Impact of second lockdown - France, Dec 2020

Report #25 [previous reports at: www.epicx-lab.com/covid-19.html]

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03/12/2020 (DATA UP TO WEEK 47,48)

SUMMARY

This report is an update of previous reports (Report #19, Report #21, Report #23) on the impact of the second lockdown implemented in France on Friday, October 30 to suppress the second wave of COVID-19 epidemic. We provide updated projections simulating a lockdown with schools open up to the end of the school session, informing the mobility reduction from Google mobility trends. We use age-stratified mathematical models calibrated to the observed epidemic trajectory in each region, and provide expected dates to reach different epidemic suppression objectives. Exit strategies are based on epidemic conditions experience before lockdown entered into effect. Results should be interpreted with caution, as behavioral changes are expected phasing out lockdown.

INTRODUCTION

France is under a second lockdown since Friday, October 30 to curb the second epidemic wave. This report presents an update of the scenario analyses on the expected impact of lockdown and exit strategies (see Report #19, Report #21, Report #23). This update considers:

- Mobility data up to w47;
- Hospitalization data up to w48;
- Lockdown ending in w51, i.e. the last week with schools in session before school holidays.
- Few hypotheses on the exit scenarios, e.g. as in the conditions of w44 (with school holidays and curfew).

The report focuses on regions of metropolitan France.

METHODS

Model. We used the model developed by INSERM to respond to the COVID-19 pandemic[1–3]. The model was shown to capture the transmission dynamics of the epidemic in the first wave[1], was used to assess the impact of lockdown, exit strategies and reopening of schools in mid-April[1,2], and to evaluate the rate of underdetection of the test-trace-isolate strategy in the months of May-June[3]. It is based on a stochastic discrete age-stratified approach using demographic, age profile, and social contact data of the regions of mainland France, to account for age-specific contact activity and role in COVID-19 transmission. The model accounts for contacts in the population in different settings and activities. Disease progression is specific to COVID-19 and parameterized with current knowledge to include presymptomatic transmission, asymptomatic and symptomatic infections with different degrees of severity (paucisymptomatic, with mild symptoms, with severe symptoms requiring hospitalization). Four age classes are considered: [0-11), [11-19), [19-65), and 65+ years old (children, adolescents, adults, seniors). A reduced susceptibility was considered for children and adolescents, along with a reduced relative transmissibility of children, following available evidence from household studies, contact tracing investigations, and modeling works. More details are provided in Ref.[3].

The model was validated region by region against the estimates of three independent serological studies conducted in France after the first wave[3].

Parameterization and calibration. For each region, the model integrates estimates on the number of individuals at workplace over time, based on Google mobility data[4] (**Figure 1**), accounts for students going back to school at the start of the school calendar on Sept 1, and integrates data on the adoption of preventive measures over time[3,5].

The model is fit to the different epidemic phases (pre-lockdown, first lockdown, exit, summer, rentrée, second lockdown) using hospital admission data by region. More details on the model and calibration are provided in Refs.[1,3]. **Results in this report account for the epidemic situation up to weeks 47,48.**

The second lockdown (LD2) is modeled with schools open, as currently in place, and fitted to hospitalization data up to w48. We use Google mobility data[4] to account for higher presence at work compared to the first lockdown, as a larger number of production sectors remain open.

Projections. Projections are obtained under a set of scenarios:

- **No-change scenario**, i.e. the epidemic continues to evolve as estimated in w42, as no interventions were implemented. This is a counterfactual scenario used for comparison.
- **LD2** applied indefinitely.
- **LD2 with exit in w52 assuming the conditions of w44**, i.e. considering the effects of school holidays and curfew experienced before lockdown entered into effect.
- **LD2 with exit in w52 assuming the conditions of w44 and 10% less people at work**, i.e. as before, but assuming that presence at work is 10% less than what registered in w44.

Universities are assumed to remain closed during all scenarios and adopt remote learning, as currently done.

