

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 week's report from 18 February. It gives a short overview on the most important indicators and contains projections and an analysis of the current epidemic status **based on data available up to 24 February**.

Main conclusions

- **The development during the current week indicates that the epidemic dynamics is further progressing towards a more volatile stage with evidences for a potential epidemic rebound based on more contagious virus variants.** The daily cases exhibit a continuing increasing trend despite the school closure during the past 2 weeks, which was anticipated to decrease social interactions and therefore infections. Thus, the linear trend of cumulative cases estimated by curve fitting has again increased to 154 cases/days (compared to 147 cases/day from last week's projection).
- **R_{eff} has stayed rather constant at 1.05** today compared to 1.04 on Thursday of last week, which corresponds now to a doubling time of 8.1 days (compared to 8.3 days of last week). The R_{eff} average of the current week has increased to 1.09 compared to 1.0 of last week. Note that these values larger than 1 further indicate the increasing daily case numbers.
- The total number of estimated active cases has increased at around 2927 cases.
- The projections of the midterm model for daily cases exhibit again a more pessimistic trend compared to last week's projection. **When considering the higher contagiousness of the UK virus variant, the projections indicate that the increase in daily case numbers might represent the start of an epidemic rebound.** The current estimate for the prevalence of the more contagious UK virus variant (B.1.1.7) of 57% for the second week of February is very close to the previous projections from last week with the slightly reduced social interactions of 3% compared to beginning of February. The projections indicate a potential rebound with a peak in daily cases of around 500 cases/day in May. [Note that prevalence data of the more contagious UK virus variant is not yet fully representative (except for the second week of February) and therefore the assessment is accompanied with a high uncertainty. Furthermore, the projections reflect the possible evolution of the pandemic in case the current trend – and thus the current societal behavior – continues and does not take the effect of vaccination or changes in social interactions explicitly into account.]
- Hence, the **current epidemic situation is further developing towards a potential epidemic rebound driven by the more contagious virus variants.** This makes common social efforts in reducing physical interactions, respecting hygiene measures and active participation in large-scale testing now even essential to suppress this potential epidemic rebound.

Analysis of the current situation

Overall, the epidemic situation has further developed towards a volatile epidemic regime during the current week as shown by

- (i) a rather constant R_{eff} value of 1.05 (compared to 1.04 last week) that corresponds now to a doubling time of 8.1 days compared to 8.3 days last week (Figure 1),
- (ii) the analysis of daily new cases and corresponding projections by curve fitting that exhibits again an increase in the linear trend of 154 cases/compared to 147 cases/days from last week's projection (Figures 2 and 3),
- (iii) the midterm projection by an epidemiological SIR model exhibits again a more pessimistic estimate compared to last week's projection (Figures 4). Considering the more contagious UK virus variant indicates a substantial danger of an epidemic rebound (Figure 5 and 6),
- (iv) an increase in the positivity rate to around 3% from 2% last week (Figure 7),
- (v) an increase in the number of estimated active cases to 2927 (Figure 8).

The analysis indicates that, despite the past vacation period, the epidemic status is on a volatile level. Thus, the evidences for the anticipated turning point in the epidemic dynamics has manifested and the presence of the more contagious UK virus variant bears the danger of a significant epidemic rebound (Figure 5 and 6) and makes ongoing social efforts essential to stabilize the epidemic state again. Therefore, strict monitoring of the epidemic dynamics and representative data on the virus variants over the next weeks are important to evaluate the epidemic regime.

