RESEARCH LUXEMBOURG
COVID-19 Task Force

Policy brief: COVID-19 situation assessment

29 September 2022

Background information

This policy brief 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 policy brief dated 30 June 2022. The assessment is based on a **set of indicators** detailed below. It gives a short overview on those indicators and contains projections and an analysis of the current epidemic status **based on data on inhabitants available up to 28 September 2022**. It includes an assessment on the situation in hospitals with respect to normal care hospital and ICU occupancy but does not provide an analysis of deaths due to COVID-19.

Overall assessment

Based on the set of indicators detailed below, which reflect the situation over the past week, the current levels are high with a rapidly increasing trend, except for hospital indicators which are currently at normal levels and remain constant.

Indicator	Level[i] last week	Level this week	Trend[ii] last week	Trend this week
Numbers of cases per day	**High**	**High**	**Increasing**	**Rapidly increasing**
R_{eff}	**High**	**High**	**Increasing**	**Increasing**
Normal care hospital occupancy	**Normal**	**Normal**	**Constant**	**Constant**
ICU occupancy	**Normal**	**Normal**	**Constant**	**Constant**
Level in wastewater	**High**	**High**	**Constant**	**Increasing**
Variants of concern	**High**	**High**	**Constant**	**Constant**

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[i] Level ranges from low to medium to high. Levels for normal care hospital occupancy and ICU occupancy ranges from normal to low to medium to high to very high.
[ii] Trend ranges from rapidly decreasing to decreasing to constant to increasing to rapidly increasing.
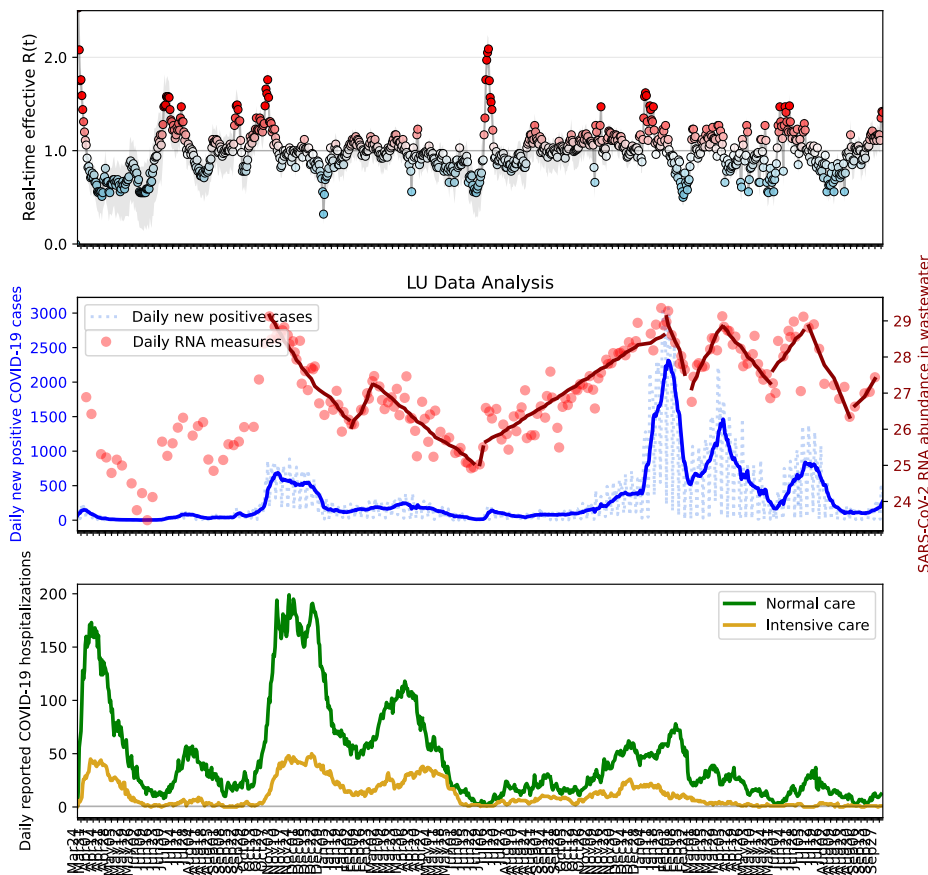
Overview of the situation

Figure 1: Overview of the current situation. Top: During the current week, R_{eff} of today has increased to 1.41 compared to 1.11 last week. The 7-day average of the current week has increased to 1.26 (compared to 1.15 of a week ago).