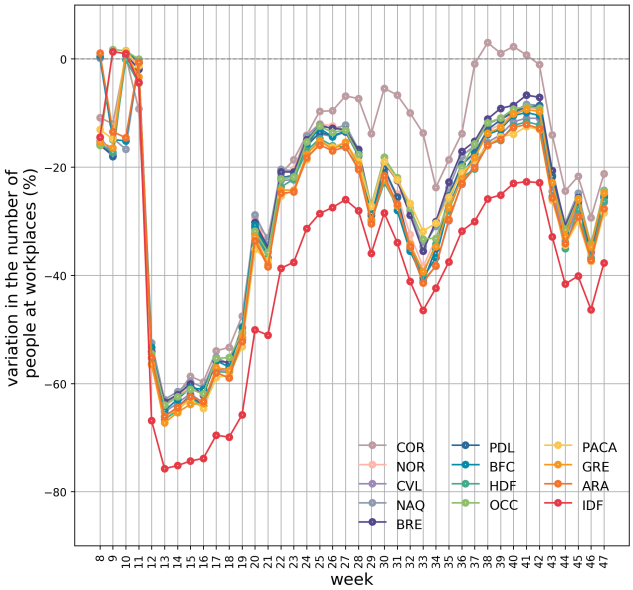

Figure 1. Estimated presence at workplaces by region and over time. Weekly estimates by region of presence at workplaces are based on Google mobility data[4]. The variation is computed with respect to pre-epidemic conditions, in the months of January-February (level corresponding to zero on the vertical axis).