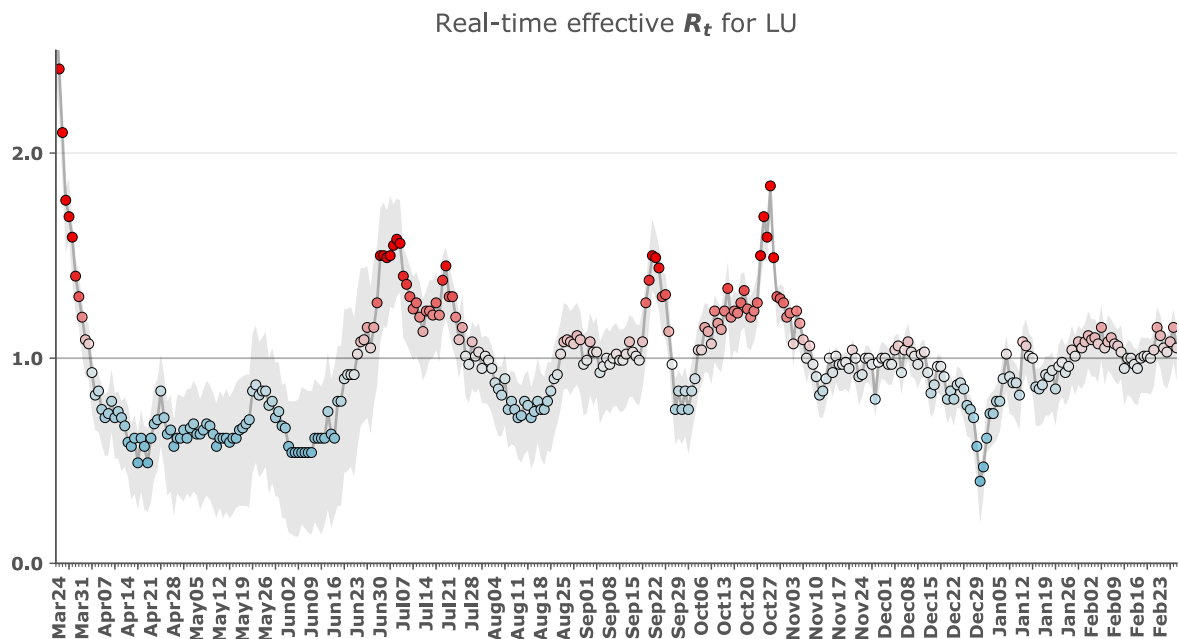


Figure 1. For the current week, the effective reproduction number in Luxembourg exhibits a rather constant value with 1.05 for today compared to 1.04 for last Thursday which corresponds to a doubling time of 8.1 days compared to 8.3 days last week. The weekly average has slightly increased to 1.09 for this week compared to 1.0 for last week. Note that effective mitigation requires values below 0.8.

