



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

27 January 2022

Authors: Atte Aalto, Silvia Martina, Daniele Proverbio, Stefano Magni, Françoise Kemp, Paul Wilmes, Jorge Goncalves, Alexander Skupin

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 20 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 26 January**.

Main conclusions

- The development during the current week exhibits a continuing exponential epidemic dynamics but with a further slightly relaxed trend. Thus the 7-day average of daily cases for the current week has further increased to 2,307 cases/day compared to 1,925 cases/day for the week before, which corresponds to a 20% increase compared to a 23% increase observed last week.
- R_{eff} of today has decreased to 1.01 compared to 1.21 on Thursday of last week (Figure 1). The 7day average value of R_{eff} has remained rather constant with 1.11 for this week compared to 1.12 for the previous week.
- The last week exhibits a continuing exponential dynamic with a slightly decreased trend. A linear fitting to the cumulative cases for the last month indicates an increased slope of 1,708 cases/day compared to 1,245 cases/day for last week's estimate (Figure 2 and 3).
- The 7-day average for the **normal care hospitalization demands has increased** compared to last week (58.1 cases on average for this week compared to 52.9 cases for last week). The average **ICU occupancies has further decreased** with 12.3 cases on average for this week compared to 18 cases for last week.
- Based on the current trend of the epidemic dynamics, the current **midterm projections of daily cases indicate a potential slowing down of the increase** in case numbers for the next weeks with an anticipated peak in the 7-day average of daily cases of around 2500 cases/day beginning of February (Figure 4). Note that the projections do not consider future changes in social behavior.
- 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. With these adapted assumptions reflecting the current epidemiological dynamics in Luxembourg, the projections indicate a small increase in the normal care demands to around 85 beds in February compared to 90 beds from last week's projection (Figure 5). With the adapted assumption for disease severity, the current projection for ICU demands is indicating a potential demand of around 20 beds for the next weeks (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 further increased to around 36% compared to 33% for last week (Figure 7).
- The total number of **estimated active cases has further increased** to 31,807 cases compared to 26,318 cases for the previous week (Figure 8).



As expected, the increased transmissibility and partial immune evasion of the Omicron variant has led to a continuing increase in case numbers, which led to a significant epidemic rebound. Although evidences from Luxembourg data seem to overall indicate a reduction in hospitalization rate for the Omicron variant in comparison to the Delta variant similarly to what is observed in Denmark, data from the USA still indicate a potential significant increase in hospital demands. As the Omicron variant is likely to still lead to a further increase in the case numbers which might lead a significant short cut in different sectors, 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 1.01 today compared to 1.21 on Thursday of last week. The 7-day average of the current week has remained constant with 1.11 compared to 1.12 of last week but remains on a high level.



Figure 2. Official COVID-19 case numbers up to 26 January (red dots) were approximated with an adapted model for shortterm forecasts for the different phases of the epidemics (color coded). **The dynamics during the current week indicates a exponential (green) regime and a linear fit (grey) exhibits an increased slope of 1,708 cases/day** compared to 1,245 cases/day for the fit of last week.





Figure 3. The daily COVID-19 case numbers up to 26 January (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 further increased to 2,307 cases/day compared to 1,925 cases/day for the week before, which corresponds to an increase of 20% compared to a 23% 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 a 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 small increase in the anticipated peak of cases to around 2300 cases/day for the next days (Figure 4 left) compared to a peak of 2,000 cases/days in last week's projections (Figure 4 right) and is in the range of last week's pessimistic scenario with a 6% increase in social interactions and an epidemic rebound with a peak of around 2,400 cases/day. This is also in agreement with the comment of last week that except for the UK and the USA, which exhibit a decrease in daily cases, the case numbers are still raising in most other countries such as Denmark, France or Germany and therefore suggesting that the pessimistic projection might become a more likely scenario. With this assumption, the projections indicate a further increase in daily case numbers above 2,500 cases/day within the next weeks and assuming further increased interactions on a level as of last December might lead to a peak of more around 3,500 cases/day.





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 a 8% decrease and increase in social interactions for this week's and 6% for last week's projections, respectively. The comparison indicates a further increase of the dynamics with an anticipated peak in the 7-day average of around 2300 cases/day in February compared to 2000 cases/day in 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. Therefore, the increase in case numbers (Figure 4) is only partially mimicked in the anticipated peak of normal care demands of around 85 beds in February compared to 90 beds in the projection from last week (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 epidemic rebound might still lead to a more significant increase in hospitalizations as shown by the pessimistic scenarios with a 8% increase in social interactions, which could lead to an increase in hospital demands in February of around 100 cases (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 a 8% decrease and increase in social interactions, respectively for this week, and 6% for the projections from last week. **The comparison indicates an increase in normal care demands to around 85 beds in February (left) compared to a larger peak of 90 beds in the projections of last week (right)** based on the reduced hospitalization risks. The volatile epidemic regime could lead to a more significant increase in normal care demands as shown by the pessimistic scenario with a 8% increase in social interactions leading potentially to around 100 cases in February.



The corresponding **projections for ICU demands** also reflect the reduced hospitalization risk for the Omicron variant. Together with the current age distribution of cases, the projections with the adapted hospitalization risk only indicate a moderate increase to around 20 ICU beds for the next weeks (Fig. 6 left) similar to the projection of last week (Fig. 6 right). The pessimistic scenario with a 8% increase in social interactions indicates around 27 ICU cases in February. Note that hospitalization and specifically ICU demands depend strongly 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. The current data on the hospitalization risk for the Omicron variant is still not coherent and therefore the projections are accompanied by uncertainties. In this respect, the current data may indicate a further reduction of the severity risk which would lead to subsequent smaller demands.



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 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 20 ICU beds for the next weeks (left) similar to last week's projections (right)**. The current pessimistic scenario with a 8% increase in social interactions also shows a potential increase to around 27 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 further increased to above 36% compared to around 33% last week.





Figure 8. During the current week, the number of estimated active cases has further increased to 31,807 cases compared to 26,318 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 further increased to 2,600 cases for this week compared to around 2,200 cases last week.