RESULTS

France

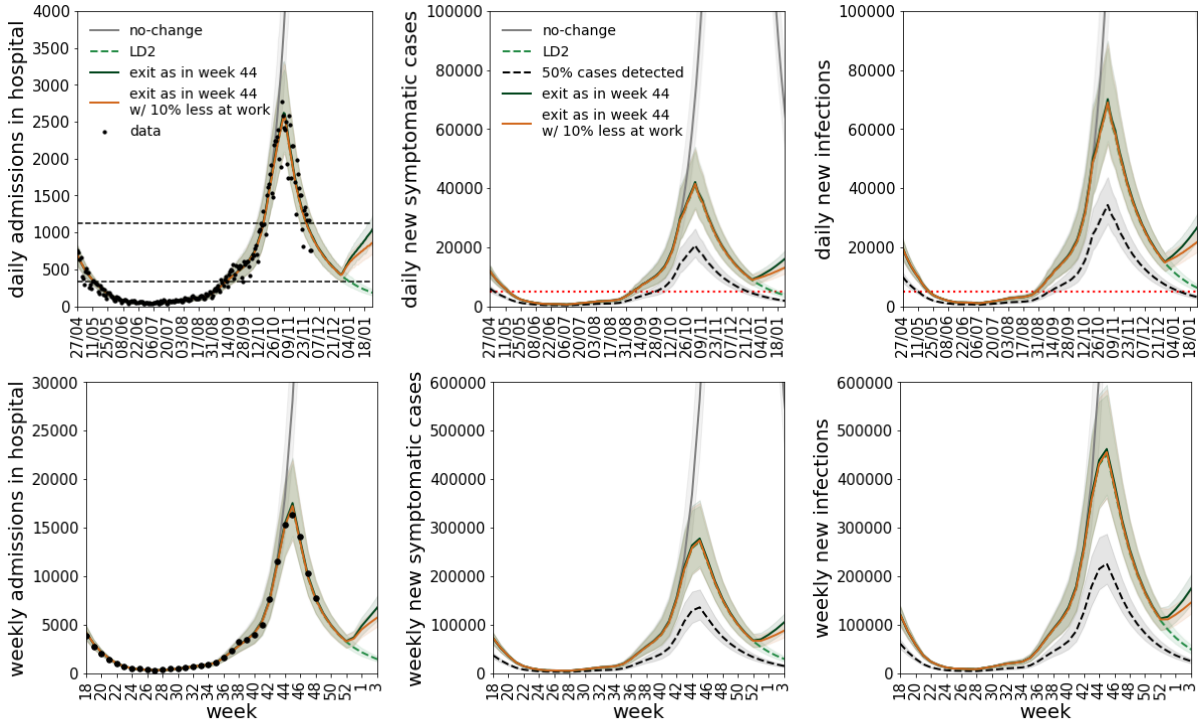

Figure 2. Epidemic trajectories for daily (top) and weekly (bottom) hospitalizations (left), new symptomatic cases (center) and new infections (i.e., both symptomatic and asymptomatic) (right) under the effect of the second lockdown and different exit strategies in w52. In each plot, each curve corresponds to a different condition: grey (continuous line) for the *no-change scenario*, i.e. if the situation is unchanged and the epidemic continues along the tendency estimated for w44; green (dashed line) for *LD2*, i.e. applying indefinitely the second lockdown fitted up to w48; dark green (continuous line) for the lockdown followed by an *exit with conditions as in w44* (school holidays and curfew, as measured prior the lockdown application); orange (continuous line) for the lockdown scenario followed by an *exit with conditions as in w44 and 10% less people at work* (school holidays and curfew, as measured prior the lockdown application, assuming less people would go to work). The black dashed line in trajectories of cases and infections (center and right panels) indicates detected cases, assuming detection rate at 50%. Lines correspond to median values obtained from 500 stochastic numerical simulations of the model. The shaded areas correspond to the 95% probability range. Dots correspond to daily hospitalizations data. The two dashed horizontal lines in the left panel correspond to the levels of hospital admissions registered at the entry into the first lockdown on March 17 (top dashed line), the exit from the first lockdown on May 11 (bottom dashed line). Exit in w52 is at the start of school holidays. The red dotted horizontal line in the top center and right panels indicates 5,000 cases.