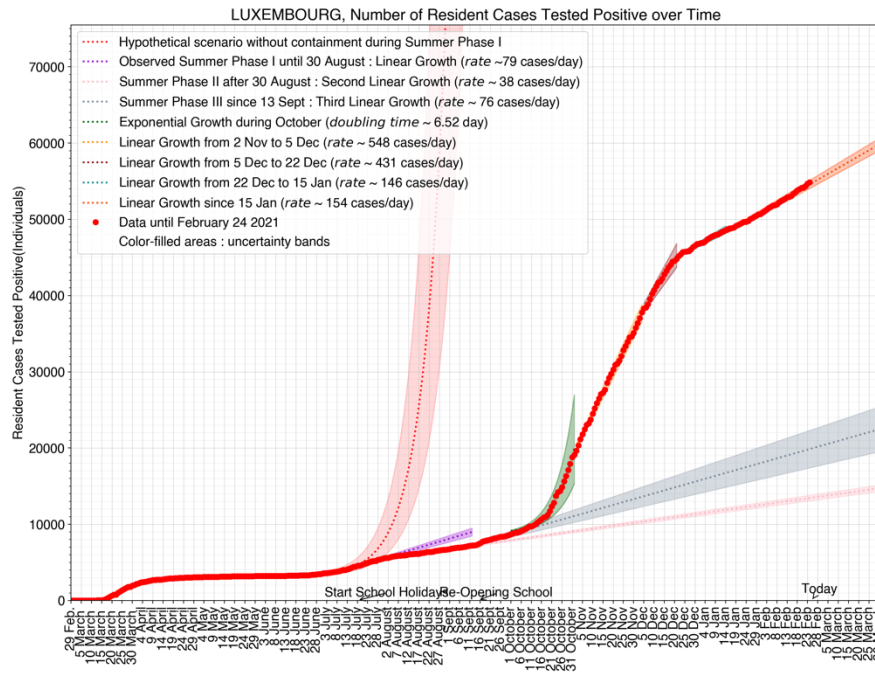


Figure 2. Official COVID-19 case numbers up to February 24 (red dots) were approximated with an adapted model for short-term forecasts. From 14 June on an initial exponential increase was observed as a second wave (red line). From mid to end of July the daily increase of cases showed an increase of 80 cases/days (summer phase I, magenta line) and from beginning of August to mid of September a linear increase of 38 cases/days (summer phase II, red line). After the end of the vacation period mid of September, the situation seemed to have a similar behavior as the summer phase I with 76 cases/day (summer phase III, grey line). The development during October indicated an accelerated exponential behavior (green) with a high number of daily cases. During November, the dynamics exhibits a linear behavior (orange line) with a rather constantly but high number of 548 cases/days. For beginning to mid of December, the independent fit shows a reduced rate of 431 cases/day (magenta) which has been further reduced to 135 cases/day during the holiday period. **For the current week, the trend since mid of January has increased to 154 cases/day (compared to 147 cases/day from last week's projection) (orange).**

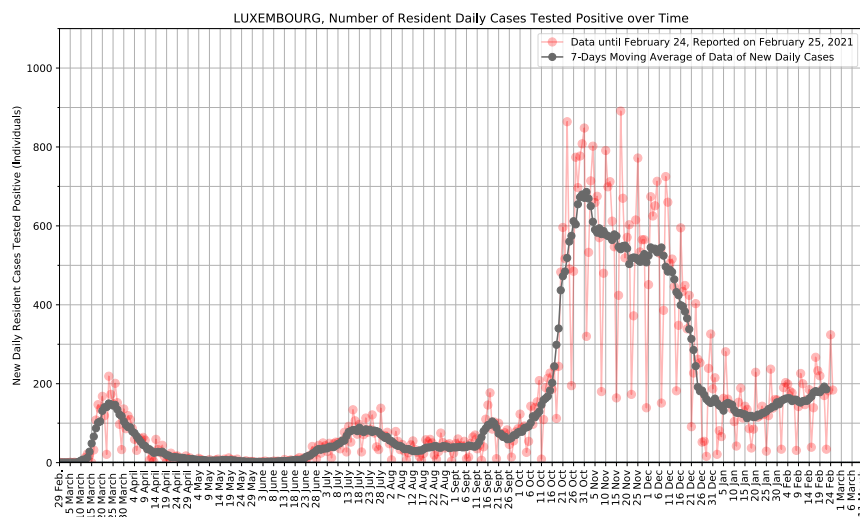


Figure 3. The daily COVID-19 case numbers up to February 24 (red dots) and the 7-day average (grey). Note that a linear regime is characterized by a flat curve such as during the vacation period with 38 cases/day and an exponential behavior would correspond to a straight line such as for end of September to beginning October. During October, the curve clearly exhibited a non-linear increase in daily cases which corresponds to an accelerated exponential dynamics. For the first weeks in November, the numbers exhibited a small but consistently decreasing trend. After the stagnation during November and beginning of December, the number of daily cases has consistently decreased during December but was also amplified by the reduced testing over the holidays. **During the last 2 weeks, the number of daily cases has continuously increased and the 7-day average is reaching nearly 200 cases/day.**



To estimate the midterm dynamics, we also apply an SIR model and parameterized it by a Kalman filter. The increased case numbers for the current week have again led to a more pessimistic midterm projections compared to last week's projection (Figure 4). **Note that this model does not consider the more contagious UK virus variant and is therefore still projecting decreasing case numbers whereas considering the UK virus variant demonstrates the potential epidemic rebound (Figure 5).**