Middle: The 7-day average smoothed data of daily new cases (blue) reflects the currently increasing trend. The wastewater data (red) also shows a recent uptick.

Bottom: Over the past week, normal care hospital occupancy has remained rather constant (green) while the occupancy of intensive care unit beds has also remained constant (brown).

Statistical analysis and projections[1]

- Overall, the epidemic dynamics exhibits a strongly increasing trend for the last three weeks. Thus, the 7-day average of daily cases for the current week has increased to 275 cases/day today compared to 159 cases/day for the week before, which corresponds to a 73% increase compared to a 27% increase for the previous week.

- R_{eff} of today has increased to 1.41 compared to 1.11 on Thursday of last week with an increasing trend for the last days. Also, the 7-day average value of R_{eff} has increased to 1.26 for this week compared to 1.15 a week ago. This indicates the establishment of an exponential dynamics.

- The 7-day average for the normal care hospitalization demands has remained rather constant compared to the previous week (10.1 cases on average for this week compared to 9.2 cases for last week). The average ICU occupancy has remained rather constant at low level with 0.7 beds on average for this week compared to 1 case the previous week.

- Given the strongly increasing case numbers of the current epidemic dynamics, the corresponding midterm projections of daily cases anticipate a continuing increase for the next weeks with potentially more than 800 cases in November.

- The corresponding projections for the hospitalization demands reflect the apparently milder disease progression for the Omicron variants. The current projections indicate a potential increase in normal care demand between 30 to 50 beds in November. Based on the decreased disease severity for the Omicron variants, the projections of ICU demands exhibit a moderate increase with a potential level of around 10 beds in November. Note that hospitalization and specifically ICU demands strongly depend on the age structure of the cases, the vaccination status and linked effectiveness to corresponding variants as well as antiviral treatments. 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 increased to around 22%.
- The total number of estimated active cases has increased to 3,356 cases compared to 2,431 cases last week which corresponds to a 38% increase compared to a 30% increase observed for last week.

Analysis of wastewater[2]

- Since the last report, the level of contamination of wastewater by SARS-CoV-2 has undergone a significant decrease to reach values close to the limit of medium level during the weeks 34 and 35.
- For the last two weeks (weeks 36 to 38), the trend has reversed with a resurgence of the virus circulation in wastewater and an increase of the flux measured at the national level.
- The same observations were made at the regional level, although some wastewater treatment plants were more impacted by the increase in SARS-CoV-2 contamination than others.
- Today (week 39), the upward trend seems to be confirmed and generalised to all the wastewater treatment plants in the monitoring network.

SARS-CoV-2 strains currently in circulation (week 24/2022)[3]

- Last week, the Microbial Genomics Platform at the LNS sequenced 465 specimens, including 415 having been collected from residents. The weekly sequencing coverage remains at 41.5% (out of 999 cases registered in Luxembourg).
- The Omicron variant remains the only one detected in the representative sample. The Omicron BA.5 lineage is the most frequent one (93.9%, confidence interval: 91.4 - 96.3%), followed by Omicron BA.4 (4.5%, confidence interval: 2.4 - 6.6%).

Note. The representative population size is estimated based on the number of positive cases in Luxembourg in week of study. The minimum sample size to calculate variant prevalence with 2.5% precision, according to the ECDC guidelines applied to our epidemiological situation, was 375 specimens.

## Socio-demographic characteristics (period: 12 September – 25 September 2022)[4]

- Infections dropped in August after a peak in observed in July. We now observe an uptick but infections (confirmed with PCR test) remain at about the lowest level observed in 2022.
- Infection rates are going up in all socio-economic groups.
- Higher levels of infections are observed among middle-aged population (in the age range 25-54).
- There is a clear spike among civil servants among whom infection rates are twice as large as other groups of workers. Correspondingly, infection rates are comparatively high among Luxembourg-born and individuals with Luxembourg citizenship, and among the higher income groups.
- The canton of Clervaux seems to witness a substantially higher infection rate.
- There is very little gradient related to household structure.