Regions

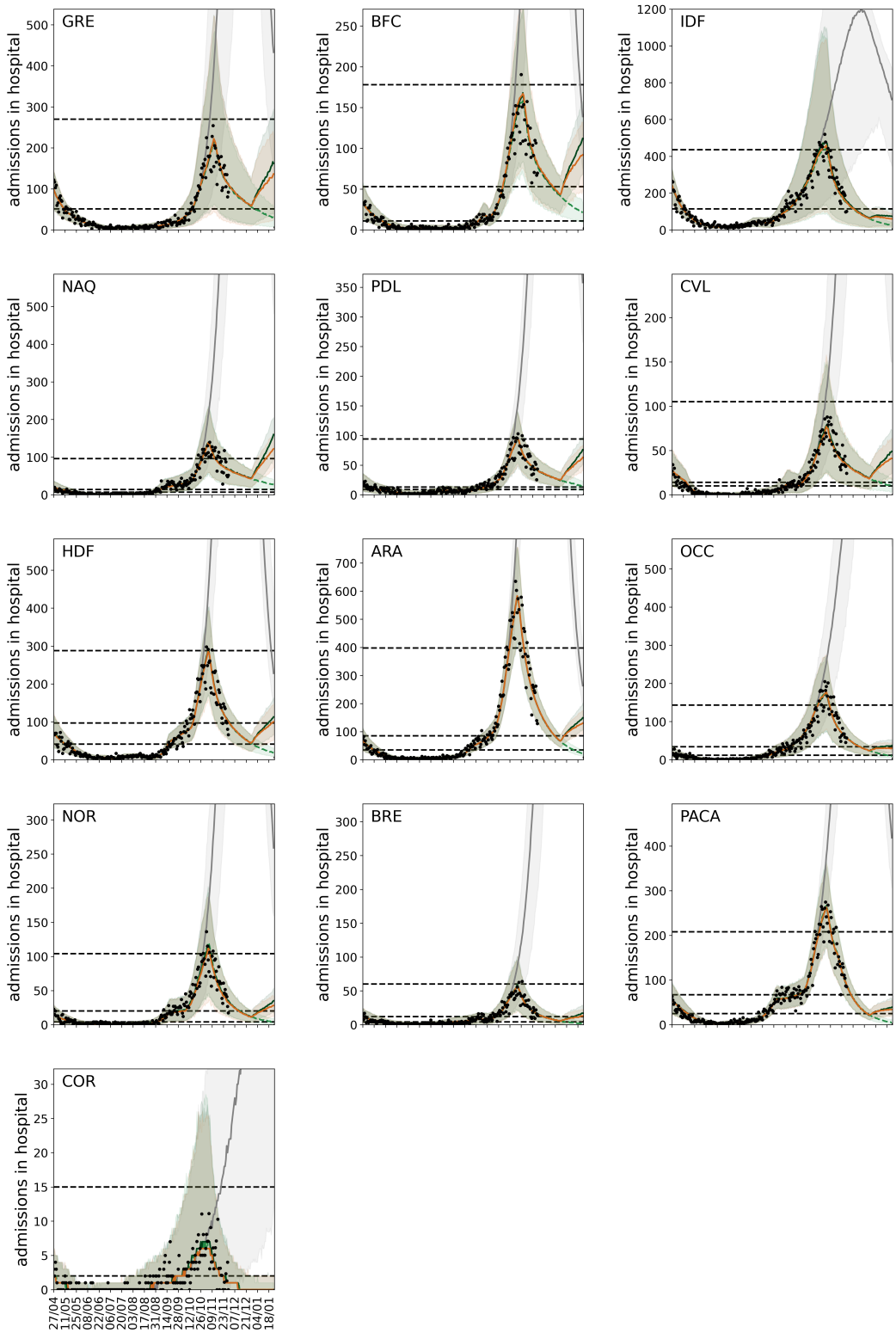

Figure 3. Epidemic trajectories for daily hospitalizations under different exit strategies. Each plot shows a region in metropolitan France. In each plot, each curve corresponds to a different condition: grey (continuous line) for the *no-change scenario*, i.e. if the situation is unchanged

and the epidemic continues along the tendency estimated for w44; green (dashed line) for *LD2*, i.e. applying indefinitely the second lockdown fitted up to w48; dark green (continuous line) for the lockdown followed by an *exit with conditions as in w44* (school holidays and curfew, as measured prior the lockdown application); orange (continuous line) for the lockdown scenario followed by an *exit with conditions as in w44 and 10% less people at work* (school holidays and curfew, as measured prior the lockdown application, assuming less people would go to work). Lines correspond to median values obtained from 500 stochastic numerical simulations of the model. The shaded areas correspond to the 95% probability range. Dots correspond to daily hospitalizations data. The two dashed horizontal lines in the left panel correspond to the levels of hospital admissions registered at the entry into the first lockdown on March 17 (top dashed line), the exit from the first lockdown on May 11 (bottom dashed line).

Table 1. Expected date to reach the level of daily hospitalizations as on the exit from the first lockdown and 5,000 new daily cases in France.

	daily hospitalizations reached at the exit from first lockdown	5,000 new symptomatic cases		5,000 new infections	
		Predicted cases	**Detected cases** (assuming detection rate of 50%)	**Predicted cases**	**Detected cases** (assuming detection rate of 50%)
Expected date (median and 95% CI)	Jan 4 [Dec 28 - Jan 11]	Jan 15 [Jan 8 – Jan 22]	Dec 22 [Dec 15 – Dec 29]	Feb 2 [Jan 27- Feb 8]	Jan 9 [Jan 2 -Jan 15]

KEY ELEMENTS

- Exit scenarios in w52 assume an abrupt relapse to the situation before lockdown implementation, with school holidays and curfew in place. They do not envision a slow adaptation to the new measures, or behavioral changes. Caution should be used in interpreting these results.
- LD2 projections after week 48 (Nov 23-29) assume the same conditions as in the first week of lockdown and they do not envision the relaxation of restrictions starting November 28. Updated projections will consider this aspect.
- The impact of the same measures applied nationally will be heterogenous across regions, due to several aspects, including: the epidemic situation at the start of lockdown; the percentage of the population infected during the first wave; the adoption of preventive measures that may vary across regions[5]; a region-dependent reduction of mobility, as already observed during the first lockdown, due to demographic and socio-economic constraints that are region-specific[6].

MAIN LIMITATIONS

- The time of the peak is not fitted. It is assumed to be one week after lockdown implementation for all regions, except for Grand Est and Bourgogne-France-Comté where it is assumed to be after two weeks, because the change in tendency of hospitalization data became visible later in

these regions with respect to the rest of the country. However, the impact of the choice of the time of the peak on the predictions is negligible.

- Other limitations were mentioned in previous reports (see Report #19, Report #21, Report #23).

ACKNOWLEDGMENTS

This study is partially funded by: ANR projects DATAREDUX (ANR-19-CE46-0008-03) and EVALCOVID-19 (ANR-20-COVI-0007); EU H2020 grants MOOD (H2020-874850) and RECOVER (H2020-101003589); REACTing COVID-19 modeling grant. We thank Sante publique France for useful discussions.

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