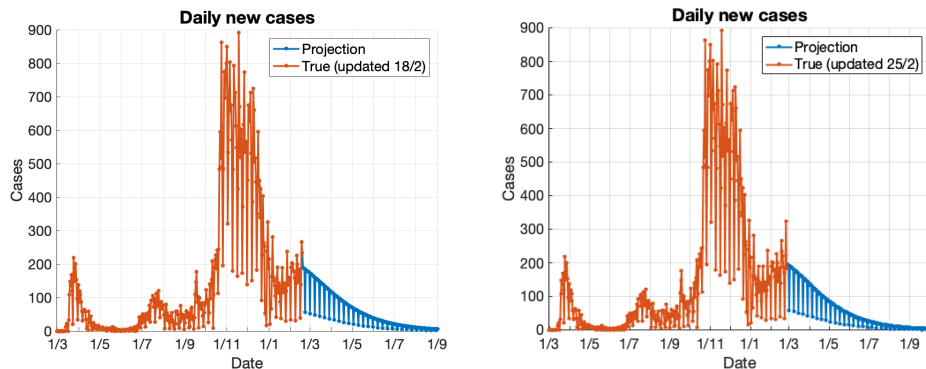


Figure 4. Comparison of midterm projections for daily cases from last week (left) and this week (right) based on an epidemiological SIR model parameterized by a Kalman filter. **The comparison exhibits again a more pessimistic projection compared to last week but still suggests a slow decrease in the daily case numbers over the next weeks. However, considering the more contagious UK virus variant, the model projects a significant rebound as shown in Figure 5.**

From the current available data, we estimate a 39% increased contagiousness of the UK virus variant where the frequency of variants currently reported in Luxembourg is not yet fully representative (except for the second week of February) but only indicative due to a potential selection bias of sequenced samples and a low number of samples with full metadata. With the reported 57% prevalence of the UK virus variant (B.1.1.7) in Luxembourg for the second week of February and the 39% increased contagiousness, the projection with the current estimated social interactions indicates an epidemic rebound with a peak of around 500 cases/day in May (Fig. 5 left). Note that this projection is very well aligned with the previous projection of last week, which considered a prevalence of 16% for end of January, a 37% increased contagiousness and a 3% reduction in social interactions compared to beginning of February (Fig. 5 right). Figure 6 shows corresponding zooms into the current time frame for the previous projections to allow for better comparison between the recent case numbers and the projections from 3 weeks ago. Note that the projections do not consider the effect of vaccination or changes in social interactions explicitly.

