 100,000 inhabitants that is used by different countries to set thresholds for risk zone definitions such as Germany with 50 cases per week and per 100,000 inhabitants (dark red line). During the current week, the number of weekly cases per 100,000 inhabitants has decreased to 2,100 cases for this week compared to around 2,600 cases last week.