Positive test/Case -- 12sep2022 - 25sep2022 (Adjusted for age and gender)

Hospitalisation for COVID-19 -- 12sep2022 - 25sep2022 (Adjusted for age and gender)
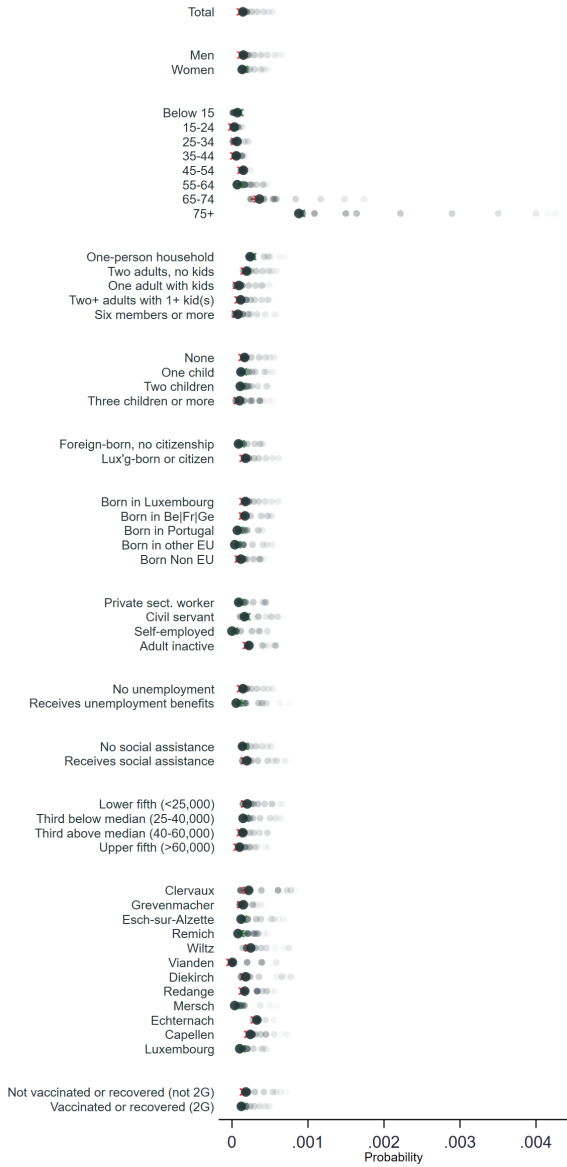
Thresholds for levels and criteria for trends

Average number of cases per day amongst residents over the preceding week (N)

High: N > 150
Medium: 10 ≤ N ≤ 150
Low: N < 10

Rationale: The number of 150 is based on the situation in the week of 12/10/2020 (beginning of the upsurge in the current wave; a similar number of tests was carried that week compared to the rest of the autumn/winter period) and we know that the overall situation remained somewhat manageable going forward. It is also the number of new index cases per day that the contact tracing team can still deal with. The number of 10 is the rounded number for Luxembourg based on the criterion of containcovid-pan.eu (10 new COVID-19 cases or less per million people per day; https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(20)32625-8/fulltext).

Trend in case numbers (dN)

Constant: |dN| < CI
Changing: 1 CI ≤ |dN| ≤ 2 CI
Rapidly changing: |dN| > 2 CI

Rationale: The trend of the case numbers can be assessed by the 90% confidence interval (CI) of the fitting procedure. If the case number is within the CI projected the week before, the case number is stable. In case it deviates between one and 2 CIs, the change is either slowly decreasing or slowly increasing. Every change larger than 2 CIs is considered to be either strongly increasing or strongly decreasing.

Average R_{eff}

High: R_{eff} > 1
Medium: 1 ≤ R_{eff} ≤ 0.8
Low: R_{eff} < 0.8

Rationale: Effective mitigation should obey a doubling time of the order of the incubation period to ensure that the decrease is sustained. For the SARS-CoV-2 incubation period of up to 14 days this corresponds to R_{eff} < 0.8 (and a corresponding doubling time of 16 days). Furthermore, for R_{eff} < 0.8 the period needed to suppress new infections is drastically decreasing (half-time around a week) allowing for effective mitigation.

Trend of R_{eff}

Constant: |dR_{eff}| < CI
Changing: 1 CI ≤ |dR_{eff}| ≤ 2 CI
Rapidly changing: |dR_{eff}| > 2 CI

Rationale: The inference of R_{eff} from the daily case numbers is associated with uncertainty expressed by confidence intervals. Retrospective analysis has shown that the 50% confidence interval (CI) is an appropriate quantity to characterize this uncertainty in the data from Luxembourg. In particular, an increase of the lower CI above 1 is associated with the start of an epidemic wave. Therefore, fluctuations within 1 CI are not significant and changes above 2 CI bands indicate strong changes.