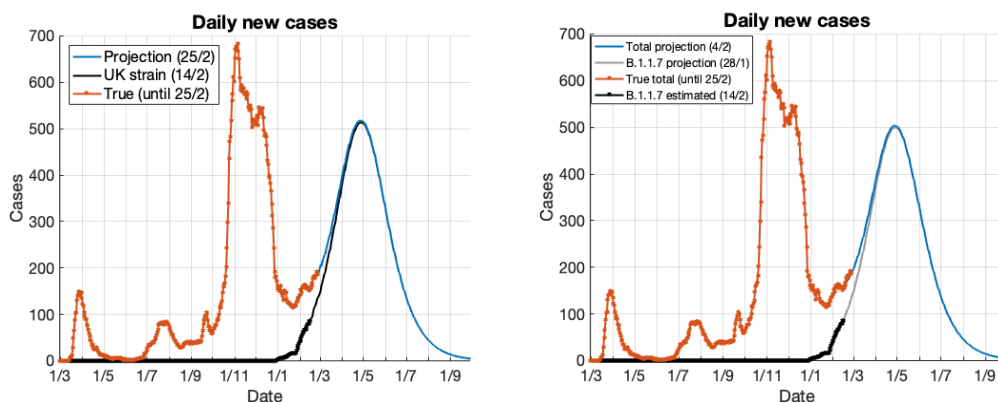


Figure 5. Estimates of the potential effect of the more contagious UK virus variant. Based on the epidemic dynamics of observed cases (red line for 7-day average), the projections show the overall dynamics (blue) and the potential contribution of the UK strain B.1.1.7 (black). **Left:** Considering the reported prevalence of 57%, a 39% increased contagiousness and current social interactions, the projection exhibits a potential rebound with a peak of 500 cases/day in May. **Right:** Projections from last week, considering a prevalence of 16% for end of January, a 37% increased contagiousness and a 3% reduction in social interactions compared to beginning of February, exhibit a very similar dynamics and indicate the accuracy of the projections. [Note that the model does not consider vaccinations or the effect of potential changes in social interactions.]

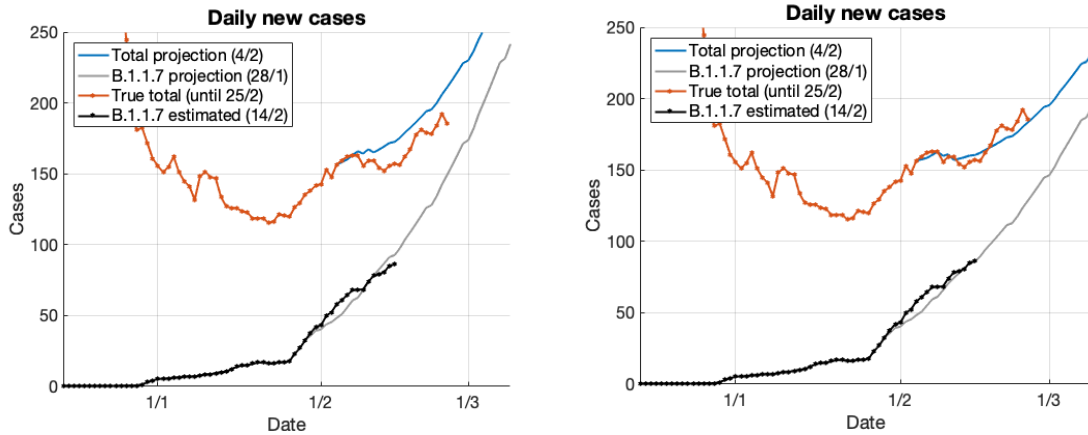


Figure 6. Zoom-in of projections from 4 February shown in the right panel of Fig. 5 on the potential effect of the more contagious UK virus variant. For the last 3 weeks, the epidemic dynamics of observed cases (red line for 7-day average) are in rather good agreement with the previous projections from 4 February for the overall dynamics (blue line) and the potential contribution of the UK strain (black) for an estimated 37% increased contagiousness of the UK variant. **Left:** Considering social interactions as of the beginning of February, the projections (blue) slightly overestimated the real case numbers (red). **Right:** With a 3% reduction in social interactions for the last 3 weeks (potentially linked to school break and/or more cautious behavior of the population), the projections (blue) describe the data (red) rather well and further indicates the potential epidemic rebound shown in Figure 5. [Note again, that the frequency of variants reported is not yet fully representative (except for the second week of February) but only indicative of samples referred to LNS for sequencing with potential selection bias with only a low number of samples with full metadata.]

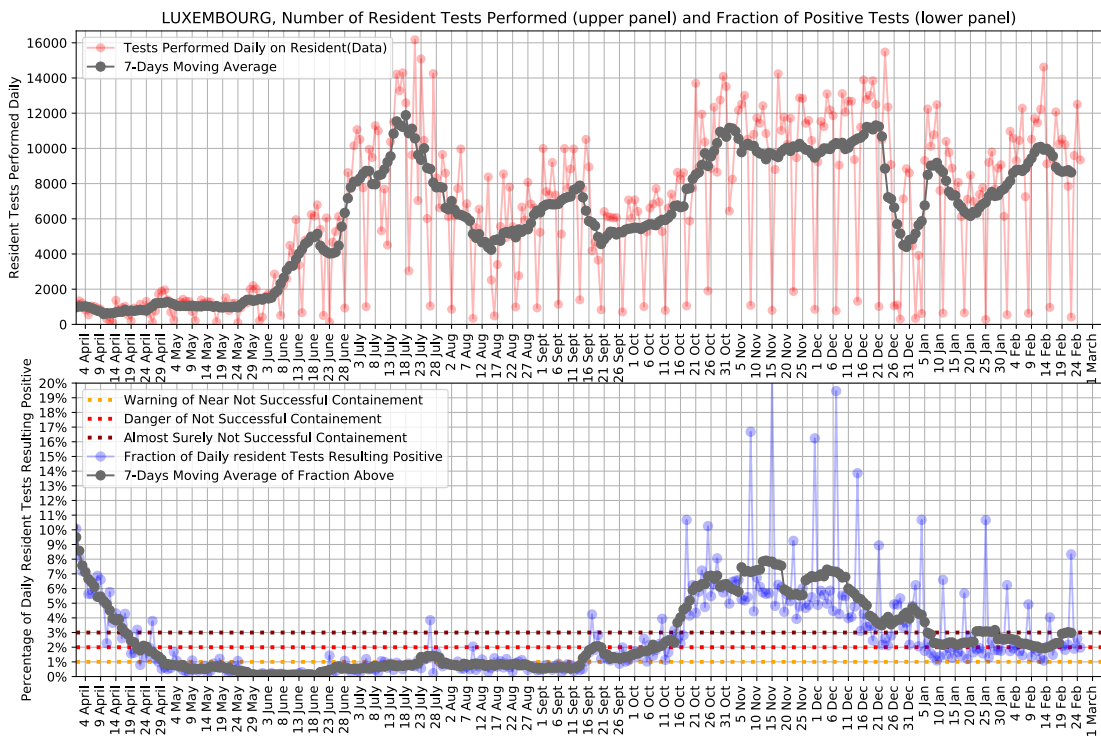


Figure 7. The number of daily tests performed (top) and overall normalized positive tests (bottom). The number of daily tests has been significantly reduced over the holiday period. **During the current week, the 7-day average positivity rate (grey) as increased from 2% to around 3%.**