Average number of hospital bed occupancy in terms of normal care due to COVID-19 ($N_{hospital}$)

Very High: $N_{hospital} > 164$
High: $83 < N_{hospital} \leq 164$
Medium: $43 < N_{hospital} \leq 83$
Low: $19 < N_{hospital} \leq 43$
Normal: $N_{hospital} \leq 19$

Rationale: The gradation in terms of normal care hospital occupancy is based on the thresholds for the phasing of the national hospital sector whereby "normal" corresponds to phase 0 (normal operations; COVID-19 patients are treated in the context of the national service for infectious diseases), "low" to phase 1 (the hospital sector operates with very few restrictions, COVID-19 patients are centrally admitted at the Centre Hospitalier de Luxembourg), "medium" to phase 2 (COVID-19 patients are centrally admitted at the Centre Hospitalier de Luxembourg, every hospital starts to allocate resources to the treatment of COVID-19 patients and suspected cases of COVID-19, units are beginning to be confined, staff are cohorted), "high" to phase 3 (each hospital accepts COVID-19 patients, units are confined, staff are cohorted, and non-COVID-19-related, non-emergency medical procedures are postponed), and "very high" to phases 4 and 5 (significant increases in admission of COVID-19 patients in each hospital, shutdown of normal activities and further adjustments according to needs).

Trend in hospitalisations ($dN_{hospital}$)

Constant: $| dN_{hospital} | < 1$ STD
Changing: $1\ STD \leq | dN_{hospital} | \leq 2$ STD
Rapidly changing: $| dN_{hospital} | > 2$ STD

Rationale: The trend in hospitalisations is assessed based on the standard deviation (STD) of the 7-day average. If the numbers of hospitalized patients of the present week are within the standard deviation of the mean of numbers of hospitalized patients of the week before, numbers are considered constant. In case the number deviates between one and two standard deviations, the change is either slowly decreasing or slowly increasing. Every change that is larger than two standard deviations is considered either strongly increasing or strongly decreasing.

Average number of ICU beds occupied by COVID-19 patients (N_{ICU})

Very High: $N_{ICU} > 42$
High: $19 < N_{ICU} \leq 42$
Medium: $7 < N_{ICU} \leq 19$
Low: $2 < N_{ICU} \leq 7$
Normal: $N_{ICU} \leq 2$

Rationale: The gradation in terms of ICU occupancy is based on the thresholds for the phasing of the national hospital sector whereby "normal" corresponds to phase 0, "low" to phase 1, "medium" to phase 2, "high" to phase 3, and "very high" to phases 4 and 5.

Trend in ICU occupancy (dN_{ICU})

Constant: $| dN_{ICU} | < 1$ STD
Changing: $1\ STD \leq | dN_{ICU} | \leq 2$ STD
Rapidly changing: $| dN_{ICU} | > 2$ STD

Rationale: The trend in ICU occupancy is assessed based on the standard deviation (STD) of the 7-day average. If the numbers of patients in ICU of the present week are within the standard deviation of the mean of numbers of ICU patients of the week before, numbers are considered constant. In case the number deviates between one and two standard deviations, the change is either slowly decreasing or slowly increasing. Every change that is larger than two standard deviations is considered either strongly increasing or strongly decreasing.

Level in wastewater (SARS-CoV-2 flux)

High: SARS-CoV-2 flux > 2.0x10E11 copies/day/100,000 inhabitants
Medium: 2.0x10E11 ≤ SARS-CoV-2 flux ≤ limit of detection
Low: SARS-CoV-2 flux < limit of detection

Rationale: Analogous to the criteria for the average number of cases per day over the preceding week, we use the levels in wastewater for the week of 05/10/2020 (levels had reached a plateau then and it is one week preceding the week of 12/10/2020 when levels in wastewater already started picking up; this also accounts for the early warning based on levels in wastewater) as the upper bound. As the lower bound, we propose to use the values of the week of 08/06/2020 (the lowest levels reached since the beginning of the pandemic) when the limit of detection was reached.

Trend of wastewater level

Constant: change within standard deviation
Changing: changes larger than 1 and smaller than 2 standard deviations
Rapidly changing: changes larger than 2 standard deviations

Rationale: In analogy to the trend of R_{eff}, the linear regression between the data point gives the range within which changes can represent only fluctuations. Changes larger than one standard deviation are statistical significant and changes larger than two standard deviations have a strong impact.

References

1. https://researchluxembourg.lu/publications/
2. https://www.list.lu/fr/covid-19/coronastep/
3. https://lns.lu/departement/microbiologie/revilux/
4. To be determined.