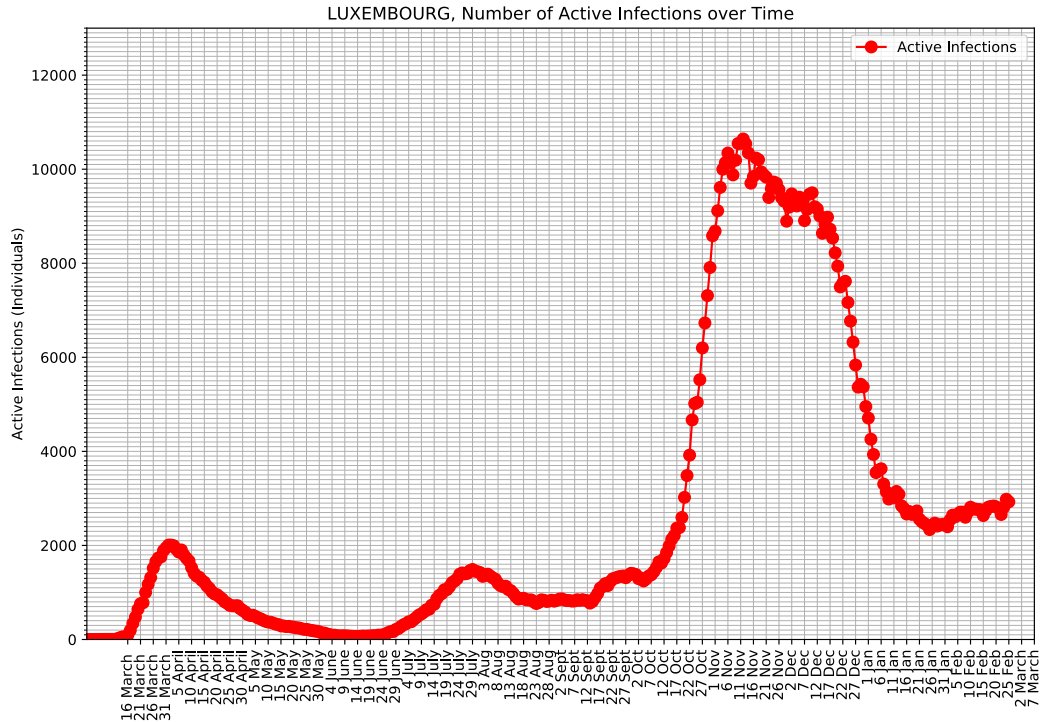


Figure 8. During the current week, the number of estimated active cases has increased to 2927 cases.

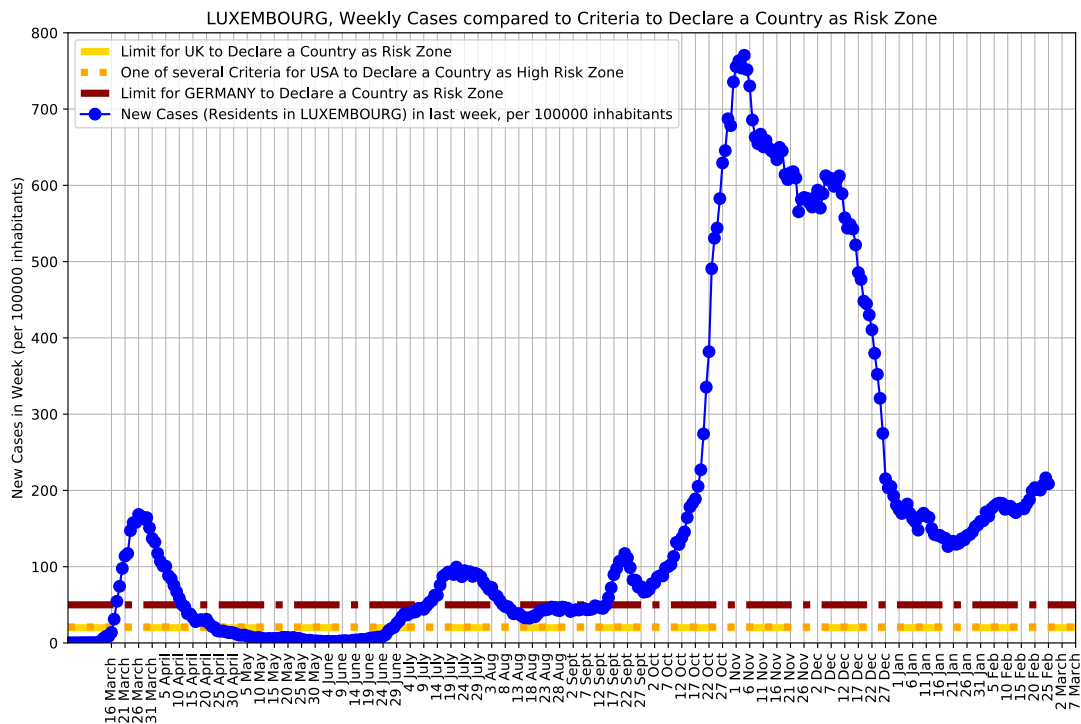


Figure 9. The number of weekly cases per 100,000 inhabitant that is used by different countries to declare thresholds for risk zone definitions such as Germany with 50 cases per week and 100,000 inhabitants (dark red line). Luxembourg has surpassed this threshold since the week of 17 September and has reached more than 700 cases per week and 100,000 inhabitants beginning of November. **During the current week, the number of weekly cases per 100,000 inhabitants has just crossed the 200 mark again.**